

INCH-POUND

MIL-PRF-21038F

April 2, 2004

SUPERSEDING

MIL-PRF-21038E

April 10, 1998

PERFORMANCE SPECIFICATION  
TRANSFORMERS, PULSE, LOW POWER  
GENERAL SPECIFICATION FOR

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

## 1. SCOPE

1.1 Scope. This specification covers the general requirements for low-power pulse transformers.

1.2 Classification. Transformers covered by this specification are classified according to product levels (see 1.2.1). (NOTE: See 6.6 for supersession information on the type designation system used in previous revisions of this specification.)

1.2.1 Product level. This specification makes provision for three product levels: level C, for high reliability commercial/industrial type applications; level M, for general purpose military applications; and level T, for high reliability critical military applications. These product levels are coded into the part or identifying number (PIN) (see 3.1). Examples of the PIN's are shown below:

M21038/27-01C - denotes the C level part with a C code on the end of the PIN.

M21038/27-01 - denotes the M level part. (NOTE: This PIN system was in use in previous revisions of MIL-PRF-21038.)

M21038/27-01T - denotes the T level part with a T code on the end of the PIN.

## 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 or 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents in section 3 or 4 of this specification, whether or not they are listed.

### 2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

#### DEPARTMENT OF DEFENSE STANDARD

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

MIL-STD-810 - Environmental Test Methods and Engineering Guidelines.

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

(Copies of these documents are available online at <http://assist.daps.dla.mil/quicksearch/> or [www.dodssp.daps.mil](http://www.dodssp.daps.mil) or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

Comments, suggestions or questions on this document should be addressed to Defense Supply Center Columbus, ATTN: VAT, Post Office Box 3990, Columbus, OH 43216-5000, or emailed to [Transformer@dsccl.dla.mil](mailto:Transformer@dsccl.dla.mil). Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at [www.dodssp.daps.mil](http://www.dodssp.daps.mil).

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2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/NCSL Z540-1	-	Calibration Laboratories and Measuring and Test Equipment - General Requirements.
ISO 10012-1	-	Quality Assurance Requirements for Measuring Equipment - Part 1: Metrological Confirmation System for Measuring Equipment.

(Copies of these documents are available from [www.ansi.org/](http://www.ansi.org/) or American National Standards Institute (ANSI), 11 West 42nd Street, New York, NY 10036-8002).

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

## 3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 Qualification. Transformers furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable Qualified Products List (QPL) before contract award (see 4.4 and 6.3).

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.

3.3.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.3.2 Flammable materials. Materials used in the construction of transformers shall be nonflammable and nonexplosive.

3.3.3 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 transformers shall be noncorrosive.

3.3.4 Solder and soldering flux. Solder and soldering flux shall be of such a quality as to enable the transformer to meet all the requirements of this specification. Tin plating is prohibited on any internal or external surface as a final finish (see 6.8). Use of tin-lead (Sn-Pb) finishes are acceptable provided a minimum lead content is 3 percent by weight.

3.3.5 Magnet wire. Magnet wire shall conform to ANSI/NEMA MW-1000 (see 6.7) or to an approved equivalent as authorized by the qualifying activity.

3.4 Interface and physical dimensions. Transformers shall meet the interface and physical dimensions specified (see 3.1).

3.4.1 Solderable terminals. Solderable terminals shall be as specified (see 3.1) and shall meet the solderability requirements specified herein. (see 3.17).

3.4.2 Case material. Transformers shall be enclosed in a suitable case in order to allow the transformers to meet the requirements and tests specified herein.

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3.5 Screening (T level only). When transformers are tested as specified in 4.7.2, there shall be no leakage of filling material, no cracking of encapsulating material; and no evidence of physical or mechanical damage affecting the mechanical or electrical operation.

3.6 Electrical characteristics (including waveform parameters) (as specified see 3.1). When transformers are tested as specified in 4.7.3, the applicable electrical characteristics shall be as specified.

3.7 Dielectric withstanding voltage. When transformers are tested as specified in 4.7.4, there shall be no arcing, flashover, breakdown on insulation, or other evidence of damage.

3.8 Insulation resistance. When transformers are tested as specified in 4.7.5, the minimum insulation resistance shall be 1,000 megohms.

3.9 Resistance to soldering heat. When transformers are tested as specified in 4.7.6, there shall be no softening of insulation, loosening of the winding or terminals, or cracking of the devices.

3.10 Terminal strength. When transformers are tested as specified in 4.7.7, there shall be no evidence of loosening, rupturing, or other mechanical damage. Bends shall not be considered as damage unless surface cracking is evident. Except for flexible leads, there shall be no rotation of the terminals. Rotation of the external portion of the metallic portion of a "hook" type terminal exceeding 10 degrees shall not constitute a failure.

3.11 Winding continuity. When transformers are tested as specified in 4.7.8, all windings shall be electrically continuous.

3.12 Life. When transformers are tested as specified in 4.7.9, 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 tested) or short circuit occurring within the transformer (such as shorted turns or faulty insulation between layers, between turns, between windings, between winding and case or core, or between windings and shield). In addition, transformers shall meet the following requirements:

- a. Insulation resistance ----- Shall be as specified in 3.8.
- b. Dielectric withstanding voltage ----- Shall be as specified in 3.7 (at atmospheric pressure)

The electrical characteristics shall remain within the tolerance or limits specified (see 3.1).

3.13 Vibration. When transformers are tested as specified in 4.7.10, there shall be no leakage of filling material and no evidence of other physical damage affecting the mechanical or electrical operation.

3.14 Shock. When transformers are tested as specified in 4.7.11, there shall be no leakage of filling material and no evidence of other physical damage affecting the mechanical or electrical operation.

3.15 Thermal shock. When transformers are tested as specified in 4.7.12, there shall be no leakage of filling material; and no evidence of other physical damage affecting the mechanical or electrical operation.

3.16 Moisture resistance. When transformers are tested as specified in 4.7.13, there shall be no evidence of physical damage or corrosion affecting the mechanical or electrical operation.

3.17 Solderability. When tested as specified in 4.7.14, transformers shall meet the applicable criteria for terminal evaluation in the test method.

3.18 Resistance to solvents. When transformers are test as specified in 4.7.15, there shall be no evidence of mechanical damage, corrosion, or other deterioration and the markings shall remain legible.

3.19 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 or shall perform the test specified in 4.7.16. There shall be no evidence of fungus growth on the external surfaces.

3.20 Temperature rise. When transformers are tested as specified in 4.7.17, the temperature rise of any winding above the specified maximum ambient temperature (see 3.1) shall not exceed the value specified (see 3.1), and there shall be no evidence of physical damage.

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3.21 Marking. Transformers shall be marked with the military PIN, manufacturer's PIN, code symbol, terminal identification (terminals shall be identified by appropriate numbers unless otherwise specified (see 3.1), and date code in accordance with MIL-STD-1285, method 1. The marking may be applied to more than one side of the case if the required marking necessitates 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 priority as listed above. Markings shall remain legible after all tests.

3.22 Workmanship. Transformers shall be processed in such a manner as to be uniform in quality and shall meet the requirements of this specification and be free from any defects that will affect life and serviceability.

## 4. VERIFICATION

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

- a. Qualification inspection (see 4.4).
- b. Retention of qualification (see 4.5).
- c. Conformance inspection (see 4.6)

4.2 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, to permit performance of the required inspection shall be established and maintained by the contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with ANSI/NSCL Z540-1, ISO 10012-1 or an equivalent system approved by the qualifying activity.

4.3 Inspection conditions. Unless specified herein, all inspections shall be performed in accordance with the test conditions specified in the "GENERAL REQUIREMENTS" of MIL-STD-202.

4.3.1 Test frequency. When a nominal test frequency is specified herein, the frequency used shall be within  $\pm 2$  percent of the nominal value.

4.4 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government on sample units produced with equipment and procedures normally used in production.

4.4.1 Sample size. The number of sample units comprising a sample of transformers to be submitted for qualification inspection shall be as specified in the appendix to this specification.

4.4.2 Test routine. Samples shall be subjected to the qualification inspection specified in table I in the order shown.

4.4.3 Failures. One or more failures shall be cause for refusal to grant qualification approval.

4.4.4 Qualification by similarity. Qualification by similarity for qualification of similar transformer types is specified in the appendix. The manufacturer also has the option of recommending additional qualification by similarity proposals for approval by the qualifying activity.

4.5 Retention of qualification. To retain qualification, the manufacturer shall provide verification to the qualifying activity of the following items every 12 months:

- a. Design of the transformer has not changed.
- b. Conformance inspections (e.g., group A and group B) have been performed on inspection lots supplied to the requirements of this specification.
- c. The manufacturer retains the capability to manufacture and test transformers to this specification.

In the event that no production has occurred in this period, the manufacturer shall verify to the qualifying activity that the capability to manufacture and test the QPL transformer still exists and that the manufacturer wants to remain on the QPL.

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4.6 Conformance inspection.

4.6.1 Inspection of product for delivery. For C level transformers, inspection of product for delivery shall consist of group A inspection (for C level). For M level transformers, inspection of product for delivery shall consist of group A inspection (for M level) and group B inspection. For T level, inspection of product for delivery shall consist of group A inspection (for T level) and group B inspection.

4.6.1.1 Inspection lot. An inspection lot shall consist of all transformers of a specific PIN to a specification sheet, produced under essentially the same conditions, and offered for inspection at one time.

TABLE I. Qualification inspection.

Inspection	Requirement paragraph	Method paragraph
<u>Group I ( 8 samples)</u>		
Electrical tests	3.6	4.7.3
Dielectric withstanding voltage	3.7	4.7.4
Insulation resistance	3.8	4.7.5
Visual and mechanical	3.4, 3.21, 3.22	4.7.1
Resistance to soldering heat	3.9	4.7.6
Terminal strength	3.10	4.7.7
Winding continuity	3.11	4.7.8
Electrical characteristics	3.6	4.7.3
<u>Group II (2 samples)</u>		
Temperature rise	3.20	4.7.17
Life	3.12	4.7.9
Insulation resistance	3.8	4.7.5
Dielectric withstanding voltage (at atmospheric pressure)	3.7	4.7.4
Electrical characteristics	3.6	4.7.3
<u>Group III (6 samples)</u>		
Vibration	3.13	4.7.10
Shock	3.14	4.7.11
Thermal shock	3.15	4.7.12
Moisture resistance	3.16	4.7.13
Electrical characteristics	3.6	4.7.3
Solderability (2 samples)	3.17	4.7.14
Resistance to solvents (3 samples)	3.18	4.7.15
<u>Group IV (if required)</u>		
Fungus (1 sample or certification)	3.19	4.7.16

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4.6.2 Group A inspection.

4.6.2.1 C level. For the group A inspection, the manufacturer shall establish and maintain an inspection system to verify that transformers meet electrical characteristics and visual and mechanical requirements. In-line or process controls may be part of such a system. The inspection system shall also include criteria for lot rejection and corrective action. (NOTE: Since the C level is the M level design without the mandatory conformance inspection system, this product is still expected to meet the environmental qualification type requirements (e.g., moisture resistance, shock, vibration).)

4.6.2.2 M level. Group A inspections shall consist of the inspections specified in table II, in the order shown. (NOTE: M level transformers are not subjected to group I.) A sample of transformers shall be selected in accordance with table III. If one or more defects are found, the lot shall be screened for that defect and defects removed. Any minor visual or mechanical defects not affecting part performance may be reworked. A new sample of parts shall be randomly selected again in accordance with table III. If one or more defects are found in the second sample for the same defect or rejection cause, the lot shall be rejected and shall not be supplied to this specification.

4.6.2.3 T level. Group A inspections shall consist of the inspections specified in table II, in the order shown. T level also requires the 100 percent testing shown in group I. If during the 100 percent inspection of group I, more than 10 percent or 2 units whichever is greater, of the lot is found to be defective, the lot shall be rejected and not supplied to this level. For group II, T level shall follow the same sampling rules, defects criteria, and rescreening procedures as M level (see 4.6.2.2).

TABLE II. Group A inspection (M level and T level).

Inspection	Requirement paragraph	Method paragraph
<u>Group I (T level only)</u>		
Thermal shock	3.15	4.7.12
Winding continuity	3.11	4.7.8
Electrical characteristics (except impedance)	3.6	4.7.3
<u>Group II (M and T level)</u>		
Electrical characteristics 1/	3.6	4.7.3
Visual and mechanical	3.4, 3.21, 3.22	4.7.1

1/ Since T level product has been 100 percent tested for electrical characteristics in group I, group II sampling for these same tests is not required for T level. Impedance testing for product level T shall be performed in group II (see 3.1).

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TABLE III. Sampling plans for group A and group B inspections.

Lot size	Group A, group II inspections	Group B
1 to 5	100 percent	100 percent
6 to 13	100 percent	5
14 to 50	13	5
51 to 90	13	7
91 to 150	13	11
151 to 280	20	13
281 to 500	29	16
501 to 1,200	34	19
1,201 to 3,200	42	23
3,201 to 10,000	50	29

4.6.3 Group B inspection (M level and T level only). Group B inspections shall consist of the inspections specified in table IV in the order shown. A sample of parts shall be selected from each inspection lot in accordance with table III. If one or more defects are found, the lot shall be screened for that defect, and defects removed. A new sample of parts shall be randomly selected again in accordance with table III. If one or more defects are found in the second sample for the same defect or rejection cause, the lot shall be rejected and shall not be supplied to this specification. Sample units which have passed group B inspections (except for solderability samples) may be delivered on the contract provided the samples still meet specification requirements.

TABLE IV. Group B inspection (M level and T level only).

Inspection	Requirement paragraph	Method paragraph
Dielectric withstanding voltage	3.7	4.7.4
Insulation resistance	3.8	4.7.5

4.7 Methods of examination and test.

4.7.1 Visual and mechanical examination (see 3.4, 3.21, and 3.22). Transformers shall be examined to verify that the materials, external interface and physical dimensions, marking, and workmanship are in accordance with the requirements of this specifications.

4.7.2 100 percent screening (T level only) (see 3.5). T level transformers shall be subjected to thermal shock screening in accordance with MIL-STD-202, method 107, test condition A (5 cycles). The temperature for step 3 shall be the maximum operating temperature for the class of transformer (see 3.1). Following the thermal shock screening, the winding continuity test shall be performed on all transformers.

4.7.3 Electrical characteristics (including waveform parameters (see 3.1 and 3.6)). Waveform parameters shall be measured as specified in 3.1. Electrical characteristics shall also be measured as specified in 4.7.3.1 through 4.7.3.4.

4.7.3.1 DC resistance (primary and secondary). The primary and secondary resistance of the windings shall be measured at or corrected to 25°C ±5°C.

4.7.3.2 Primary inductance. The primary inductance of the windings shall be measured at the specified pulse amplitude and pulse repetition rate (see 3.1).

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4.7.3.3 Ratio of transformation (turns ratio). The ratio of transformation of two windings shall be determined by connecting the windings series aiding in the production of magnetic flux, applying a sinusoidal voltage to the series configuration, and measuring the voltage ratio using a calibrated potentiometer and null meter or any other suitable method may be used. The following details shall apply: Test frequency shall be high enough so that the effect of any winding resistance unbalance will be negligible.

4.7.3.4 Polarity. Winding polarity shall be determined by comparing the voltages or impedances of transformer windings when connected series aiding and series opposing and may be determined during the test for ratio of transformation or any other suitable method may be used.

4.7.4 Dielectric withstanding voltage (see 3.7). Transformers shall be tested in accordance with MIL-STD-202, method 301. The following details shall apply:

- a. Magnitude of test voltage and nature of test potential: (see 3.1).
- b. Duration of application of test voltage: 60 seconds minimum for qualification testing and 5 seconds minimum for conformance inspection.
- c. Points of application of test voltage:
  - (1) For metal case transformers, between all windings.
  - (2) For nonmetallic case transformers, between windings.

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

- a. Test condition: As specified (see 3.1).
- b. Electrification time: One minute maximum.
- c. Points of application of test voltage:
  - (1) For metal case transformers, between all windings.
  - (2) For nonmetallic case transformers, between windings.

4.7.6 Resistance to soldering heat (see 3.9). Transformers shall be tested in accordance with test condition MIL-STD-202, method 210. NOTE: Care should be taken to assure the lead length is not cut so short as to preclude performance of the terminal strength test. The following details apply:

- a. Special preparation of specimen: Sample units shall not have been soldered during any of the previous tests.
- b. Test conditions:
  - (1) Test condition C: ( $260^{\circ}\text{C} \pm 5^{\circ}\text{C}$ ; immersion, 10 seconds,  $\pm 2$  seconds) for transformers intended for printed circuit board through hole mounting.
  - (2) Test conditions I, J, or K of MIL-STD-202 method 210 for surface mount.
  - (3) Test condition A or B for other types. For condition B, immerse to a point .125 inches (3.18 mm) from the nearest insulating material or to one-half the exposed length of the terminal, whichever is closer to the insulating material.
- c. Cooling time before final examination: 3 hours maximum.

4.7.7 Terminal strength (see 3.10). Transformers shall be tested in accordance with MIL-STD-202, method 211. The following details shall apply:

- a. Test condition: A.
- b. Points of measurement: A force shall be applied in the direction of the axis of the termination and shall be increased gradually until the magnitude of the force specified (see 3.1) is reached.

4.7.8 Winding continuity (see 3.11). All windings of transformers shall be tested for electrical continuity by any suitable means.



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4.7.9 Life (see 3.1 and 3.12). Unless otherwise specified (see 3.1), transformers shall be subjected to five life cycles a week for 12 weeks. Four of the cycles each week shall consist of 20 hours at oven temperature equal to the specified maximum ambient temperature (see 3.1) for the transformers under test, and 4 hours at room ambient temperature. The fifth cycle of the week shall be 68 hours at the specified maximum ambient temperature (see 3.1) for the transformers under test, and 4 hours at room ambient temperature. When the transformers are subjected to the maximum ambient temperature, they shall be applied with pulse test in accordance with individual specification sheets, as specified in the electrical characteristics (see 4.7.3). After the test, the transformers shall be examined for evidence of physical damage.

4.7.10 Vibration, high frequency (see 3.13). Transformers shall be tested in accordance with MIL-STD-202, method 204, test condition B. Transformers shall be rigidly mounted by their normal mounting means.

4.7.11 Shock, specified pulse (see 3.14). Transformers shall be tested in accordance with MIL-STD-202, method 213, test condition I. Transformers shall be rigidly mounted by their normal mounting means.

4.7.12 Thermal shock (see 3.15). Specimens shall be tested in accordance with MIL-STD-202, method 107, test condition A, with the following exceptions: Number of cycles equals 10 (ten) and step 3 temperature to be maximum operating temperature (see 3.1). In the event of no more than one unintentional test interruption (power interruption or equipment failure) prior to the completion of the first five cycles, the test cycle shall be repeated and the test continued. Unintentional interruptions occurring during the last cycle require a repeat of the cycle plus an additional uninterrupted cycle. Any intentional interruption, or any unintentional interruption of greater than 24 hours requires a complete retest.

4.7.13 Moisture resistance (see 3.16). Transformers shall be tested in accordance with MIL-STD-202, method 106. The following details and exceptions shall apply:

- a. Mounting: Transformers shall be clamped in the trough of a 90 degree metallic V-block using a metallic strap with a .075 inch (1.91 mm)-thick layer of conductive moisture-resistant resilient material, having a resistivity of less than 1,000 ohms per centimeter, bonded to the surface of the strap next to the transformer. The body of the transformer shall not extend beyond the extremities of the block or resilient material. The surface of the V-block shall be free from contamination. The transformer leads shall be so positioned that the distance between the leads and any point of the V-block shall be not less than one half of the shortest base dimension. The metallic V-block shall be of non-corrosive material. An alternative mounting method is shown in figure 1.
- b. Initial measurements: Not applicable.
- c. Polarization: Unless otherwise specified (see 3.1 and 6.2), the polarizing voltage shall be applied during steps 1 through 6 between the coil winding (all leads connected together) and the metal strap to the transformer assembly as specified in figure 1 or with the transformer strapped into a V-block. When dielectric withstanding voltage is less than 100 volts rms, a 25 volt rms or a 25 volts dc may be used. The polarizing voltage shall be positive with respect to the core and or the case.
- d. Final examinations: Upon completion of step 6 of the final cycle, transformers shall be removed from the humidity chamber and shall be conditioned for 24 hours minimum in a test chamber at  $85^{\circ}\text{C} \pm 5^{\circ}\text{C}$ . After this conditioning period, transformers shall be examined for evidence of leakage and other visible damage.

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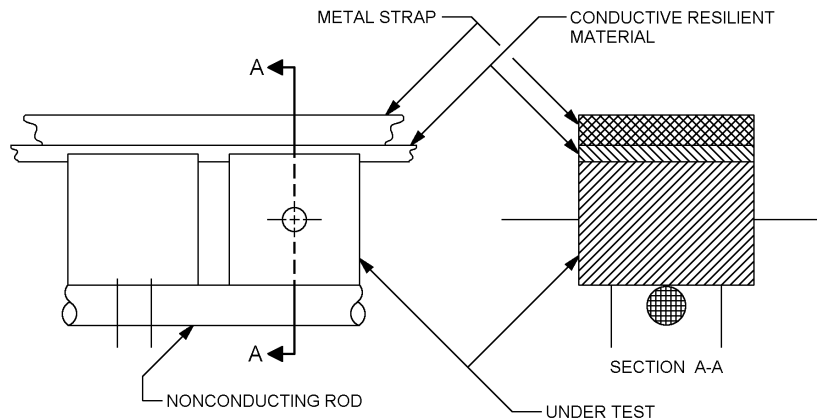


FIGURE 1. Transformer contacting assembly for mounting during polarization

4.7.14 Solderability (see 3.17). Transformers shall be tested in accordance with MIL-STD- 202, method 208. Sample units used for solderability shall not have been soldered during any of the previous tests. A minimum of two terminals of each terminal type for the individual part shall be tested.

NOTE: Solderability is considered a destructive test and samples subject to solderability shall not be supplied as conforming units on contract. Electrical rejects or dummy transformers can be used for solderability testing.

4.7.15 Resistance to solvents (see 3.18). Transformers shall be tested in accordance with MIL-STD-202, method 215. The marked portion of the transformer shall be brushed.

4.7.16 Fungus (see 3.19). Unless certification is provided, transformers shall be tested in accordance with MIL-STD-810, method 508.

4.7.17 Temperature rise (see 3.20). Unless otherwise specified (see 3.1), 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:

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

Where:

- $\Delta T$  = Temperature rise in degrees centigrade above specified maximum ambient temperature (see 3.1).
- $R$  = Resistance of winding in ohms at temperature  $(T + \Delta T)$ .
- $r$  = Resistance of winding in ohms at temperature  $(t)$ .
- $t$  = Specified initial ambient temperature in degrees centigrade.
- $T$  = Maximum ambient temperature in degrees centigrade (at time of power shut-off). "T" shall not differ from "t" by more than 5°C.

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The transformer shall be conditioned for at least 8 hours at temperature (t) in a location free from drafts before resistance (r) is measured. Rated voltage shall be applied to the primary with the specified loads across the secondaries (see 3.1). Transformers shall be operated until two consecutive resistance readings on the highest resistance winding, taken 30 minutes apart, are the same. The resistance measurements (R) shall be made as soon as possible, but not more than 20 seconds after shut-off of power. The transformers shall be examined for evidence of physical damage.

4.7.17.1 Test procedure. The transformers shall be supported centrally by means of two low-thermal-conductivity cleats (3 inches (76 mm) in height) and a test cabinet of low thermal capacity and shall be free of test area drafts and direct thermal radiation. The cabinet used shall provide a minimum clearance of 8 inches (203 mm) between the sides and top of the transformer under test and the internal planes of the test cabinet. Any closure approved by the Government which gives equivalent performance may be substituted for the above.

## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The transformers covered by this specification are military unique due to the fact that these devices must be able to operate satisfactorily in military systems under the following demanding conditions: -55°C to +130°C operating temperature range, 15 gravity units of vibration, 100 gravity units of shock. In addition, these military requirements are verified under a qualification system. Commercial components are not designed to withstand these military environmental conditions.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of the specification, applicable specification sheet, and the complete PIN (see 3.1).
- b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1).
- c. Packaging requirements (see 5.)

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products that are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL No. 21038 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from DSCC-VQP, P. O. Box 3990, Columbus, Ohio 43216-5000 or <mailto:vqp.re@dla.mil>.

6.4 Maximum operating temperature. The maximum operating temperature is the same as the allowable temperature rise plus the maximum ambient temperature for the device. Accordingly, temperature rise is the allowable temperature differential between the ambient and maximum operating temperature for a given insulation for a specified life. For example, a device has a maximum operating temperature designation of 105°C with a temperature rise of 20°C. Then this same transformer could operate in an ambient as high as 85°C (85°C + 20°C = 105°C).

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6.5 Subject term (key word listing).

Transformer  
Pulse  
MIL-STD-1553

6.6 Supersession of type designation. The type designation system used in previous revisions of MIL-PRF-21038 was eliminated in this revision. The type designation system was not the PIN system but was a classification system created to distinguish between various types of low-power pulse transformers. Since the majority of low pulse power transformers in production currently are miniature, plastic case type devices there is no longer a need for this classification system. The original type designation system covered a much wider range of products which are older designs that are no longer covered under this specification. Revision E of this specification streamlines the document to focus on requirements for miniature, low-power pulse transformers. Revision D of this specification can be referred to for any drawings that reference the old type designation system.

6.7 Magnet wire (see 3.3.5). It is recommended that ANSI/NEMA

W-1000 be considered for magnet wire.

6.8 Tin plated finishes. Tin plating is prohibited (see 3.3.4) since it may result in tin whisker growth. Tin whisker growth could adversely affect the operation of electronic equipment systems. For additional information on this matter, refer to ASTM B545 (Standard Specification for Electrodeposited Coating of Tin).

6.9 Changes from previous issue. Marginal notations are not use in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

6.10 Environmentally preferable material. Environmentally preferable materials should be used to the extent possible to meet the requirements of this specification. Table V lists the Environmental Protection Agency (EPA) top seventeen hazardous materials targeted for major usage reduction. Use of these materials should be minimized or eliminated unless needed to meet the requirements specified herein (see section 3).

TABLE V. EPA top seventeen hazardous materials.

Benzene	Dichloromethane	Tetrachloroethylene
Cadmium and Compounds	Lead and Compounds	Toluene
Carbon Tetrachloride	Mercury and Compounds	1,1,1 - Trichloroethane
Chloroform	Methyl Ethyl Ketone	Trichloroethylene
Chromium and Compounds	Methyl Isobutyl Ketone	Xylenes
Cyanide and Compounds	Nickel and Compounds	

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## APPENDIX

## PROCEDURE FOR QUALIFICATION INSPECTION

## A.1. SCOPE

A.1.1 Scope. This appendix details the procedure for submission of samples for qualification inspection of transformers covered by this specification. The procedure for extension of qualification is also outlined herein. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

## A.2. SUBMISSION

A.2.1 Product levels. Qualification of C level product is predicated upon meeting the qualification requirements as described herein for M level product. Qualification of the high reliability T level is predicated upon meeting qualification requirements for the M level and the capability to perform the additional conformance inspections required in group A.

A.2.2 Sample. This submission procedure prescribes qualification to the M level. A sample consisting of eight transformers shall be subjected to the tests of table I. Unless otherwise specified (see A.2.1), the sample shall be a specific part from a given specification sheet and selection of the specific PIN for qualification is the option of the manufacturer. If the manufacturer does not certify to the fungus requirements, then one additional sample is required. This qualification sample can be the basis for extending qualification to families of similar products (see A.3.1 of appendix) and also extending qualification to C level product and T level product (see A.3.2 of appendix).

## A3. EXTENT OF QUALIFICATION

A.3.1 Extension of qualification. The qualification sample selected in accordance with A.2.1 of appendix can be used as the basis for extending qualification to similar transformers (i.e., other than the PIN selected in A.2.2 of appendix). Generally this extension shall be in accordance with the following requirements, however, the manufacturer may propose additional extensions for approval by the qualifying activity. (NOTE: The specific specification sheet may provide additional recommendations for part qualification extensions.)

- a. Extension of qualification may be granted for similar products in a given specification sheet. Typically, these products would be manufactured using the same or similar materials (e.g., same plastics for the case, same lead materials and finishes.).
- b. Products must be manufactured in the same facility using manufacturing processes and materials that were used to manufacture the product originally qualified.
- c. If the manufacturer wants to extend qualification to additional lead and terminal finishes other than that originally qualified, qualification will be based on certification by the manufacturer that all requirements of this specification are met by the alternate lead/finish.

To facilitate consideration of alternative extent of qualification proposals, the qualifying activity may request the manufacture to demonstrate capability by existing internal test data similar to the group A and group B inspections.

A.3.2 Extension of qualification from M level to C level and T level. Upon successful qualification of M level, the manufacturer may request qualification to C level and T level of this specification. The products involved shall be the same design and manufactured in the same facilities using the same processes and materials as the M level parts. C level and T level qualification will only be granted for the same envelope of products for which M level qualification was granted (see A 3.1).

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Custodians:  
Army - CR  
Navy - EC  
Air Force - 11

Preparing activity:  
DLA - CC  
(Project 5950-1175)

Review activities:  
Army - MI  
Navy - AS, OS, SH  
Air Force - 99

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <http://www.dodssp.daps.mil/>.