

MIL-T-83720(USAF)
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SUPERSEDING
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MILITARY SPECIFICATION

TRANSFORMERS AND INDUCTORS, NON-EXPLOSIVE,
GENERAL SPECIFICATION FOR

1.0 SCOPE

1.1 Scope. This specification contains the general requirements for non-explosive transformers of open coil and core construction intended for use in sealed electronic air-environment enclosures.

2.0 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.

SPECIFICATIONS

Military

MIL-T-27	Transformers and Inductors (Audio power, and high power pulse General Specification for)
MIL-P-116	Preservation, Methods of

STANDARDS

Federal

Fed STD-595	Paint, Requirements
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Military

MIL-STD-129	Marking for shipment & storage
MIL-STD-130C	Identification marking of U. S. Military Property

(Copies of specifications and standards required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the Contracting Office.)

FSC 5950

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2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on 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 25, D. C.)

Official Classification Committee
Uniform Freight Classification Rules.

(Application for copies should be addressed to the Official Classification Committee, One Park Avenue at 33d Street, New York 16, N. Y.)

3.0 REQUIREMENTS

3.1 Detail Requirements. Applicable detail requirements and the requirements of this specification shall form the total requirements for individual non-explosive transformers or inductors. When detail requirements and this specification conflict, the detail specification shall govern. Detail requirements may be Drawings, Specifications, or MS Military Standards.

3.2 Preproduction. Preproduction testing shall be performed in accordance with paragraph 4.3 unless otherwise specified. Preproduction approval is valid only on the contract under which it is granted unless extended by the government to another contract.

3.3 Material. All material used in the manufacture of transformers and inductors within the scope of this specification shall be such that their products of decomposition are non-explosive over the temperature range specified in 4.3.1 when mixed with air in any portion in the presence of an ignition source.

3.3.1 Substitution of Material. 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.

3.3.2 Corrosive Materials. Corrosive materials used in any of the manufacturing processes shall be removed or neutralized so that corrosion will not result from such use. So far as practicable, materials used in the construction of transformers and inductors shall be non-corrosive.

3.4 Design & Construction

3.4.1 Solder terminals. Solder terminals may be of any shape and shall be capable of being readily soldered. The height of the solder terminal shall be considered as the maximum distance from the terminal mounting surface to the highest point of the terminal. The maximum size of round wire which the terminal will accept externally shall be as specified.

3.4.2 Internal Lead Wires. Internal lead wires shall be attached to the coils and other internal components and terminals or mounting surface by soldering, welding, brazing or other methods in such a manner as to provide adequate electrical connection and mechanical strength. Where soft solder is used to provide the electrical connector, lead wires shall be anchored mechanically.

3.4.3 Core and Coil Mounting. Cores and coils shall be secured rigidly to prevent any permanent change in the relative position of the parts. When the total volume of a unit exceeds 6.5 cubic inches, the means of securing the core and coil to the devices for mounting the transformer or inductor in the equipment (studs, lugs, inserts, brackets, etc.) shall not depend on soft solder alone for mechanical strength, nor shall the transmission of the mechanical load of the core to the mounting device depend only on soft solder. Unless otherwise specified, (see 3.1) the core shall be grounded to the case or be electrically accessible, except for toroidal coils and non metallic cores such as ferrites.

3.4.4 Mounting and terminal screws and nuts. Screw threads shall be class 2A or 2B, as applicable, in accordance with Handbook H2B. Screw threads, class 2 fit, shall, after receiving a finish, be capable of accepting a nut of class 2B with maximum installation torque in accordance with the following:

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

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

3.5 Terminal strength. When transformers and inductors are tested as specified in MIL-T-27, there shall be no evidence of loosening or rupture of the terminals, or other mechanical damage. Bends shall not be considered as damage unless surface cracking is evident (see 4.1).

3.6 Explosion. When transformers and inductors are tested as specified in 4.5.1.1 of this specification, there shall be no evidence of explosion or violent burning such as:

- a. Audible explosion
- b. Visible flash or flame
- c. Displacement of the cover of the inner explosion chamber.

3.7 Corona Discharge. When specified, transformers shall be tested as outlined in MIL-T-27 or as specified (see 3.1). The corona as indicated on the oscilloscope shall not exceed one inch peak-to-peak deflection on the oscilloscope (see 4.1).

3.8 Dielectric withstanding voltage. When transformers and inductors are tested as specified in MIL-T-27, there shall be no arcing, flashover, breakdown of insulation or evidence of damage (see 4.1).

3.8.1 Barometric pressure - (when applicable). When transformers and inductors are tested as specified in MIL-T-27, there shall be no arcing, flashover, breakdown of insulation, or evidence of damage (see 4.1).

3.9 Induced Voltage. When transformers and inductors are tested as specified in MIL-T-27, there shall be no evidence of continuous arcing, breakdown of insulation, or any abrupt changes in input current (see 4.1).

3.10 Insulation Resistance. When transformers and inductors are measured as specified in MIL-T-27, the minimum insulation resistance shall be 7500 megohms (see 4.1).

3.11 Winding Continuity. When transformers and inductors are tested as specified in MIL-T-27, all windings shall be electrically continuous (see 4.1).

3.12 Electrical Characteristics. When transformers and inductors are tested as specified in MIL-T-27, the applicable electrical characteristics shall be as specified, including tolerances (see 3.1 and 4.1).

3.13 Temperature Rise. When transformers and inductors are tested as specified in MIL-T-27, 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 (see 4.1).

3.14 Thermal Shock. When transformers and inductors are tested as specified in MIL-T-27, not more than 10 percent of the surface shall have peeling, flaking, chipping, cracking, crazing, or other impairment of the protective coating (see 4.1).

3.15 Vibration. When transformers and inductors are tested as specified in MIL-T-27, not more than 10 percent of the surface shall have peeling, flaking, chipping, cracking, crazing, or other impairment of the protective coating (see 4.1).

3.16 Shock. When transformers and inductors are tested as specified in MIL-T-27, not more than 10 percent of the surface shall have peeling, flaking, chipping, cracking, crazing, or other impairment of the protective coating (see 4.1).

3.17 Overload. When transformers and inductors are tested as specified in MIL-T-27, not more than 10 percent of the surface shall have peeling, flaking, chipping, cracking, crazing, or other impairment of the protective coating (see 4.1).

3.18 Life. When transformers and inductors are tested as specified in MIL-T-27, there shall be no evidence of physical or electrical damage (see 4.1).

3.19 Resistance to Soldering Heat. When transformers and inductors are tested as specified in MIL-T-27, there shall be no softening of the insulation or loosening of windings or terminals (see 4.1).

3.20 Marking. Transformers and inductors shall be marked in accordance with MIL-STD-130. The manufacturer's part number shall be stamped on the transformer or inductor and each terminal shall be identified by the applicable number specified in the detail specification.

3.20.1 Symbol. Transformers and inductors supplied per this specification shall be identified by the symbol illustrated in Figure 1. The color shall be red 11105 per Fed. STD 595.

3.21 Workmanship. Transformers and inductors shall be processed in such a manner as to be uniform in quality and shall be free from defects that will affect life or serviceability.

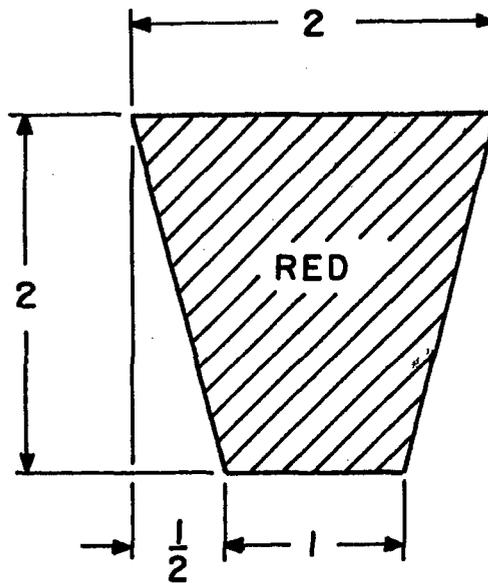
4.0 QUALITY ASSURANCE PROVISIONS

4.1 Quality Assurance. The quality assurance provisions of MIL-T-27 apply as requirements of this specification unless otherwise specified.

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MARKING SYMBOL

Outline dimensions of the marking symbol to be of the relative proportions indicated below.



Numbers are absolute

FIGURE 1 Marking Symbol
(see para 3.20)

4.1.1 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, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. Inspection records of the examination and tests shall be kept complete and available to the Government as specified in the contract or order. 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.

4.1.1.1 Test equipment and inspection facilities. Test equipment and inspection facilities shall be of sufficient accuracy, quality, and quantity to permit performance of the required inspection. The supplier shall establish calibration of inspection equipment to the satisfaction of the Government.

4.2 Classification of Inspections. The examination and testing of transformers and inductors shall be classified as follows:

- a. Preproduction Inspection
- b. Acceptance Inspection

4.3 Preproduction Inspection. Preproduction inspection will be performed by the supplier after award of contract and prior to production at a location acceptable to the Government. The tests to be performed shall consist of the tests listed in Table I. The tests shall be performed in accordance with MIL-T-27, unless otherwise specified.

4.3.1 Material Decomposition. Suppliers furnishing transformers and inductors per this specification shall furnish detailed data showing quantitatively the gases of decomposition of the materials of the transformer or inductor at temperatures from 100°C through 500°C. The data shall be sufficient to prove to the satisfaction of the Government that the materials of decomposition are non-explosive and cannot combine to form an explosive mixture (see 6.2).

TABLE I
PREPRODUCTION TESTS

<u>Group I (All sample units)</u>	<u>Requirement</u>	<u>Test Method Para</u>
Visual & Mechanical Inspection (External)	3.1, 3.4, 3.4.1 3.4.4, 3.5, and 3.21	4.1
Dielectric Withstanding Voltage	3.8	4.1
Barometric Pressure (When applicable)	3.8.1	4.1
Induced Voltage (When specified)	3.9	4.1
Electrical Characteristics	3.12	4.1
Corona Discharge (When specified)	3.7	4.1
Insulation Resistance ⁹	3.10	4.1
<u>Group II (2 ea units)</u>		
Temperature Rise (1 sample)	3.13	4.1
Thermal Shock	3.14	4.1
(Winding Continuity)	3.11	4.1
Vibration	3.15	4.1
Shock	3.16	4.1
Dielectric withstanding voltage (90% of initial)	3.8	4.1
Induced Voltage	3.9	4.1
Winding Continuity	3.11	4.1
Overload	3.17	4.1
Dielectric withstanding voltage	3.8	4.1
Induced voltage	3.9	4.1
Insulation Resistance	3.10	4.1
Winding Continuity	3.11	4.1
<u>Group III (2 ea units)</u>		
Life	3.18	4.1
Dielectric withstanding voltage (90% of initial)	3.8	4.1
Insulation Resistance	3.10	4.1
Induced Voltage	3.9	4.1
Visual & Mechanical (external)	3.1, 3.4, 3.4.1, 3.4.4 3.5, and 3.21	4.1
<u>Group IV</u>		
Explosion Test (1 ea unit)	3.6	4.5.1.1
Visual Examination (internal & external)	3.1, 3.4, 3.4.1 3.4.2, 3.4.3, 3.4.4 3.5, 3.3, and 3.2.1	4.1

4.3.2 Samples - Five samples shall be subjected to the test in Table I. The number of samples to be used in each test group shall be as indicated,

4.3.3 Failure - Failure in any of the applicable examinations or tests will be cause for refusal to authorize production.

4.3.4 Disposition of Samples - Samples submitted to preproduction tests shall not be delivered as part of the contract quantity.

4.4 Acceptance Inspection

4.4.1 Inspection Groups. Inspection of product for delivery shall consist of Group A, B, and C.

4.4.1.1 Group A and B. Group A and B inspection shall be per MIL-T-27, except that performance of sealing test is not required.

4.4.1.2 Group C. Group C inspection shall consist of the explosion test per 3.6 and 4.5.1.1 of this specification. A transformer or inductor shall be classified as a failure if any or all requirements of paragraph 3.6 are not satisfied.

4.4.1.3 Sampling Plan - Two sample units of each part number shall be selected from each month's production except that, if more than three part numbers are being produced concurrently, no more than one sample each to a maximum of six types need be subjected to this test in any given month.

4.4.1.4 Disposition of Sample Units - Sample units which have been subjected to explosion testing shall be forwarded to the contracting office, but shall not be considered as part of the contract order quantity.

4.4.1.5 Non-Compliance - If any sample fails to pass Group B inspection, production shall be immediately held up and one of the following actions taken as applicable:

(a) One part number in production. Two additional sample units shall be selected and subjected to the explosion test. If a failure occurs, all units in the lot shall be scrapped. The contracting officer shall be notified, and failure determined and corrective action taken. Upon approval by the Government, of the failure report and corrective action proposal, production may be resumed. If no failure occurs, the lot may be shipped.

(b) More than one part number in production. Two additional sample units of each part number shall be selected and subjected to the explosion test.

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(1) If a failure re-occurs only on a unit or units of the same part number (s) which failed initially, the lot of this particular design shall be scrapped, the cause of failure determined and corrective action taken. Upon approval by the Government, of the failure report and corrective action proposal, production may be resumed.

(2) If the samples of any particular part number (s) pass both test and re-test, the lot of this particular design (s) shall be shipped.

4.4.2 Inspection of Preparation for Delivery Sample - Items and packs shall be selected and inspected in accordance with specification MIL-P-116 to verify conformance with requirements in Section 5 of this specification.

4.5 Methods of Examination and Tests

4.5.1 Examination and Tests - Examination and Tests shall be performed using methods in accordance with MIL-T-27, unless otherwise specified. The examinations and tests to be performed shall correspond with the requirements of this specification, MIL-T-27 and the applicable detail drawing or specification.

4.5.1.1 Explosion test.

4.5.1.1.1 Equipment - The basic equipment shall be as shown in Figure 2.

4.5.1.1.2 Explosion Chambers - The outer chamber shall be capable of protecting test personnel from injury should an explosion occur. There shall be a provision for observing the inner chamber during the entire test period. The volume of the inner explosion chamber shall be equal to the volume of the free air space of the equipment in which the transformers and/or inductors will be used. (See note 6.3). The chamber shall be cubical in shape and shall be formed of a material that does not outgas. The chamber shall be airtight when the cover is fitted into place. A press fit cover shall be designed such that a pull of 15 lbs minimum shall be required to displace it. Provisions shall be made for insulated feed throughs for DC power to be applied to the windings of the test transformer and an arcing rod by which an arc can be produced in the chamber. The insulation material shall be non-explosive.

4.5.1.1.3 Power supply - The power supply shall be capable of supplying a DC current to the transformer windings such that the temperature of the transformer windings may be increased at a controlled rate up to 500°C.

4.5.1.1.4 Resistance Bridge - The resistance bridge shall be an instrument capable of measuring the transformer winding resistance accurately within $\pm 1\%$.

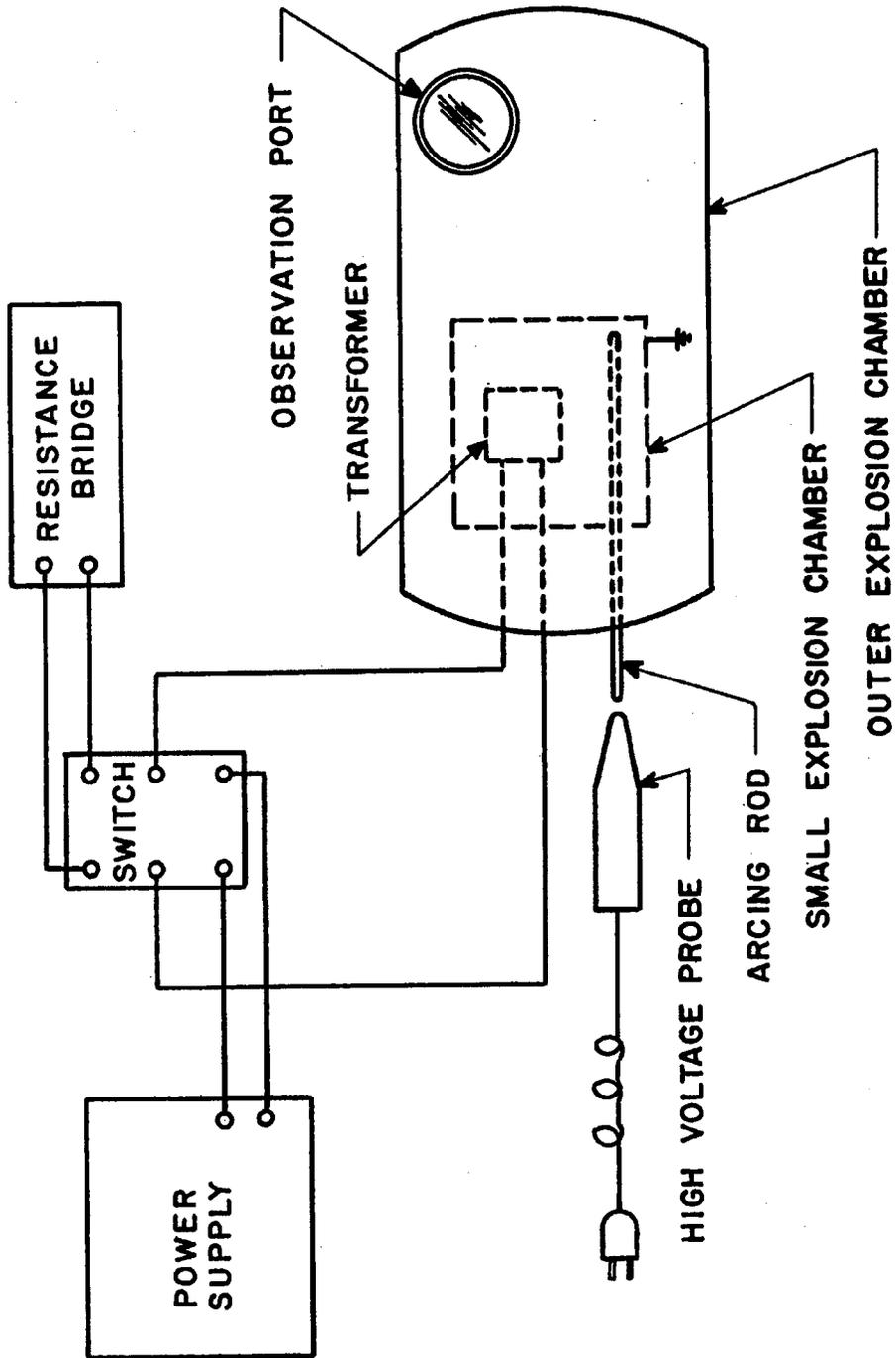


FIGURE 2 Explosion test set-up

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4.5.1.1.5 Switch - A double pole single throw switch shall be used to connect the transformer winding to either the DC power supply or the resistance bridge.

4.5.1.1.6 High Voltage Probe - Tesla Coil, Arthur H. Thomas Co., Philadelphia 5, Pa., Catalog No. 1060 or a government approved equivalent.

4.5.1.1.7 Test Method - Unless otherwise specified, the winding having the greatest resistance shall be connected to the DC power supply as illustrated in Figure 1. A resistance vs temperature graph shall be made for the winding of the test transformer or inductor to which DC voltage is to be applied. The graph shall be computed from the formula

$$\frac{R_2}{R_1} = \frac{234.5 + T_2}{234.5 + T_1} \quad \text{where } (R_1) \text{ is the resistance of the winding of the}$$

test transformer at a known temperature (T_1). T_2 represents assumed values of temperature in the range 100°C - 600°C . R_2 is the resistance of the test winding at T_2 . Using the graph while using the test set-up in Figure 2, the temperature of the transformer can be determined. After hook-up and before placing the cover on the inner explosion chamber, the position of the arcing rod should be adjusted so that an arc occurs in the chamber when the high voltage probe is applied to the external connection of the arcing rod. The cover of the inner chamber shall be secured. The chamber shall contain no other liquid or gas except air. The outer chamber shall be secured. Power shall be applied to the test winding such that the average rate of temperature rise shall not exceed 300°C per hour nor be less than 200°C per hour. When the test winding reaches a temperature of 400°C an arc shall be generated within the chamber. The inner chamber should be observed through the observation port of the outer chamber when the arc occurs. An arc shall be generated at 50°C intervals until a minimum temperature of 500°C is reached or an explosion occurs. The arc shall be applied for 5 sec minimum. Upon completion of the test, the cover of the inner chamber shall be carefully removed, the chamber ventilated and an arc generated to verify that arcing occurred during the test.

5.0 PREPARATION FOR DELIVERY

5.1 Preservation and Packaging.

5.1.1 Level A. Transformers and inductors shall be individually protected and unit packaged in accordance with Method II of Specification MIL-P-1116 and the packaging table of this specification. In addition, adequate protection for the terminals and mounting lugs shall be provided in the unit package. The items shall be cushioned in a manner that will prevent damage during shipment, handling, storage and redistribution.

5.2 Packing. Packing shall be in accordance with 5.2 of MIL-T-27 and shall afford adequate protection during shipment, handling, indeterminate storage and world wide distribution.

5.3 Marking. In addition to any special marking required by the contract or order, unit package and exterior shipping containers shall be marked in accordance with MIL-STD-129.

6.0 NOTES

6.1 Intended Use - Transformers supplied per this specification are intended for use in high temperature applications where gases may accumulate in explosive proportions.

6.2 Gaseous Explosive Limits - Bulletin 503 "Limits of Flammability of Gases and Vapors", by G. W. Jones and H. F. Coward may be helpful in determining explosive combinations of gases. Copies may be obtained from the Superintendent of Documents, Washington 25, D. C.

6.3 Explosion Chamber - The dimensions of the cubical inner explosion chamber used to perform the explosion test per paragraph 4.5.1.1 shall be 8.5 inches unless otherwise specified.

6.4 Open transformer. Open transformers per this specification are defined as units not intended for encapsulation or encasement.

6.5 Ordering Data.

6.5.1 Procurement Documents - Procurement documents should specify the following:

- (a) Title number and date of this specification.
- (b) Applicable drawings covering envelope mounting and other physical dimensions (see 3.1).
- (c) Whether preproduction is required.
- (d) Whether core ground is to be electrically accessible (see 3.4.3).
- (e) Whether corona discharge test is required (see 3.7).
 - (1) The required test of Figure 5 of MIL-T-27.

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- (f) Electrical characteristics and tolerances (see 3.12).
- (g) Ambient temperature range and maximum allowable temperature rise (see 3.13).
- (h) Dielectric withstanding test voltages.
 - (1) Windings with special dielectric features.
 - (2) Pulse transformers.
- (i) Whether dielectric withstanding voltage test at reduced barometric pressure is applicable and test condition letter (see 3.8).
- (j) Induced voltage.
- (k) Shock test (see 3.16).
 - (1) Whether test condition B or C is applicable for shock test method I.
 - (2) Whether shock test method II is applicable.
- (1) Whether high frequency vibration is required.

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