MILITARY SPECIFICATION

TRANSFORMERS, INTERMEDIATE FREQUENCY, RADIO FREQUENCY, AND DISCRIMINATOR, GENERAL SPECIFICATION FOR

This specification is mandatory for use by all Departments and Agencies of the Department of Defense

1. SCOPE

1.1 Scope. This specification covers the requirements for tuned and untuned intermediate, radio frequency, and discriminator transformers These inductive components may be combined with additional circuit elements such as capacitors and resistors which are functionally related to the inductive elements for the purpose of coupling, impedance conversion, and isolation

1.2 Classification. Transformers covered by this specification shall be of the following types grades, and classes as specified (see 3.1 and 6.1)·

Type I - Intermediate frequency transformer.
Type II - Radio frequency transformer.
Type III - Discriminator transformer

Grade 1 - For use when immersion and moisture resistance tests (see 4 7.19 and 4 7 20) are required
Grade 2 - For use when moisture resistance test (see 4 7 20) is required
Grade 3 - For use in sealed assemblies.

Class O - 85° C maximum operating temperature.
Class A - 105° C maximum operating temperature.
Class B - 125° C maximum operating temperature
Class C - > 125° C maximum operating temperature.

NOTE· The class denotes the maximum operating temperature (temperature rise plus maximum ambient temperature)

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

QQ-S-571	- Solder, Tin Alloy Lead-Tin Alloy, and Lead Alloy
QQ-S-781	- Strapping, Steel, Flat and Seals.
PPP-B-566	- Boxes Folding, Paperboard.
PPP-B-585	- Boxes, Wood, Wirebound.
PPP-B-636	- Box, Fiberboard
PPP-B 676	Boxes, Setup
PPP-B-601	- Boxes Wood Cleated-Plywood
PPP-B-621	- Boxes, Wood, Nailed and Lock-Corner.
PPP-T-60	- Tape Pressure-Sensitive Adhesive Waterproof For Packaging
PPP-T-76	- Tape Pressure-Sensitive Adhesive Paper (For Carton Sealing)

SPECIFICATIONS

MILITARY

MIL-P-116	-	Preservation, Methods of
MIL-W-583	-	Wire, Magnet, Electrical
MIL-F-14256	-	Flux, Soldering Liquid (Rosin Base)
MIL-B-43014	-	Boxes, Water Resistant Paperboard, Folding Set-Up and Metal-Stayed
MIL-C-45662	-	Calibration System Requirements

STANDARDS

MILITARY

MIL-STD-105	-	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	-	Marking for Shipment and Storage.
MIL-STD-147	-	Palletized and Containerized Unit Loads 40" x 48' Pallets, Skids, Runners, or Pallet-Type Base.
MIL-STD-202	-	Test Methods for Electronic and Electrical Component Parts.
MIL-STD-275	-	Printed Wiring for Electronic Equipment
MIL-STD-454	-	Standard General Requirements for Electronic Equipment
MIL-STD-810	-	Environmental Test Methods
MIL-STD-1276	-	Leads, Weldable, For Electronic Component Parts
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 document forms a part of this specification to the extent specified herein Unless otherwise indicated, the issue in effect on the 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, DC 20402)

3 REQUIREMENTS

3 1 Detail requirements. Detail requirements or exceptions applicable to individual types of transformers shall be as specified in the applicable drawing or procurement document (see 6.1) In the event of any conflict between requirements of this specification and the drawing or procurement document the latter shall govern (see 6 1)

3 2 First article Transformers furnished under this specification shall be products which have been tested and have passed the first article inspection specified in 4 5 (see 6 2) First article approval is valid only on the contract under which it is granted, unless extended by the Government to another contract

3 2 1 Information to be furnished with the first article sample The applicable information outlined in 6 1 shall be furnished with the first article sample together with any other pertinent information as required by the Government

3.3 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 transformers 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. Insofar as practicable, materials used in the construction of transformers shall be noncorrosive, nonexplosive, shall not be susceptible to out-gassing, and nonnutrient to fungus growth, or suitably treated to retard fungus growth.

3.3 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

3.3.2 Solder and soldering flux. Solder and soldering flux shall conform to requirement 5 of MIL-STD-454.

3.3 3 Magnet wire. Magnet wire shall conform to the types and sizes specified in MIL-W-583

3.3.4 Resistors and capacitors. Resistors and capacitors shall be in accordance with military specifications and standards, except when the size, design, and environmental characteristics of the transformer prohibit

3 3.5 Screws nuts, and washers. All mounting and terminal screws, nuts, and washers shall be of corrosion-resistant material or shall be protected against corrosion.

3 4 Design and construction Transformers shall be of the design, construction, weight, and physical dimensions specified (see 3.1 and 6 1)

3 4.1 Threaded parts. Unless otherwise specified (see 3 1 and 6.1), all threaded parts shall be in accordance with Handbook H28.

3.4.1.1 Engagement of threaded parts. Unless otherwise specified (see 3.1 and 6.1), all threaded parts shall engage by at least three full threads

3 4.2 External can shields (when applicable, see 3.1 and 6.1). External can shields shall be so constructed that they can be effectively mounted mechanically and grounded electrically by their normal mounting means

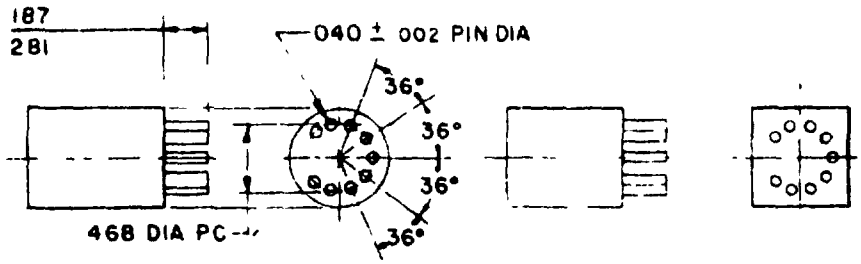
3.4.3 Terminals (see 3.1 and 6.1).

3.4.3.1 Solder-type terminals. Solder terminals may be of any shape, and solderability of terminals shall comply with the requirements of 3.12. The height of the solder terminal shall be considered as the maximum distance from the terminal mounting surface to the highest point, including the additional height obtained if semiflexible terminals are straightened. (It is not intended that the "hook" in the hook-type terminal be straightened from its normal hooked position.) The type of terminal and the maximum size of round wire which the terminal will accept externally shall be as specified (see 3.1 and 6.1).

3.4 3.2 Solderable/weldable lead terminals. Unless otherwise specified (see 3.1 and 6 1), the manufacturer shall verify by certification that all leads conform to type C of MIL-STD-1276

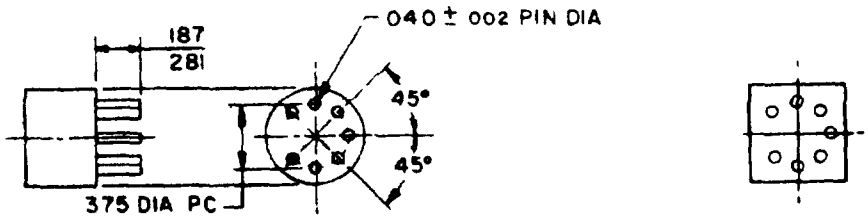
3.4.3.3 Pin-type terminals for printed circuit applications. The preferred diameter for the terminal pins of printed circuit transformers is 0 028 inch The grid matrix shall conform to a 0 1 inch matrix in accordance with MIL-STD-275 with centers to a tolerance of ±0.002 inch Uninsulated solid wire terminals not greater than 1 inch in length shall be considered to be pins.

3.4 3 4 Pin-type terminals for electron tube type sockets Pins for use with electron tube type sockets shall conform with standard 7-pin base E7-1 or standard 9-pin base E9-1 (see figure 1) Uninsulated solid wire terminals not greater than 1 inch in length shall be considered to be pins



STANDARD 9-PIN BUTTON BASE E9-1

INCHES	MM
.002	.05
.040	1.02
187	4.75
.281	7.14
.375	9.53
468	11.89



STANDARD 7-PIN BUTTON BASE E7-1

NOTES
1 Dimensions are in inches
2. Metric equivalents (to the nearest 01 mm) are given for general information only and are based upon 1 inch = 25.4 mm

FIGURE 1 Pin-type terminals for electron tube type sockets

3 4 3 5 Screw-type terminals. When specified (see 3 1 and 6.1), external screw terminals shall be supplied with two nuts, two flat washers, and one lockwasher For grades 1 and 2 transformers, 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 ±1/16 inch shall be as specified (e.g., screw, No. 8-32 x 3/8) (see 3.1 and 6.1)

3 5 Seal (when applicable, see 3.1 and 6 1).

3 5 1 Gas-filled units When transformers are tested as specified in 4 7 2 1, the leakage rate shall not exceed 1×10^{-8} atmospheric cubic centimeters per second (atm cc/sec)

3 5 2 All other units When transformers are tested as specified in 4 7 2 2, there shall be no continuous flow of air bubbles or leakage of compound from the body of the units

3 6 Dielectric withstanding voltage. When transformers are tested as specified in 4 7 3 there shall be no arcing, flashover, breakdown of insulation leakage current in excess of 1 milliampere (unless otherwise specified, see 3 1 and 6 1), or other evidence of damage.

3 7 Induced voltage (applicable when winding terminal voltage exceeds 25 volts) When transformers are tested as specified in 4 7 4, there shall be no continuous arcing, breakdown of insulation, flashover, any abrupt changes in the input current or Q, or any other evidence of damage

3 8 Insulation resistance. When transformers are tested as specified in 4 7 5, the insulation resistance shall be not less than 1,000 megohms.

3 9 Electrical characteristics. When transformers are tested as specified in 4.7 6, the applicable electrical characteristics, with values and tolerances, shall be as specified (see 3 1 and 6 1).

3.10 Stability at temperature extremes. When transformers are tested as specified in 4.7 7, there shall be no evidence of mechanical damage and the insertion loss or discrimination shall be as specified (see 3.1 and 6 1). The dielectric withstanding voltage shall be as specified in 3.6.

3.11 Operating torque (when applicable, see 3.1 and 6.1). When transformers are tested as specified in 4.7.8, the torque required to rotate the tuning core shall be within the limits specified (see 3.1 and 6.1).

3.12 Solderability (when applicable, see 3.1 and 6.1). When transformers are tested as specified in 4.7 9, they shall meet the applicable criteria for terminal evaluation as specified in method 208 of MIL-STD-202.

3.13 Resistance to solvents When transformers are tested as specified in 4.7.10, there shall be no evidence of mechanical damage and the marking shall remain legible.

3 14 Life. When transformers are tested as specified in 4.7.11, there shall be no evidence of physical or electrical damage as indicated by an open circuit (a break in the continuity of any electrical circuit within the transformer being tested) or short circuit occurring within the transformer (such as shorted turns or faulty insulation between layers, turns, between windings, between windings and core or case, or between windings and shield) In addition transformers shall meet the following requirements

Dielectric withstanding voltage - - - - - Shall be as specified in 3.6.
Insulation resistance - - - - - - - - - - - Shall be as specified in 3.8.

There shall be no change of electrical characteristics greater than specified (see 3.1 and 6 1)

3 15 Temperature rise (when applicable, see 3.1 and 6.1). When transformers are tested as specified in 4.7.12, the temperature rise of any winding above the specified maximum ambient temperature (see 3.1 and 6.1) shall not exceed the value specified (see 3.1 and 6.1) and there shall be no evidence of physical damage.

3.16 Resistance to soldering heat (when applicable, see 3.1 and 6 1). When transformers are tested as specified in 4.7.13, there shall be no softening of the insulation or loosening of the windings or terminals.

3.17 Terminal strength. When transformers are tested as specified in 4.7.14, there shall be no evidence of loosening or rupturing of the terminals, or other mechanical damage. Bends shall not be considered as damage unless surface cracking is evident

3 18 Vibration When transformers are tested as specified in 4.7 15 there shall be no discontinuity or evidence of physical damage

3.19 Winding continuity When transformers are tested as specified in 4 7 16 all windings shall be electrically continuous

3.20 Shock. When transformers are tested as specified in 4 7 17, there shall be no winding discontinuity or evidence of physical or mechanical damage.

3 21 Thermal shock When transformers are tested as specified in 4 7 18 there shall be no winding discontinuity or evidence of physical or mechanical damage.

3 22 Immersion (grade 1 only). When transformers are tested as specified in 4.7.19, there shall be no winding discontinuity or evidence or corrosion or other visible damage.

3 23 Moisture resistance (grades 1 and 2 only). When transformers are tested as specified in 4.7.20, the dielectric withstanding voltage shall be as specified in 3.6, the insulation resistance shall be as specified in 3.8 (for grade 1 units) or not less than 100 megohms (for grade 2 units), and there shall be no evidence of corrosion affecting the mechanical or electrical operation of the units.

3.24 Visual and mechanical examination (post test) When transformers are examined as specified in 4 7 1.1 1, not more than 10 percent of the surface shall have peeling, flaking, chipping, cracking, crazing, or other impairment of the protective coating There shall be no leakage of the filling material, and no evidence of other physical damage, such as cracks, bursting, or bulging of the case, or corrosion affecting the mechanical or electrical operation of the units

3.25 Flammability (when applicable, see 3 1 and 6 1). When transformers are tested as specified in 4.7.21, there shall be no evidence of violent burning which results in an explosive-type fire, and the coating material used on the transformers shall be self-extinguishing. A transformer shall not be considered to have failed, in the event that it is consumed by the applied flame, unless dripping of flaming material or an explosive-type flame has occurred A transformer shall be considered to have failed only if an explosion or dripping of flaming material occurs, an explosive-type flame is produced, or if visible burning continues beyond the allowable duration of 3 minutes after removal of the applied flame. Material will be considered self-extinguishing if the following conditions are met

(a) The duration of visible flame does not exceed 3 minutes after removal of the applied flame.
(b) There is no explosion, nor any violent burning which results in an explosive-type flame.
(c) There is no dripping of flaming material from the transformer under test.

3 26 Fungus The manufacturer shall certify that all external materials are fungus resistant, or shall perform the test specified in 4.7.22. When transformers are tested as specified in 4 7 22, there shall be no evidence of fungus growth on the external surfaces

3 27 Marking Transformers shall be marked in accordance with method I of MIL-STD-1285. Marking shall include the date code, the item identifying part number assigned by the applicable drawing or procurement document (see 3.1), an item identifying part number assigned by the manufacturer, and code symbols for both part numbers. The marking may be applied to more than one side of the case if the required marking requires more space than is available on the one side. Where the surface areas are insufficient for all of the required information as many as possible of the markings shall be applied using the order of precedence listed in MIL-STD-1285 Markings shall remain legible after all tests

3 27 1 Terminal identification Unless otherwise specified (see 3.1 and 6.1), terminals shall be identified by appropriate numbers or where space does not permit numbering, by color coding in accordance with table I

TABLE I Terminal color code

Color	No	Color	No.
Black	0	Green	5
Brown	1	Blue	6
Red	2	Violet	7
Orange	3	Gray	8
Yellow	4	White	9

3.28 Workmanship. Workmanship shall be in accordance with MIL-STD-454, requirement 9

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. Test and measuring equipment and inspection facilities of sufficient accuracy, quality and quantity to permit performance of the required inspection shall be established and maintained by the supplier The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with MIL-C-45662.

4.2 Classification of inspections The inspections specified herein are classified as follows

(a) Materials inspection (see 4.3).
(b) First article inspection (see 4.5).
(c) Quality conformance inspection (see 4.6).

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 documents prior to such fabrication

TABLE II Materials inspection.

Material	Requirement paragraph	Applicable document
Solder and soldering flux - - -	3.3.2	MIL-STD-454
Magnet wire - - - - - - - - - -	3.3 3	MIL-W-583
Solderable/weldable lead terminals - - - - - - - - - - -	3 4 3.2	MIL-STD-1276

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 voltage The test voltage shall contain no more than 5-percent harmonic distortion

4 4 2 Test frequency The test frequency used shall be within ±0.1 percent of the nominal value

4 4 3 Demagnetization When necessary to overcome remanence effects, demagnetization is permitted

4.5 First article inspection. 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 sample units which have been produced with equipment and procedures normally used in production. First article approval is valid only on the contract or purchase order under which it is granted, unless extended by the Government to other contracts or purchase orders.

4.5.1 Sample size. Twenty-one sample units shall be subjected to first article inspection, however, two additional sample units shall be required if certification is not provided for the fungus test and three additional sample units shall be required when a comparison standard is used (see 4.5.2.1).

TABLE III. First article inspection

Examination or test	Requirement paragraph	Method paragraph
Group I (All sample units excluding those for group II inspection)		
Visual and mechanical examination (external)	3.1, 3.3, 3.4, 3.27, and 3.28	4.7.1.1
Seal (when applicable)	3.5	4.7.2
Dielectric withstanding voltage		
At atmospheric pressure	3.6	4.7.3.1
At barometric pressure (when applicable)	3.6	4.7.3.2
Induced voltage (when applicable)	3.7	4.7.4
Insulation resistance	3.8	4.7.5
Electrical characteristics	3.9	4.7.6
Stability at temperature extremes	3.10	4.7.7
Operating torque (when applicable)	3.11	4.7.8
Group II (3 sample units)		
Solderability (when applicable)	3.12	4.7.9
Resistance to solvents 1/	3.13	4.7.10
Group III (6 sample units)		
Life	3.14	4.7.11
Dielectric withstanding voltage	3.6	4.7.3.1.2
Insulation resistance	3.8	4.7.5
Electrical characteristics	3.9	4.7.6
Visual and mechanical examination (external)	3.1, 3.3, 3.4, 3.27, and 3.28	4.7.1.1
Group IV (6 sample units)		
Temperature rise (when applicable) (3 sample units)	3.15	4.7.12
Resistance to soldering heat (when applicable) (3 sample units)	3.16	4.7.13
[illegible] strength	3.17	4.7.14
Electrical characteristics	3.9	4.7.6

See footnote at end of table.

TABLE III. First article inspection. - (Continued)

Examination or test	Requirement paragraph	Method paragraph
Group V (6 sample units)		
Vibration	3.18	4.7.15
Winding continuity	3.19	4.7.16
Shock	3.20	4.7.17
Winding continuity	3.19	4.7.16
Thermal shock	3.21	4.7.18
Winding continuity	3.19	4.7.16
Immersion (grade 1 only)	3.22	4.7.19
Winding continuity	3.19	4.7.16
Moisture resistance (grades 1 and 2 only)	3.23	4.7.20
Dielectric withstanding voltage	3.6	4.7.3.1.2
Insulation resistance	3.8	4.7.5
Operating torque (when applicable)	3.11	4.7.8
Electrical characteristics	3.9	4.7.6
Visual and mechanical examination (post test)	3.24	4.7.1.1.1
Visual and mechanical examination (internal) (two sample units)	3.3, 3.4, and 3.28	4.7.1.2
Flammability (when applicable) (two sample units)	3.25	4.7.21
Group VI (2 sample units)		
Fungus 2/	3.26	4.7.22

1/ Printed circuit type transformers only.

2/ Test need not be performed if manufacturer provides certification that all external materials are fungus resistant.

4.5.2 Inspection routine. The sample units shall be subjected to the inspections specified in table III, in the order shown. All sample units (excluding those for group II) shall be subjected to the inspections of group I. Three sample units shall be subjected to the inspections of group II. The sample units which were subjected to the inspections of group I shall then be divided as specified in table III for groups III through V (or III through VI, if applicable) and subjected to the inspections for their particular group.

4.5.2.1 Comparison standards. When the use of comparison standards is specified (see 3.1 and 6.1), three sample units nearest to the design-center values of the electrical characteristics (see 4.7.6) shall be selected from those sample units which have been subjected to the inspections of group I of table III and clearly and permanently marked with these values. Two of the sample units selected shall be retained by the Government as standards. The remaining sample unit shall be returned to the supplier as a comparison standard (see 6.3) for correlation of measurements in the electrical characteristics quality conformance inspection specified (see 3.1 and 6.1).

4.5.3 Failures. One or more failures shall be cause for refusal or grant first article approval.

4.6 Quality conformance inspection.

4.6.1 Inspection of product for delivery. Inspection of product for delivery shall consist of groups A and B inspections. Except as specified in 4.6.2.1.4, delivery of products which have passed the groups A and B inspections shall not be delayed pending the results of the group C inspection.

4.6.1.1 Inspection lot. Transformers of the same type, grade, class, and electrical characteristics manufactured under essentially the same conditions and offered for inspection at one time shall form a lot.

4.6.1.2 Group A inspection. Group A inspection shall consist of the examination and tests specified in table IV in the order shown.

4.6.1.2.1 Sampling plan. Statistical sampling and inspection shall be in accordance with MIL-STD-105 for general inspection level II. The acceptable quality level (AQL) shall be as specified in table IV. Major and minor defects shall be as defined in MIL-STD-105.

4.6.1.2.2 Rejected lots. If an inspection lot is rejected, the supplier may rework it to correct the defects, or screen out the defective units, and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

TABLE IV. Group A inspection.

Examination or test	Requirement paragraph	Method paragraph	AQL (percent defective) Major	AQL (percent defective) Minor
Visual and mechanical examination (external)	3.1, 3.3, 3.4, 3.27, and 3.28	4.7.1.1	1.0	4.0
Seal (when applicable)	3.5	4.7.2	1.0	---
Operating torque (when applicable)	3.11	4.7.8		
Electrical characteristics	3.9	4.7.6		

4.6.1.3 Group B inspection. Group B inspection shall consist of the tests specified in table V, in the order shown, and shall be made on sample units which have been subjected to and have passed the group A inspection unless it is more practical to select a separate sample from the lot for group B inspection.

4.6.1.3.1 Sampling plan. The sampling plan shall be in accordance with MIL-STD-105 for special inspection level S-4. The sample size shall be based on the inspection lot size from which the sample was selected for group A inspection. The AQL shall be 6.5 percent defective.

4.6.1.3.2 Rejected lots. If an inspection lot is rejected, the supplier may rework it to correct the defects, or screen out the defective units, and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

4.6.1.3.3 Disposition of sample units. Sample units which have been subjected to group B inspection shall not be delivered on the contract or purchase order.

TABLE V. Group B inspection.

Test	Requirement paragraph	Method paragraph
Dielectric withstanding voltage		
At atmospheric pressure	3.6	4.7.3.1
At barometric pressure (when applicable)	3.6	4.7.3.2
Induced voltage (when applicable)	3.7	4.7.4
Insulation resistance	3.8	4.7.5

4.6.2 Periodic inspection. Periodic inspection shall consist of group C inspection.

4.6.2.1 Group C inspection. Group C inspection shall consist of the examinations and tests specified in table VI, in the order shown. Group C inspection shall be made on sample units selected from inspection lots which have passed the groups A and B inspections.

TABLE VI. Group C inspection

Examination or test	Requirement paragraph	Method paragraph
Subgroup 1 (3 sample units every 12 months)		
Solderability (when applicable) 1/	3.12	4.7.9
Temperature rise (when applicable) (2 sample units)	3.15	4.7.12
Electrical characteristics	3.9	4.7.6
Stability at temperature extremes	3.10	4.7.7
Terminal strength 1/	3.17	4.7.14
Operating torque (when applicable)	3.11	4.7.8
Resistance to solvents 2/	3.13	4.7.10
Visual and mechanical examination (external)	3.1, 3.3, 3.4, 3.27, and 3.28	4.7.1.1
Subgroup 2 (3 sample units every 18 months)		
Vibration	3.18	4.7.15
Winding continuity	3.19	4.7.16
Shock	3.20	4.7.17
Winding continuity	3.19	4.7.16
Thermal shock	3.21	4.7.18
Winding continuity	3.19	4.7.16
Immersion (grade 1 only)	3.22	4.7.19
Winding continuity	3.19	4.7.16
Moisture resistance (grades 1 and 2 only)	3.23	4.7.20
Dielectric withstanding voltage	3.6	4.7.3.1.2
Insulation resistance	3.8	4.7.5
Operating torque (when applicable)	3.11	4.7.8
Electrical characteristics	3.9	4.7.6
Visual and mechanical examination (external)	3.1, 3.3, 3.4, 3.27, and 3.28	4.7.1.1
Visual and mechanical examination (internal) (2 sample units)	3.3, 3.4, and 3.28	4.7.1.2
Flammability (when applicable) (2 sample units)	3.25	4.7.21
Subgroup 3 (3 sample units every 18 months)		
Resistance to soldering heat (when applicable)	3.16	4.7.13
Life	3.14	4.7.11
Dielectric withstanding voltage	3.6	4.7.3.1.2
Insulation resistance	3.8	4.7.5
Electrical characteristics	3.9	4.7.6
Visual and mechanical examination (external)	3.1, 3.3, 3.4, 3.27, and 3.28	4.7.1.1
Visual and mechanical examination (post test)	3.24	4.7.1.1.1

1/ Once a particular type of terminal has been subjected to the solderability and terminal strength tests, other transformers containing that terminal type need not be subjected to these tests for the remainder of the 12-month period from which that terminal type was selected.

2/ Printed-circuit type terminals only

4.6.2.1.1 Sampling plan

4.6.2.1.1.1 Subgroup 1. Every 12 months, 3 sample units of each grade and class shall be subjected to the tests in subgroup 1, in the order shown. If, during a 12-month period, first article testing has been successfully completed on transformers of the same grade and class, and similar construction and materials, the test data may be submitted in lieu of subgroup 1 testing for that 12-month period.

4.6.2.1.1.2 Subgroup 2. Every 18 months, 3 sample units of each grade and class shall be subjected to the tests in subgroup 2, in the order shown. If, during an 18-month period, first article testing has been successfully completed on transformers of the same grade and class, and similar construction and materials, the test data may be submitted in lieu of subgroup 2 testing for that 18-month period.

4.6.2.1.1.3 Subgroup 3. Every 18 months, 3 sample units of each grade and class shall be subjected to the tests in subgroup 3, in the order shown. If, during an 18-month period, first article testing has been successfully completed on transformers of the same grade and class, and similar construction and materials, the test data may be submitted in lieu of subgroup 3 testing for that 18-month period.

4.6.2.1.2 Failures. If one or more sample units fail to pass group C inspection, the sample shall be considered to have failed.

4.6.2.1.3 Disposition of sample units. Sample units which have been subjected to group C inspection shall not be delivered on the contract or purchase order.

4.6.2.1.4 Noncompliance. If a sample fails to pass group C inspection, the supplier shall take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same conditions, with essentially the same materials, processes, etc., and which are considered subject to the same failure. Acceptance of the product shall be discontinued until corrective action, acceptable to the Government, has been taken. After the corrective action has been taken, group C inspection shall be repeated on additional sample units (all inspection, or the inspection which the original sample failed, at the option of the Government). Groups A and B inspections may be reinstituted; however, final acceptance shall be withheld until the group C reinspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure and corrective action taken shall be furnished to the cognizant inspection activity.

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

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 3.1, 3.3, 3.4, 3.2, and 3.28).

4.7.1.1.1 Post-test. Transformers shall be examined to verify that the protective coating, filling material, and [illegible] are in accordance with the applicable requirements (see 3.24).

4.7.1.2 Internal. Transformers shall be disassembled and examined to verify that the materials, internal design and construction, and workmanship are in accordance with the applicable requirements (see 3.3, 3.4, and 3.28).

4.7.2 Seal (when applicable, see 3.1 and 6.1) (see 3.5) Transformers shall be tested in accordance with 4.7.2.1 or 4.7.2.2, as applicable. Any transformer which shows evidence of leakage may be given remedial treatment. After completion of the treatment, the seal test shall be repeated as evidence that such remedial treatment is adequate.

4.7.2.1 Gas-filled units. Transformers shall be tested in accordance with method 112 of MIL-STD-202. The following details shall apply:

(a) Test-condition letter - C.
(b) Leakage-rate sensitivity - 10^{-8} atm cc/sec.
(c) Procedure number - III or IV, as specified (see 3.1 and 6.1)

4.7.2.2 All other units. Transformers shall be immersed for 2 to 3 minutes in a bath of water (or other suitable liquid of no greater density or surface tension) maintained at a temperature of 85° C $^{+5°}_{-0°}$ C. The temperature of the transformer shall not exceed 40° C at the time of immersion. The following alternate test may be used when specified (see 3.1 and 6.1). The transformers shall be immersed in a container of water containing approximately 1 percent wetting agent such as Aerosol which shall then be placed in a vacuum chamber. The pressure shall be reduced to 3.4 inches of mercury and maintained at this pressure for a period of at least 3 minutes.

4.7.3 Dielectric withstanding voltage (see 3.6). Transformers shall be tested in accordance with 4.7.3.1 and 4.7.3.2, when applicable.

4.7.3.1 At atmospheric pressure. Transformers shall be tested in accordance with method 301 of MIL-STD-202. The following details and exception shall apply:

(a) Magnitude of test voltage - As specified in table VII.
(b) Nature of potential - AC.
(c) Duration of application of test voltage - A minimum of 60 seconds.
(d) Points of application of test voltage - Unless otherwise specified (see 3.1 and 6.1), the test voltage shall be applied between each winding and the case or mounting hardware. Windings not under test shall be grounded to the case or mounting hardware.
(e) Examination during and after test - Transformers shall be examined for evidence of damage resulting from arcing, flashover, breakdown of insulation, or other damage.

4.7.3.1.1 For special designs. Windings with special dielectric features (i.e., graded insulation) shall be subjected to the test voltages specified for such windings (see 3.1 and 6.1).

4.7.3.1.2 At reduced voltage. Transformers shall be subjected to the dielectric withstanding voltage test specified in 4.7.3.1, except that the test voltages shall be 90 percent of the values shown in table VII and shall be applied for a period of 5 seconds, or 75 percent of the values shown in table VII applied for a period of 1 minute.

TABLE VII. Dielectric withstanding voltage at atmospheric pressure.

Working voltage 1/	Rms test voltage (at 28 to 32 inches of mercury)
≤ 25 - - - - - -	50
> 25 to 50 incl - - - -	100
> 50 to 100 incl - - -	300
> 100 to 175 incl - - -	1,000
> 175 to 700 incl - - -	2.8 x working voltage
> 700 - - - - -	1.4 x working voltage, -1,000

1/ The working voltage is defined as the maximum instantaneous voltage stress that may appear under normal rated operation across the insulation being considered. This insulation may be between windings or between a winding and the case or core.

4.7.3.2 At barometric pressure (when applicable, see 3.1 and 6.1). Transformers designed for operation above 10,000 feet shall be tested in accordance with method 105 of MIL-STD-202. The following details and exceptions shall apply:

(a) Test-condition letter - As specified (see 3.1 and 6.1).
(b) Magnitude of test voltage - As specified in table VIII. A greater potential may be used at the option of the supplier.

TABLE VIII. Dielectric withstanding voltage at reduced barometric pressure

Working voltage [1]	Test voltage
Volts	Volts, rms
≤ 25 - - - - - -	50
> 25 to 50 incl - - -	100
> 50 - - - - - -	300 or 1.25 x working voltage, whichever is greater

1. The working voltage is defined as the maximum instantaneous voltage stress that may appear under normal rated operation across the insulation being considered. This insulation may be between windings or between a winding and the case or core.

(c) Examinations during and after test - Transformers shall be examined for evidence of damage resulting from arcing, flashover, breakdown of insulation, or other damage.

4.7.4 Induced voltage (applicable when winding terminal voltage exceeds 25 volts) (see 3.7). Transformers shall be subjected to a voltage sufficient to cause twice the rated voltage to appear across any winding. The test voltage may be applied to any winding. Windings shall be grounded as they would be in service. The frequency shall be at least twice the minimum frequency of the specified frequency range (see 3.1 and 6.1) and shall be remote from any resonant frequency such that the operational flux density of the core will never be reached. The test potential shall be applied for 7,200 ± 200 cycles or 5 ± 1.2 seconds, whichever is greater. During the test, transformers shall be examined for evidence of continuous arcing, breakdown of insulation, and abrupt changes in the input current. Means shall be provided to indicate fluctuations of input current or changes in Q, as applicable.

4.7.5 Insulation resistance (see 3.8). Transformers shall be tested in accordance with method 302 of MIL-STD-202. The following details shall apply:

(a) Test-condition letter - B (except that for transformers with a dielectric withstanding test voltage less than 500 volts (see 4.7.3), test-condition letter A shall be used).
(b) Points of measurement - Unless otherwise specified (see 3.1 and 6.1), measurements shall be made between mutually insulated points. Each winding shall be tested with all other windings connected together and to the shield.

4.7.6 Electrical characteristics (see 3.9). With the transformers mounted by their normal mounting means, the following electrical characteristics shall be determined when specified (see 3.1 and 6.1).

4.7.6.1 DC resistance. Transformers shall be tested in accordance with method 303 of MIL-STD-202.

CAUTION. The current of the measuring instrument shall not cause a saturation effect when measuring transformers with ferrite cores.

4.7.6.2 Inductance. The inductance of each winding or between stated terminals shall be specified (see 3.1 and 6.1). Effective inductance of the transformer shall be measured at the frequency specified (see 3.1 and 6 1). For quality conformance inspection, the measurement of effective inductance shall be referred to a comparison standard for correlation, when specified (see 3.1, 4 5 2.1, 6.1, and 6 3). When true inductance is specified (see 3.1 and 6 1), the following test procedure, or equivalent, shall be used. A calibrated capacitor shall be used to tune the winding to resonance at several frequencies. The points will describe a straight line of added capacitance, one point of which shall be $\frac{1}{fo^2}$ as abscissa (fo = self-resonant frequency of the transformer at the abscissa of zero capacity), versus the reciprocal of the frequency squared, as ordinate, to be plotted, and true inductance to be calculated by the following formula

$$\text{True inductance} = KM$$

Where

$$K = \frac{1}{4\pi^2} = 0.026$$

M = Slope of line representing added capacitance

4.7.6.3 Incremental current inductance reduction. The incremental current inductance reduction test shall be performed using a General Radio type 1633-A incremental bridge, or equivalent, at 10 kilohertz (KHz) for inductance values between 10 and 100 microhenries and at 1 KHz for inductance values greater than 100 microhenries, and the General Radio type 1632-A inductance bridge, or equivalent, at 10 KHz for inductance values less than 10 microhenries. The ac test voltage for incremental current testing shall be the lowest voltage across the transformer which will permit the bridge to operate satisfactorily The inductance of the transformer under test with the determined ac test voltage applied shall be measured and recorded with zero dc current in the transformer at 1 or 10 KHz, as applicable. The inductance value shall represent a reduction of 5 percent or less than the inductance measured with zero dc current (see 3.1)

4.7.6.4 Q. The Q shall be measured at the frequency specified (see 3.1 and 6.1). For quality conformance inspection, the measurement shall be referred to a comparison standard for correlation, when specified (see 3.1, 4.5.2.1, 6.1, and 6.3).

4 7 6 5 Impedance

4 7.6.5.1 Untuned radio frequency transformers (primary impedance) Transformer primary impedance shall be measured with all secondaries loaded with their specified impedances, and with specified dc currents flowing in the windings. The resistance and reactance looking into the primary shall be measured at the specified input frequency and voltage by a bridge or equivalent method approved by the Government (see 3.1 and 6 1).

4.7.6.5.2 Variable-frequency units. The impedance of variable-frequency transformers shall be measured using an impedance bridge, or equivalent, at the frequency specified (see 3 1 and 6 1)

4 7 6 5.3 Fixed-tuned, resonant units. The impedance of fixed-tuned resonant transformers shall be measured using an impedance bridge, or equivalent, at the frequency specified (see 3 1 and 6 1). The measurements of impedance shall be referred to a comparison standard for correlation, when specified (see 3 1, 4 5 2 1, 6 1, and 6 3) The following measurements shall be made when specified (see 3 1 and 6.1)

Rd = Antiresonant impedance.
Rds = Antiresonant secondary impedance with primary short-circuited
Rdp = Antiresonant primary impedance with secondary short-circuited
Rdps = Antiresonant primary impedance with secondary unterminated, but resonated to the specified frequency.

4 7 6 6 Coupling.

4 7 6 6.1 Coupling coefficient The coupling coefficient shall be measured using an impedance bridge, or equivalent, at the frequency specified (see 3.1 and 6 1). When the coupling coefficient is greater than 0.9, the open- and short-circuited secondary method shall be used. When the coupling coefficient is equal to or less than 0.9, the series-aiding series-opposing method, or a mutual inductance bridge, shall be used. Units having variable couplings shall be measured at the specified extremes of the coupling range, and units having permeability tuning shall be measured at the middle and at the specified end points of the tuning range (see 3 1 and 6 1)

4 7 6 6 2 Coupling factor The coupling factor for which Rd measurements are made (see 4 7 6 5 3) shall be calculated by the following formula

$$Fc = \frac{Rdp}{Rdps} = 1 + \left(\frac{K}{Kc}\right)^2 = 1 + K^2 QpQs$$

Where

Fc = Coupling factor
K = Actual coefficient of coupling.
Kc = Coefficient at critical coupling
Qp = Q of the primary.
Qs = Q of the secondary

4.7.6 7 Bandwidth and gain. The bandwidth and gain (see 6 4) of transformers shall be measured at the points specified, using the specified circuit (see 3 1 and 6 1) For quality conformance inspection, the measurement of bandwidth and gain shall be referred to a comparison standard for correlation, when specified (see 3 1, 4.5 2.1, 6 1, and 6 3)

4 7 6 8 Voltage standing wave ratio (VSWR) (when applicable, see 3 1 and 6.1). The transformer under test shall be terminated with its required impedance and the VSWR shall be measured over the operating frequency range The test frequencies and the maximum allowable ratio shall be as specified (see 3 1 and 6 1) The formula ratio is defined as follows

$$V_o = \frac{V_f + V_r}{V_f - V_r}$$ or alternately in terms of power

$$V_o = \frac{1 + \sqrt{\frac{P_r}{P_f}}}{1 - \sqrt{\frac{P_r}{P_f}}}$$

Where

V_o = VSWR
V_f = Forward voltage
V_r = Reverse voltage
P_f Forward power
P_r Reverse power

4 7 6 9 Insertion loss Transformers shall be tested in accordance with 4 7 6 9 1 4 7 6 9 2 or 4 7 6 9 3 as specified (see 3 1 and 6 1) The insertion loss in decibels (dB) shall be as specified (see 3 1 and 6 1)

NOTE Insertion loss (see 6 4) is defined as the ratio of the power delivered to the load (before insertion of the transformer) to the power delivered to the load after insertion of the transformer

4.7.6.9.1 For equal input and output impedance. With a constant voltage, Eg, across the generator, the load voltage, with and without the transformer in the circuit, shall be recorded at each frequency. The insertion loss shall be calculated using the following formula:

$$I.L. = 20 \log_{10} \frac{E_1}{E_2}$$

Where:

I.L. = Insertion loss (in dB) with Eg constant
E_1 = The load voltage with the transformer not in the circuit at the reference frequency
E_2 = The load voltage with the transformer in the circuit at the reference frequency

A typical test circuit is shown in figure 2.

4.7.6.9.2 Untuned transformer with unequal input and output impedance. The insertion loss shall be determined as above using the test circuit in figure 2. The insertion loss shall be calculated using the following formula:

$$I.L. = 20 \log_{10} \frac{E_g}{2E_L} + 10 \log_{10} \frac{Z_L}{Z_s}$$

Where:

I.L. = Insertion loss (in dB).
E_g = Constant voltage across the generator
E_L = Load voltage with transformer in circuit
Z_s = Source impedance.
Z_L = Load impedance.

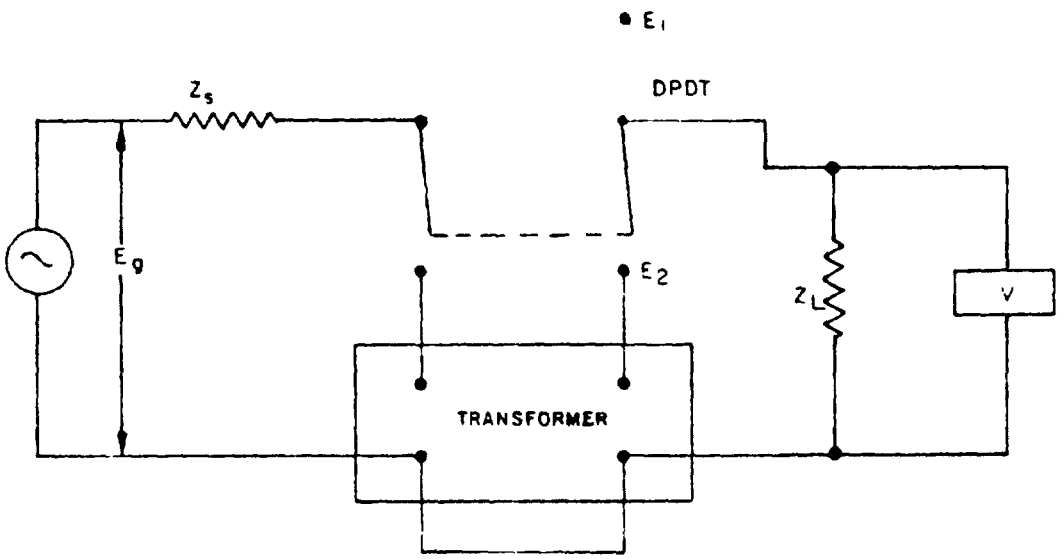


FIGURE 2. Typical measurement circuit for insertion loss.

4.7 6.9.3 For tuned transformers with unequal input and output impedance The formula specified in 4 7 6 9 2 shall be used. A typical test circuit is shown in figure 3.

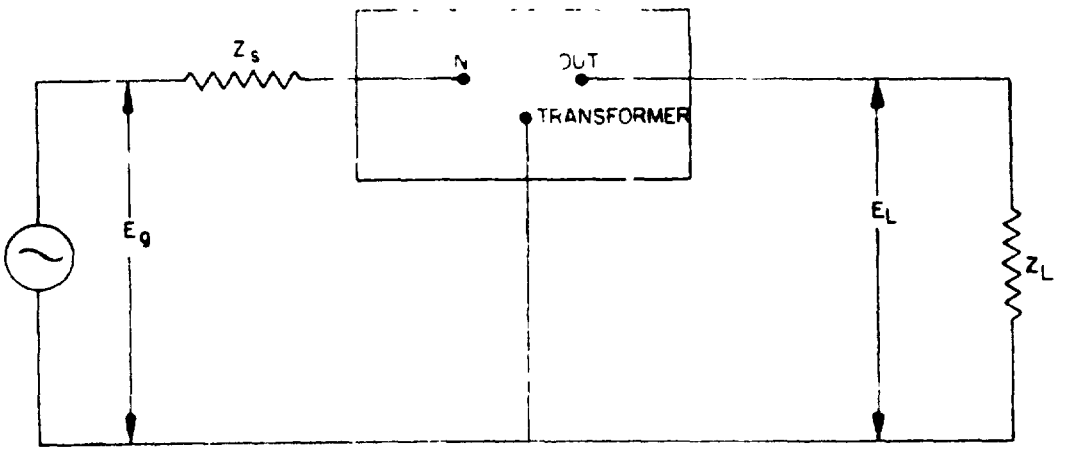


FIGURE 3 Typical measurement circuit for insertion loss for tuned transformers with unequal input and output impedance

4 7 6 10 Discrimination (applicable to tuned transformers). The insertion loss in the stop band of the transformer shall be measured using a test circuit as shown in figure 2 Measurements shall be made at frequencies or over frequency bands as specified (see 3.1 and 6 1). The algebraic difference between the insertion loss at a specified frequency, and the insertion loss at the reference frequency, shall be defined as the discrimination (OC) at the specified frequency, measured as specified (see 3 1 and 6 1)

4 7.7 Stability at temperature extremes (see 3 10) Transformers shall be exposed to a temperature of $-55^{+0^\circ}_{-3^\circ}$ C for a period of time as specified in table IX At the end of this exposure period and while the transformers are at this temperature the insertion loss or discrimination shall be measured as applicable (see 3 1 and 6 1) The transformers shall then be exposed at the maximum operating temperature for the class $^{+3^\circ}_{-0^\circ}$ C for a period of time as specified in table IX. At the end of this exposure period and while the transformers are at this temperature, insertion loss or discrimination (see 3.1 and 6.1) shall again be measured The transformers shall then be subjected to the dielectric withstanding voltage test specified in 4 7.3.1.2.

TABLE IX. Exposure time at extreme temperature.

Weight of transformer	Minimum time
Pounds	Hours
0 3 and below	1
Above 0 3 to 3 inclusive	2
Above 3 to 30 inclusive	4
~~Above 30 to 50 inclusive~~	8

4.7.8 Operating torque (when applicable, see 3.1 and 6.1) (see 3.11) Transformers shall be exposed to a temperature of 25° $^{+10}_{-5}$°C. Transformers shall be rigidly mounted. The timing arm shall be rotated for 8 cycles (16 excursions) from maximum core extension to minimum position for one complete cycle while not exceeding the maximum or minimum torque specified (see 3.1 and 6.1). Each cycle shall take a minimum of 40 seconds to perform.

4.7.9 Solderability (when applicable, see 3.1 and 6.1) (see 3.12) Transformers shall be tested in accordance with 4.7.9.1 or 4.7.9.2, as applicable (see 3.1 and 6.1). The method in 4.7.9.1 is preferred and shall be specified whenever practicable.

4.7.9.1 Solder bath method. Transformers shall be tested in accordance with method 208 of MIL-STD-202. The following details shall apply:

(a) Special preparation of specimen - Sample units shall not have been soldered during any of the previous tests.
(b) Number of terminations of each part to be tested - A minimum of two of each type of terminal.

4.7.9.2 Soldering iron method. The test shall be performed on solder terminations, attached to the transformer. The solder shall conform to type S, composition Sn60, of QQ-S-571. The flux shall conform to type A or W (as applicable) of MIL-F-14256. The temperature of the bit shall be 300 to 350° C. The iron and solder shall be applied to the termination for 10 seconds. The solder shall be applied to the first 2 seconds. Tinning, as evidenced by the free flowing of the solder with proper wetting of the termination, shall be completed within the first 2 seconds. The transformer under test shall remain under room ambient conditions for recovery for 15 minutes before final examination is made.

(a) Special preparation of specimen - The surface shall be smooth and properly tinned and the solder terminations shall not have been soldered during any previous test.
(b) Number of terminations - In accordance with 4.7.9.1.
(c) Examinations of terminations - In accordance with 4.7.9.1.
(d) Soldering irons - The soldering iron shall have one of the following bit sizes:
   1. 0.3 inch diameter, 1.25 inch exposed length reduced to a wedge shape over a length of approximately 0.4 inch.
   2. 0.125 inch diameter, 0.5 inch exposed length reduced to a wedge shape over a length of approximately 0.2 inch.
(e) Point of application of soldering iron - 1/4 inch from the nearest insulating material or to one-half the exposed length of the terminal, whichever point is closer to the insulating material.
(f) Examination after test - Transformers shall be examined as specified in method 208 of MIL-STD-202.

4.7.10 Resistance to solvents (see 3.13) Transformers shall be tested in accordance with method 215 of MIL-STD-202. After the final immersion and brushing, transformers shall be allowed to dry. When dry, the transformers shall be examined under a four-power magnification.

4.7.11 Life (see 3.14). Transformers shall be tested in accordance with method 108 of MIL-STD-202. The following details and exceptions shall apply:

(a) Placement of temperature-sensing device - A temperature-sensing device shall be placed 2 inches from the transformer that is furthest from the heat source.
(b) Test temperature - As specified (see 3.1 and 6.1).
(c) Operating conditions - 100 percent rated loaded conditions (see 3.1 and 6.1), 1-1/2 hours on and 1/2 hour off for the applicable number of hours specified and at the test temperatures specified (see 3.1 and 6.1). On-time shall be three-fourths of the total lapsed time.
(d) Test-condition letter - F.

(e) Examination after test - At the conclusion of the life test and while still at the elevated ambient temperature, insulation resistance shall be measured as specified in 4.7.5. The transformers shall be returned to room ambient conditions and visually examined for evidence of damage, the dielectric withstanding voltage, insulation resistance, and electrical characteristics shall then be measured as specified in 4.7 3.1 2, 4 7 5, and 4 7 6, respectively

4 7 12 Temperature rise (when applicable, see 3 1 and 6 1) (see 3 15). Unless otherwise specified (see 3.1 and 6.1), the temperature rise test shall only be performed on transformers rated at more than 0.8 watt average output The temperature rise of the windings of transformers shall be determined by any suitable method (preferably by the resistance-change method). The test shall be performed at the specified ambient temperature and with rated dc current applied (see 3.1 and 6.1) When specified, an alternating voltage of the frequency and magnitude specified (see 3.1 and 6.1), shall be superimposed on the direct current When the resistance of the winding, measured at 5-minute intervals, remains constant, the temperature of the winding shall be considered stabilized If the method used for determining the resistance of the winding requires the removal of power, the measurement shall be made within 30 seconds after the removal of power

4 7.13 Resistance to soldering heat (when applicable, see 3 1 and 6 1) (see 3.16) Transformers shall be tested in accordance with 4.7.13.1 or 4.7 13 2, as applicable (see 3 1 and 6.1) The method in 4.7.13.1 is preferred and shall be specified whenever practicable.

4 7 13.1 Solder bath method. Transformers shall be tested in accordance with method 210 of MIL-STD-202. The following details shall apply

(a) Special preparation of specimen - Sample units shall not have been soldered during any of the previous tests
(b) Depth of immersion in the molten solder - To a point 1/4 inch from the nearest insulating material to one-half the exposed length of the terminal, whichever point is closer to the insulating material.
(c) Test-condition letter - A.
(d) Examination after test - The transformers shall be visually examined and there shall be no seepage of the impregnant, loosening of the terminals, or other mechanical damage The windings of transformers shall be checked for continuity

4 7 13.2 Soldering iron method. The test shall be performed on all solder terminations, attached to the transformer. The solder shall conform to type S, composition Sn60, of QQ-S-571 The flux shall conform to type A or W (as applicable) of MIL-F-14256 The temperature of the bit shall be 300 to 350°C. The iron and solder shall be applied to the termination for 10 seconds. The solder shall be applied for the first 2 seconds. Tinning, as evidenced by the free flowing of the solder with proper wetting of the termination, shall be completed within the first 2 seconds. The transformer under test shall remain under room ambient conditions for recovery for 15 minutes, before final examination is made.

(a) Special preparation of specimen - The surface shall be smooth and properly tinned and the solder terminations shall not have been soldered during any previous test
(b) Soldering irons - The soldering iron shall have one of the following bit sizes
   1. 0.3 inch diameter, 1.25 inch exposed length reduced to a wedge shape, over a length of approximately 0 4 inch.
   2. 0 125 inch diameter, 0.5 inch exposed length reduced to a wedge shape, over a length of approximately 0 2 inch
(c) Point of application of soldering iron - 1 4 inch from the nearest insulating material or to one-half the exposed length of the terminal, whichever point is closer to the insulating material.
(d) Examination after test - As specified in 4.7.13.1(d).

4 7 14 Terminal strength (see 3 17). Transformers shall be tested as specified in 4.7 14 1 to 4 7 14 3 inclusive, as applicable After each test the terminals shall be examined for loosening rupturing and other mechanical damage Unless otherwise specified (see 3.1 and 6 1), all terminal on each test sample shall be subjected to the applicable tests, up to a maximum of four identical terminals per sample

4.7 14 1 Pull

4 7 14 1.1 Solid-wire lead terminals (other than printed-circuit terminals) Transformers shall be tested in accordance with method 211 of MIL-STD-202 The following details shall apply

(a) Test-condition letter - A
(b) Points of measurement - A force shall be applied in the direction of the axis of termination and shall be increased gradually until the magnitude specified in table X is reached, and shall be held at the value for at least 10 seconds

4 7 14 1 2 Solder terminals. Transformers shall be tested in accordance with method 211 of MIL-STD-202. The following details shall apply

(a) Test-condition letter - A
(b) Points of measurement - A force as specified in table X shall be applied to each terminal at the point where the lead from the external circuit connects to it The force shall be applied in any direction including the weakest, and shall be increased gradually to the specified magnitude and shall be held at the value for at least 5 to 10 seconds.

TABLE X Pull

Cross-sectional area of electrode at its smallest point at which lead from external circuit connects	Force
Circular mils	Pounds
≤2,000	2 5
>2,000	5 0

4 7.14.1 3 Printed-circuit and pin type terminals. Transformers shall be tested in accordance with method 211 of MIL-STD-202 The following detail and exception shall apply

(a) Test-condition letter - A
(b) Applied force - A force of 2 5 pounds shall be gradually applied to each terminal in the direction of the axis of the terminal as shown on figure 4

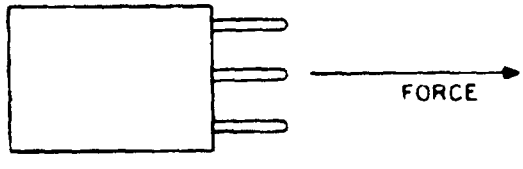


FIGURE 4 Direction of force to be applied to each pin on unit.

4 7.14.2 Twist or bend

4.7 14.2 1 Solid-wire lead terminals (other than printed-circuit terminals) Following the test specified in 4.7 14.1.1, transformers shall be tested in accordance with method 211 of MIL-STD-202 The following detail and exception shall apply

(a) Test-condition letter - D
(b) Application of torsion - The body of the part or the clamped terminal shall be rotated through 360 degrees about the original axis of the bent terminal, in alternating directions, for a total of five rotations, at the rate of approximately 3 seconds per rotation.

4.7.14.2 2 Flat solder terminals. Any terminal that shows permanent deformation greater than 15 degrees in the metal portion of the terminal in the terminal pull test specified in 4 7.14.1 shall be tested in accordance with method 211 of MIL-STD-202 This test does not apply to terminals which show permanent deformation, but are not designed to be bent 45 degrees. The following detail and exception shall apply

(a) Test-condition letter - B
(b) Number of bending operations - Five times through an angle of 90 degrees (45 degrees each side of center)

4 7.14.3 Torque.

4.7 14 3 1 Screw-thread terminals Transformers shall be tested in accordance with method 21. of MIL-STD-202, test-condition letter E

4 7 14.3 2 All other terminals. All other terminals shall be subjected to the torque specified in table XI The torque shall be applied to the terminal at the point where the external lead wires normally connect to it The motion shall be applied clockwise and counterclockwise in a plane perpendicular to the axis of the terminal The equivalent diameter is equal to two times the distance from terminal center to point of wire connection after maximum permanent deflection due to the pull test as indicated by the examples shown on figure 5 The equivalent diameter for "hook" type terminals is the diameter of the wire from which the terminal is formed

TABLE XI Torque

Equivalent diameter	Torque
Inch	Ounce-inches
1/8	8
>1/8 to 3/16 incl	18
>3/16 to 5/16 incl	40

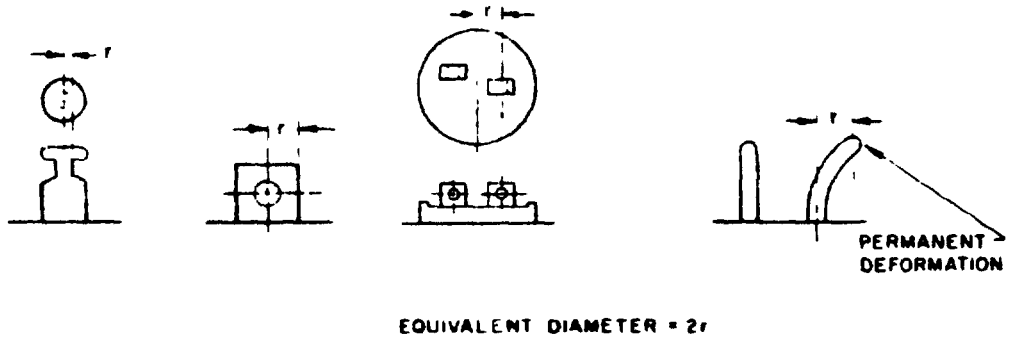


FIGURE 5 Examples of determination of equivalent diameters

4.7.15 Vibration (see 3.18) Transformers shall be tested in accordance with 4.7.15.1 or 4.7.15.2 as applicable (see 3.1 and 6.1).

4.7.15.1 Low frequency Transformers shall be tested in accordance with method 201 of MIL-STD-202. The following details and exception shall apply

(a) Method of mounting - Transformers shall be securely fastened by their normal mounting means.
(b) Electrical load conditions - As specified (see 3.1 and 6.1) The transformers shall be monitored during the entire vibration period
(c) Examination after vibration - Transformers shall be examined for evidence of physical or mechanical damage and winding discontinuity.

4.7.15.2 High frequency Transformers shall be tested in accordance with method 204 of MIL-STD-202. The following details and exception shall apply

(a) Method of mounting - As specified in 4.7.15.1(a).
(b) Test-condition letter - As specified (see 3.1 and 6.1)
(c) Electrical load conditions - As specified (see 3.1 and 6.1) The transformers shall be monitored during the entire vibration period.
(d) Examination after vibration - As specified in 4.7.15.1(c).

4.7.16 Winding continuity (see 3.19) All windings of transformers shall be tested for electrical continuity by any suitable means

4.7.17 Shock (see 3.20) Transformers shall be tested in accordance with 4.7.17.1 or 4.7.17.2 when specified (see 3.1 and 6.1)

4.7.17.1 Specified pulse Transformers shall be tested in accordance with method 213 of MIL-STD-202 The following details and exception shall apply

(a) Method of mounting - Transformers shall be mounted in relation to the test equipment in such a manner that the stress applied is in the direction which would be most detrimental
(b) Test-condition letter - H or I as specified (see 3.1 and 6.1)
(c) Examination after shock - Transformers shall be examined for evidence of physical or mechanical damage and winding discontinuity

4 7 17 2 High-impact Transformers shall be tested in accordance with method 207 of MIL-STD-202 The following detail and exception shall apply

(a) Mounting fixture - Figure 207-5 of method 207.
(b) Examination after shock - As specified in 4 7 17 1(c).

4 7 18 Thermal shock (see 3 21) Transformers shall be tested in accordance with method 107 of MIL-STD-202. The following detail and exception shall apply

(a) Test-condition letter - A, except that step 3 shall be the specified maximum ambient temperature for the class plus one-half the allowable temperature rise The temperature for step 3 shall be a minimum of 85° C for class O The time for steps 2 and 4 shall be 5 minutes maximum
(b) After cycling - Transformers shall be examined for evidence of leakage and other visible damage.

4 7.19 Immersion (grade 1 only) (see 3.22). Transformers shall be tested in accordance with method 104 of MIL-STD-202. The following details shall apply

(a) Test-condition letter - B.
(b) Measurements after final cycle - Transformers shall be examined for evidence of flow of impregnating material from the case, corrosion, or other visible damage, and winding discontinuity.

4.7 20 Moisture resistance (grades 1 and 2 only) (see 3 23). Transformers shall be tested in accordance with method 106 of MIL-STD-202. The following details and exceptions shall apply

(a) Mounting - On racks.
(b) Polarization - Unless otherwise specified (see 3.1 and 6.1), during steps 1 to 6 inclusive, a polarizing voltage of 100 volts dc shall be applied between all windings normally maintained at a positive potential, and all other windings and the mounting hardware or case, connected together. The voltage shall be positive with respect to the mounting hardware or case.
(c) Loading voltage - Not applicable.
(d) Final measurements - Following the 1-1/2 to 3-1/2 hour conditioning period, unless otherwise specified (see 3 1 and 6 1), the units shall be removed to room ambient conditions Within 30 minutes after removal, the dielectric withstanding voltage and insulation resistance shall be measured as specified in 4.7 3 1 2 and 4 7 5, respectively. Within 1 hour after these measurements, the specified electrical characteristics (see 3.1 and 6 1), shall be measured. When specified (see 3.1 and 6.1), the dielectric withstanding voltage, insulation resistance, and electrical characteristics shall be measured following a 4- to 24-hour conditioning period as specified in 4.7.3.1.2, 4.7 5, and 4.7.6, respectively After the test, transformers shall be examined for evidence of corrosion.

4.7.21 Flammability (when applicable, see 3 1 and 6 1) (see 3.25). Transformers shall be tested in accordance with method 111 of MIL-STD-202. The following details and exception shall apply

(a) Point of impingement of applied flame - One of the lower free corners, so that the flame is just in contact with the transformer. The free corners of the transformer are those corners which are the greatest distance from the mounting brackets
(b) Allowable time for burning of visible flame on specimen - 3 minutes maximum
(c) Examinations during and after test - Transformers shall be examined for evidence of violent burning which results in an explosive-type fire, dripping of flaming material ~~and visible burning which continues~~ beyond the allowable duration after removal of the applied flame.

4 7 22 Fungus (see 3.26) Unless certification is provided transformers shall be tested in accordance with method 508 of MIL-STD-810

5 PREPARATION FOR DELIVERY

5 1 Preservation and packaging Preservation and packaging shall be level A or C, as specified (see 6 1).

5.1.1 Level A.

5.1.1.1 Cleaning. Transformers shall be cleaned in accordance with MIL-P-116, process C-1

5.1 1 2 Drying Transformers shall be dried in accordance with MIL-P-116.

5 1 1.3 Preservative application. Preservatives shall not be used.

5 1 1.4 Unit packaging Transformers shall be individually packaged in accordance with the methods of MIL-P-116 specified herein insuring compliance with the general requirements paragraph under methods of preservation (unit protection) and the physical protection requirements paragraph therein

5 1.1.4 1 Hermetically sealed transformers. Hermetically sealed transformers shall be packaged in accordance with method III

5 1 1 4.2 Nonhermetically sealed transformers. Unless otherwise specified (see 6.1), nonhermetically sealed transformers shall be packaged in accordance with submethod IA-8. Each unit package exceeding 15 cubic inches shall be placed in a supplementary container conforming to PPP-B-566 or PPP-B-676.

5 1 1 5 Intermediate packaging. Transformers, packaged as described in 5.1 1 4, shall be placed in intermediate containers conforming to PPP-B-566 or PPP-B-676 Intermediate containers shall be uniform in size, shape and quantities, shall be of minimum tare and cube and shall contain multiples of five unit packages, not to exceed 50 unit packages No intermediate packaging is required when the total quantity shipped to a single destination is less than 50 unit packages or when supplementary containers are used.

5.1.2 Level C. Clean and dry transformers shall be individually packaged in a manner that will afford adequate protection against corrosion, deterioration and physical damage during shipment from supply source to the first receiving activity

5 2 Packing. Packing shall be level A, B or C, as specified (see 6.1).

5.2.1 Level A. The packaged transformers shall be packed in fiberboard containers conforming to PPP-B-636, class weather resistant, style optional, special requirements. In lieu of the closure and waterproofing requirements in the appendix of PPP-B-636, closure and waterproofing shall be accomplished by sealing all seams, corners and manufacturer's joint with tape, two inches minimum width, conforming to PPP-T-60, class 1 or PPP-T-76. Banding (reinforcement requirements) shall be applied in accordance with the appendix to PPP-B-636 using non-metallic or tape banding only

5.2.2 Level B. The packaged transformers shall be packed in fiberboard containers conforming to PPP-B-636, class domestic, style optional, special requirements Closures shall be in accordance with the appendix thereto.

5.2 3 Level C. The packaged transformers shall be packed in shipping containers in a manner that will afford adequate protection against damage during direct shipment from the supply source to the first receiving activity. These packs shall conform to the applicable carrier rules and regulations

5 2.4 Unitized loads Unitized loads commensurate with the ~~level of packing specified~~ in the contract or order shall be used whenever total quantities for shipment to one destination equal 40 cubic feet or more Quantities less than 40 cubic feet need not be unitized Unitized loads shall be uniform in size and quantities to the greatest extent practicable

5.2.4.1 Level A. Transformers, packed as specified in 5.2.1, shall be placed on pallets in conformance with MIL-STD-147, load type I, with a fiberboard cap (storage aid 4) positioned over the load.

5.2 4 2 Level B. Transformers, packed as specified in 5.2.2, shall be palletized as specified in 5 2.4.1 except that the fiberboard caps shall be class domestic.

5.2 4.3 Level C. Transformers, packed as specified in 5.2 3, shall be unitized with pallets and caps of the type, size and kind commonly used for the purpose and shall conform to the applicable carrier rules and regulations

5.3 Marking. In addition to any special marking required by the contract or order (see 6 1), each unit package, supplementary, intermediate and exterior container and unitized load shall be marked in accordance with MIL-STD-129

5 4 General.

5.4.1 Exterior containers. Exterior containers (see 5 2 1, 5 2 2 and 5 2 3) shall be of a minimum tare and cube consistent with the protection required and shall contain equal quantities of identical stock numbered items to the greatest extent practicable.

5 4.2 Navy procurements For Navy procurements the use of polystyrene loose fill material (such as strips, strands and beads) is prohibited for packaging and packing applications.

5.4.3 Army procurements (See 5 1 1 4, 5 1 1 5, 5.2.1, 5.2.2 and 5.2 4 2.) All unit and intermediate containers shall either be weather resistant or overwrapped with waterproof barrier materials. Containers conforming to PPP-B-566 or PPP-B-676 shall be overwrapped with waterproof barrier materials or shall conform to MIL-B-43014. For level A packing when quantities per destination are less than a unitized load, the fiberboard containers shall not be banded but shall be placed in a close fitting box conforming to PPP-B-601, overseas type, PPP-B-621, class 2, style 4 or PPP-B-585, class 3, style 2 or 3. Closure and strapping shall be in accordance with the applicable container specification except that metal strapping shall conform to QQ-S-781, type I, class B For level B packing fiberboard boxes shall be weather resistant as specified in level A and the containers shall be banded. Weather resistant fiberboard caps shall be used for level B unitized loads.

5.4.4 Air Force requirements. For Air Force requirements submethod IC-3 of MIL-P-116 shall be used in lieu of submethod IA-8 (see 5 1.1.4.2).

6. NOTES

6.1 Ordering data. Procurement documents should specify the following

(a) Title, number, and date of this specification and complementary document
(b) Classification (covering the type, grade, and class) and maximum operating temperature (for class 4 only) (see 1.2).
(c) Dimensions with tolerances (case, mounting, and terminal), weight, and design and construction (including a sketch or drawing) (see 3.4).
  1. Screw threads, if other than in accordance with Handbook H28 (see 3 4 1), and engagement, if other than a minimum of three full threads (see 3.4 1 1)
  2 Whether external can shields are required (see 3.4.2).
  3. Terminal data (see 3.4 3) and applicable marking (see 3.27 1)
(d) Whether seal test is required and applicable data (see 3.5 and 4 7.2 1 or 4.7.2.2)
(e) Dielectric withstanding voltage test requirements (see 3 6 and 4 7 3)
(f) Induced voltage test requirements (see 3.7 and 4.7 4)
(g) Insulation resistance test requirements (see 3 8 and 4 7 5)
(h) Applicable electrical characteristics values tolerances, and other data (see 3 9 and 4.7.6). Whether measurements are to be referred to comparison standards (see 4 5 2.1)

(i) Applicable measurements for stability at temperature extremes (see 3.10 and 4.7.7).
(j) Whether operating torque test is required and applicable torque (see 3.11 and 4.7.8).
(k) Whether solderability test is required and applicable test (see 3.12 and 4.7 9).
(l) Life test data (see 3.14 and 4 7 11).
(m) Whether temperature rise test is required and applicable test requirements (see 3 15 and 4.7 12)
(n) Whether resistance to soldering heat test is required and applicable test (see 3.16 and 4.7.13).
(o) Terminal strength test samples, if other than specified (see 4.7.14).
(p) Applicable vibration test and test requirements (see 4 7.15.1 and 4 7 15.2)
(q) Applicable shock test and test requirements (see 4.7.17 1 and 4.7 17.2).
(r) Applicable measurements for moisture resistance test (see 4.7 20)
(s) Whether flammability test is required (see 4 7.21).
(t) Levels of preservation and packaging and packing required (see 5 1 and 5.2)
(u) Method of preservation and packaging if other than submethod IA-8 (see 5 1.1.4.2)
(v) Special marking required (see 5 3).

6.2 First article inspection Information pertaining to first article inspection of products covered by this specification should be obtained from the procuring activity for the specific contracts involved (see 3.2).

6 3 Comparison standards. Comparison standards will be established during first article inspection The values of electrical characteristics (see 4 7.6) which are to be referred to comparison standards will be marked on or permanently attached to each transformer. One unit will be returned to the supplier for use in measuring those characteristics which are to be referred to the comparison standard, and two units will be retained by the Government (see 4 5.2 1)

6 4 Bandwidth and gain (insertion loss). The use of "insertion loss" rather than "gain" is preferred. The word "gain" has no meaning in a passive device. The test procedure for insertion loss is a matched condition, the test is performed in circuitry and is repeatable thereby eliminating the need for comparison standards. However, not to confuse the terminology and for use in reprocurements, there will have to be a phasing out period.

Custodians:
Army - EL
Navy - EC
Air Force - 80

Review activities
Army - MI
Navy -
Air Force - 17
DSA - ES

User activities
Army - ME, SL, WC
Navy - MC SH, OS, AS
Air Force - 19

Preparing activity
Army - EL

Agent
DSA - ES

(Project 5950-0343)

(TO DETACH THIS FORM, CUT ALONG THIS LINE)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER

2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION

4. TYPE OF ORGANIZATION *(Mark one)*

- ☐ VENDOR
- ☐ USER
- ☐ MANUFACTURER
- ☐ OTHER *(Specify)* _____

b. ADDRESS *(Street, City, State, ZIP Code)*

5. PROBLEM AREAS

a. Paragraph Number and Wording

b. Recommended Wording

c. Reason/Rationale for Recommendation

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional

b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional

c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional

8. DATE OF SUBMISSION *(YYMMDD)*

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NOTE This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document*(s)* or to amend contractual requirements.

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