DEFENSE LOGISTICS AGENCY
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MEMORANDUM FOR MILITARY/INDUSTRY DISTRIBUTION

SUBJECT: A 2nd initial Draft of the proposed surface mount coil specification and 6 new associated specification sheets is being circulated once again. Project Number(s) 5950-2014-041, -042, -043, -044, -045, -046, -047

All comments have been incorporated from the first initial draft. All changes are in red strikeout (removal of requirement) and green lettering (additions). A couple of requirements need further discussion, shock and vibration. Should the use of MIL-STD-883 or MIL-STD-750 requirements be used, or more tailored to this specification?

The initial draft for this subject document, dated 11 December 2015, is now available for viewing and downloading from the DLA Land and Maritime-VA Web site:

http://www.dscc.dla.mil/Programs/MilSpec/DocSearch.asp

Concurrence or comments are required at this Center within 60 days from the date of this letter. Late comments will be held for the next coordination of the document. Any further coordination concerning these documents will be circulated only to firms and organizations that furnish comments or reply that they have an interest. Comments from military departments must be identified as either "Essential" or "Suggested". Essential comments must be justified with supporting data. Military review activities should forward comments to their custodians of this office, as applicable, in sufficient time to allow for consolidating the department reply.

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/ SIGNED /

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NOTE: This draft dated 11 December 2015, prepared by DLA-CC has not been approved and is subject to modification.
DO NOT USE FOR ACQUISITION PURPOSES.

INCH-POUND
MIL-PRF-SMD
PROPOSED

PERFORMANCE SPECIFICATION

COILS, RADIO FREQUENCY, SURFACE MOUNT, FIXED
ESTABLISHED RELIABILITY,
GENERAL SPECIFICATION FOR

1. SCOPE

1.1 Scope. This specification covers the general requirements for established reliability (ER) fixed, radio frequency surface mount coils. Established reliability radio frequency coils covered by this specification have failure rate levels (FRL) ranging from 1.0 percent per 1,000 hours to 0.001 percent per 1,000 hours which are established at a 60 percent confidence level (see 1.2.1.4). The FRL identified by the applicable symbol specified in table III refers to operation at full load cyclic condition at the specified ambient temperature (see 3.1).

1.2 Classification.

1.2.1 Part or Identifying Number (PIN). The PIN consists of the letter M, the basic number of the specification sheet, and alphanumeric designators (see 3.1) as shown in the following example:

MXXXXX/1	A	1R0	J	M
Specification sheet number	Class (see 1.2.1.1)	Inductance (see 1.2.1.2)	Inductance tolerance (see 1.2.1.3)	Product level designator (see 1.2.1.4)

Comments, suggestions, or questions on this document should be addressed to DLA Land and Maritime ATTN: DLA Land and Maritime-VAT, P.O. Box 3990, Columbus, Ohio 43218-3990, or email to Transformer@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil.

1.2.1.1 Class. The classes of coils denoting the maximum operating temperatures (see 3.1) are identified by a single letter in accordance with table I.

TABLE I. Maximum operating temperature.

Class	Temperature
	°C
A	105
B	125
F	150

1.2.1.2 Inductance. The nominal inductance value expressed in microhenries (μH) is identified by three symbols in accordance with the following:

Nominal inductance values less than 10 μH are identified with two numbers representing the significant figures and the letter (R) designating decimal point location.

Example: 0.12 μH = R12; 1.2 μH = 1R2

Nominal inductance values of 10 μH and greater are identified by a 3-digit number. The first two digits represent significant figures, and the last digit specifies the number of zeroes to follow.

Example: 12 μH = 120; 120 μH = 121

1.2.1.3 Inductance tolerance. The inductance tolerance is identified by a single letter in accordance with table II.

TABLE II. Inductance tolerance.

Symbol	Tolerance
	percent
F	± 1
G	± 2
H	± 3
J	± 5
K	± 10
L	± 15
M	± 20

1.2.1.4 Product level designation. The specified FRL per 1,000 hours, for the indicated product level designation, is initially established at the 60 percent consumer's confidence level and maintained at a 10 percent producer's risk and is identified by a single letter in accordance with table III and as described in MIL-STD-690.

TABLE III. Product level designator.

Symbol	FRL
M	1.0 ⎫
P	0.1 ⎪
R	0.01 ⎪ 1/
S	0.001 ⎭

1/ FR in percent/1,000 hours.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 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 completeness of this list, document users are cautioned that they must meet all specified requirement documents cited in section 3 and 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 listed cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-PRF-83446 - Coils, Radio-Frequency, Chip, Fixed or Variable, General Specification for

(See supplement 1 for a list of specification sheets.)

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-202 - Test Method Standard, Electronic and Electrical Component Parts
MIL-STD-690 - Failure Rate Sampling Plans and Procedures
MIL-STD-790 - Established Reliability and High Reliability Qualified Products List (QPL) Systems for Electrical, Electronic, and Fiber Optic Parts Specifications
MIL-STD-810 - Test Method Standard, Environmental Engineering Considerations and Laboratory Tests
MIL-STD-883 - Test Method Standard, Microcircuits
MIL-STD-1285 - Marking of Electrical and Electronic Parts

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

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 the documents which are those listed in the solicitation or contract.

ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES (IPC)

IPC J-STD-004 - Requirements for Soldering Fluxes
IPC J-STD-005 - Requirements for Soldering Pastes
IPC J-STD-006 - Requirements for Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid Solders

(Requests for copies should be made at the Association Connecting Electronics Industries (IPC) website, http://www.ipc.org).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/NCSL Z540.3 - Calibration Laboratories and Measuring and Test Equipment – General Requirements.

(Copies of this document are available from http://www.ncsli.org/ or from the National Conference of Standards Laboratories(NCSL) International, 1800 30th Street, Suite 305, Boulder, CO 80301-1026.)

~~AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)~~

~~ASTM B545 - Standard Specification for Electrodeposited Coatings of Tin~~

~~(Requests for copies should be made at the American Society for Testing and Materials (ASTM) website, http://www.astm.org).~~

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO 10012 - Measurement Management Systems Requirements for Measurement Processes and Measuring

(Copies of these documents are available online at http://www.iso.org)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.4 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification 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 items 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 (see 6.2 and 6.9).

3.2 Qualification. The coils covered by specification sheets 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 before contract award (see 4.4 and 6.3). Authorized distributors which are approved to MIL-STD-790 distributor requirements by the QPL manufacturers are listed in the QPL.

3.3 QPL system. The manufacturer shall establish and maintain a QPL system for parts covered by this specification. Requirements for this system are specified in MIL-STD-790 and MIL-STD-690.

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

3.4.1 Recycled, recovered, or environmentally preferable, or biobased materials. Recycled, recovered, environmentally preferable, or biobased 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.

3.4.2 Flammable materials. So far as practicable, materials used in the construction of coils shall be nonflammable and nonexplosive (see 6.4).

3.4.3 Corrosive materials. Corrosive materials used in any of the manufacturing processes shall be removed or neutralized so that no corrosion shall result from their use. So far as practicable, materials used in the construction of coils shall be noncorrosive.

3.4.4 Internal Solder and soldering flux. Internal solder shall have a liquidus melting point greater than +270°C and a plastic stage not to exceed +10°C. The plastic stage is defined as the duration between solid and liquid. The solder and soldering flux shall be of such quality as to enable the coils to meet all the requirements of this specification. It is recommended that solder and soldering flux to be in accordance with IPC J-STD-004, IPC J-STD-005 and IPC J-STD-006.

3.4.5 Magnet wire. Magnet wire, when used, shall be selected to enable the part to meet the requirement of this specification. It is recommended that NEMA Standards Publication MW-1000 be considered for magnet wire.

3.5 Design and construction (see 4.8.1). Coils shall be of the design, construction, and physical dimensions specified (see 3.1).

3.5.1 Body structure. The body structure ~~shall be in a monolithic form that~~ shall protect the inductive element from the effects of prolonged exposure to high humidity and shall meet the requirements specified herein. The terminations shall be metallized ~~with solderable or weldable metals or alloys~~ or solder finish for use in solderable, weldable or conductive attach applications.

3.5.2 Termination area. Termination areas shall be of the shape and physical dimensions specified (see 3.1). ~~Connection to the inductive element shall be made via metallized termination areas. Unless otherwise specified, all terminations (areas) shall be available on one surface of the body of the chip coil.~~ When specified (see 3.1), the terminations shall be pretinned with a suitable solder that shall meet the solderability requirements specified herein. Termination finishes shall be as specified in Table IV. Termination finish codes A through F inclusive shall be used for solderable terminations. See 6.7 for further guidance in metallized terminations.

TABLE IV. Termination finish.

Code	Final finish	Methods of assembly
A	Gold over nickel	Solderable/weldable
B	Tin-lead over nickel	Solderable
C	Obsolete	Obsolete
D	Platinum-gold	Solderable/weldable
E	Palladium-silver	Solderable/weldable
F	Tin-lead	Solderable

3.5.2.1 Winding ends. The ends and end turns shall be secured in such a manner as to anchor them securely in place. The length of leads from windings shall be as short as practicable.

~~3.5.3 Substrate bonding. The surface opposite the side that contains the inductive element may be metallized, when specified, to provide for eutectic bonding of the chip to a substrate.~~

3.5.3 Tin-plated finishes. Use of tin plating is prohibited as a final finish and as an undercoat (see 6.6). Use of tin-lead (Sn-Pb) finishes are acceptable provided that the minimum lead content is 3 percent.

3.5.4 Weight. Each coil shall not exceed the weight specified (see 3.1).

3.6 Thermal shock. When coils are tested as specified in 4.8.3, there shall be no evidence of cracked cases or coatings, loosening of the terminals, or any other mechanical or physical damage.

3.7 Electrical characteristics. The electrical characteristics shall be as specified (see 3.1 and 4.8.4).

3.7.1 Inductance. When coils are tested as specified in 4.8.4.1, the inductance shall be as specified (see 3.1 and 6.1).

3.7.2 Quality Factor (Q) of coils. When coils are tested as specified in 4.8.4.2, the Q shall be as specified (see 3.1).

3.7.3 Self-resonant frequency. When coils are tested as specified in 4.8.4.3, the self-resonant frequency shall be as specified (see 3.1).

3.7.4 Percent coupling (when specified). When coils are tested as specified in 4.8.4.4, the percent coupling shall be as specified (see 3.1 and 6.9).

3.7.5 Incremental current inductance change (when specified). When coils are tested as specified in 4.8.4.5, inductance value shall represent a change of 5 percent or less, unless specified otherwise, of the inductance measured with zero direct current (DC) current (see 3.1).

3.7.6 DC resistance. When coils are tested as specified in 4.8.4.6, the DC resistance shall be as specified (see 3.1).

3.8 Dielectric withstanding voltage. When coils are tested as specified in 4.8.5, there shall be neither arcing, breakdown, flashover, nor other damage, and the leakage current shall not exceed 100 microamperes (μA) (see 3.1).

3.9 Barometric pressure (when specified). When coils are tested as specified in 4.8.6, there shall be neither arcing, breakdown, flashover, nor other damage, and the leakage current shall not exceed 100 microamperes (μA) (see 3.1).

3.10 Insulation resistance. When measured as specified in 4.8.7, the insulation resistance shall be not less than 1,000 megohms, unless specified otherwise (see 3.1).

3.11 Winding continuity. When coils are tested as specified in 4.8.8, all windings shall be electrically continuous.

3.12 Temperature rise. When coils are tested as specified in 4.8.9, 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 any physical or mechanical damage.

3.13 Overload. When coils are tested as specified in 4.8.10, there shall be no evidence of arcing, burning, charring, impairment of any protective coatings, or any other physical or mechanical damage.

3.14 Resistance to soldering heat. When coils are tested as specified in 4.8.11, there shall be no evidence of any physical or mechanical damage, loosening of terminals, or solder reflow.

3.15 Bond strength. When coils are tested as specified in 4.8.12, there shall be no evidence of physical or mechanical damage.

3.16 Solderability. When coils are tested as specified in 4.8.13, the immersed ~~metallized~~ termination surface shall be at least 95 percent covered with a new clean smooth coating and shall exhibit no demetallization or leaching of the terminal areas. The remaining 5 percent may contain only small pinholes or rough spots; these shall not be concentrated in one area. In case of dispute, the percentage of coverage with pinholes or rough spots shall be determined by actual measurement of these areas, as compared to the total area. Electrical connections shall be mechanically secure before soldering and electrically continuous after soldering.

3.17 Low-temperature operation. When coils are tested as specified in 4.8.14, there shall be no evidence of cracked cases, impairment of protective coatings, loosening of the windings or terminals, or any other physical or mechanical damage.

3.18 Vibration. When coils are tested as specified in 4.8.15, there shall be no evidence of any physical or mechanical damage.

3.19 Shock (specified pulse). When coils are tested as specified in 4.8.16, there shall be no evidence of any physical or mechanical damage.

3.20 Moisture resistance. When coils are tested as specified in 4.8.17, there shall be no evidence of corrosion affecting the mechanical or electrical operation.

3.21 Life.

3.21.1 Qualification inspection. When coils are tested in accordance with 4.8.18, there shall be no evidence of mechanical damage. Initial measurements shall be in accordance with the electrical characteristics (initial) requirements of the individual component specification sheet. Succeeding measurements up, to and including, the 2,000 hours shall be in accordance with the electrical characteristics (final) requirements of the individual components specification sheet (see 3.1).

3.21.2 FRL determination (extended FR test). When coils are tested in accordance with 4.8.18, there shall be no evidence of mechanical damage. Initial measurements shall be in accordance with the electrical characteristics (initial) requirements of the individual component specification sheet. Succeeding measurements up to and including the 10,000 hours shall be in accordance with the electrical characteristics (final) requirements of the individual components specification sheet (see 3.1).

3.22 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 4.8.19. There shall be no evidence of fungus growth on the external surfaces.

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3.23 Marking. If the body size and configuration of the SMD coils permit, coils shall be marked as specified herein. Other markings which in any way interfere with, obscure, or confuse those specified herein, are prohibited. ~~Each coil shall be legibly marked and~~ Markings shall withstand the environmental conditions specified herein. At the option of the manufacturer, coils may be laser marked. The marking shall remain legible after all tests.

3.23.1 Full marking. Marking (see 4.6.1 and 4.8.1). Unless otherwise specified (see 3.1 and 6.2), a noncorrosive label containing the military PIN, JAN marking, CAGE code, date code, and lot symbol shall be inserted in each package, as shown in the following examples. If the coil's body size and physical configuration permit, each coil may also be marked with the information shown in the following examples:

Example:
MXXXXX/XX-12BKR PIN (on single line)
JAN 12345 -------- --------Full JAN Marking and CAGE code
0219B ---------- --------Date code and lot symbol

Alternate Example:
MXXXXX
/x-12BKR ---------- PIN (split on two (2) separate lines as shown)
J 12345 ---------- Abbreviated JAN Marking and CAGE code
0219B ---------- Date code and lot symbol

The manufacturer's source code, date code, and lot symbol shall be in accordance with MIL-STD-1285.

3.23.2 JAN and J marking. The United States Government has adopted, and is exercising legitimate control over the certification marks "JAN" and "J", respectively, to indicate that items so marked or identified are manufactured to, and meet all the requirements of specifications. Accordingly, items acquired to and meeting all of the criteria specified herein and in applicable specifications shall bear the certification mark "JAN" except that items too small to bear the certification mark "JAN" shall bear the letter "J". If the body size and physical configuration of the SMD coil are not suitable for marking, the certification mark "JAN" shall appear on the noncorrosive label. The "JAN" or "J" shall be placed immediately before the part number except that if such location would place a hardship on the manufacturer in connection with such marking, the "JAN" or "J" may be located on the first line above or below the part number. Items furnished under contracts or orders which either permit or require deviation from the conditions or requirements specified herein or in applicable specifications shall not bear "JAN" or "J". In the event an item fails to meet the requirements of this specification and the applicable specification sheets or associated specifications, the manufacturer shall remove completely the military part number and the "JAN" or the "J" from the sample tested and also from all items represented by the sample. The "JAN"' or "J" certification mark shall not be used on products acquired to contractor drawings or specifications. The United States Government has obtained Certificate of Registration Number 504,860 for the certification mark "JAN" and Registration Number 1,586,261 for the certification mark "J".

3.23.3 Substitutability of product levels. A manufacturer may supply to those product levels, as listed in table V, with failure rates (FR) higher than that to which he is qualified. Parts with lower FR are substitutable, with acquiring agency approval, for higher FR parts, provided the lot date codes of the parts are not changed (see 6.2).

TABLE V. Product level substitution.

Parts qualified to product level	Are substitutable for product level
S	M, P, and R
R	M and P
P	M

3.23.4 Supplying to lower inductance tolerance levels. Parts qualified to lower inductance tolerance levels with procuring activity approval are suitable for higher tolerance levels as long as the label reflects the correct inductance (see table VI). Parts that are physically marked shall not be remarked unless specified in the contract or order (see 6.2).

TABLE VI. Inductance tolerance substitution.

Parts qualified to inductance tolerance	Are substitutable for inductance tolerance
F (1)	G(2), H(3), J(5), K(10), L(15), M(20)
G (2)	H(3), J(5), K(10), L(15), M(20)
H (3)	J(5), K(10), L(15), M(20)
J(5)	K(10), L(15), M(20)
K(10)	L(15), M(20)
L(15)	M(20)

3.24 Workmanship. The ~~transformers and inductors~~ coils shall be processed in such a manner as to be uniform in quality and shall meet the requirements of 4.6.1 and 4.8.1, as applicable, and shall be free of defects that will affect life or serviceability.

3.25 High-temperature exposure. When coils are tested as specified in 4.8.20, there shall be no evidence of physical or mechanical damage.

4. VERIFICATION

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

a. Qualification inspection (see 4.4).

b. Verification of qualification (see 4.5).

c. Conformance inspection (see 4.6).

d. Periodic inspection (see 4.7).

4.2 QPL system. A QPL system shall be established and maintained in accordance with 3.3. Evidence of such compliance is a prerequisite for qualification and retention of qualification.

4.3 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions as specified in the "General Requirements" of MIL-STD-202. The exception to those conditions is the Relative Humidity which should be in the range of 15 percent to 75 percent.

4.3.1 Precautions. Adequate precautions shall be taken during inspection to prevent condensation of moisture on coils except during the moisture resistance and thermal shock tests.

4.3.2 Test voltage. The test voltage shall contain no more than 5 percent harmonic distortion (see 3.1).

4.3.3 Test frequency. When a test frequency is specified without a tolerance, the frequency used shall be within +/- 0.1 percent of the specified value (see 3.1).

4.3.4 Demagnetization. When necessary to overcome remanence effects, demagnetization is permitted.

4.3.5 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, repeatability, quality, and quantity to permit performance of the required inspection shall be established and maintained by the inspection facility. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with ANSI/NCSL Z540.3 or ISO-10012 or an equivalent system as approved by the qualifying activity.

4.4 Qualification inspection. Qualification inspection shall be performed per table VII, in the order shown, at a laboratory acceptable to the Government (see 6.3) 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 coils to be submitted for qualification inspection shall be as specified in Appendix A to this specification and table VII.

4.4.2 Inspection routine. Sample units shall be subjected to the qualification inspection specified in table VII in the order shown. All sample units, except Group III, shall be subjected to the inspection of Group I. The sample units shall then be divided as specified in table VII and subjected to the inspection for their particular group.

4.4.3 Failures. Failures or the number of defectives in excess of those allowed in table VII shall be cause for refusal to grant qualification approval.

4.4.4 FRL and verification.

4.4.4.1 FR qualification. FR qualification shall be in accordance with the general and detailed requirements of MIL-STD-690 along with the following details:

a. Procedure I: Qualification at the initial FRL. Level M (1 percent/1,000 hours) of FRSP-60 shall apply. Sample units shall be subjected to the qualification inspection specified in Group II, table VII. The entire life test sample shall be continued on test to 10,000 hours as specified in 4.8.18 upon completion of the 2,000 hour qualification.

b. Procedure II: Extension of qualification to lower FRLs. To extend qualification to the R (0.01 percent / 1,000 hours) and S (0.001 percent / 1,000 hours) FRLs, two or more classes of all core materials may be combined.

c. Procedure III: Maintenance of FRL qualification. Maintenance period B of FRSP-10 shall apply. Regardless of the number of production lots produced during this period, the specified number of unit hours shall be accumulated to maintain qualification (see 4.7.1.1). For FRL R and FRL S all classes and core materials may be combined.

4.5 Verification of qualification. Every six months the manufacturer shall provide verification of qualification to the qualifying activity. Continuation of qualification is based on meeting the following requirements.

a. MIL-STD-790 program.

b. The design of the coil has not been modified.

c. Requirements for group B inspection are met (see 4.7.1).

d. FRLs are maintained as required.

4.6 Conformance inspection.

4.6.1 Inspection of product for delivery.

4.6.1.1 Visual and mechanical inspection. Coils shall be inspected under magnification power (when necessary) to verify that the materials, design, construction, physical dimensions, markings, and workmanship are in accordance with the applicable requirements herein.

4.6.1.2 ER coils. Inspection of product for delivery shall consist of group A inspection (see 4.6.3).

4.6.2 Inspection and production lot.

4.6.2.1 Inspection lot. An inspection lot shall consist of all the coils of the same core material produced under essentially the same conditions, and offered for inspection at one time. The manufacturer may combine coils of different inductance values and inductance tolerances. The inductance value shall be equally representative of the production lot for that period. The total number of pieces in any given lot submitted for quality conformance inspection shall not exceed the number of pieces accumulated from one month's production.

4.6.2.2 Production lot. A production lot shall consist of all coils of a single PIN. Manufacture of all parts in the lot shall have been started, processed, assembled, and tested as a group. A production lot consists of parts manufactured from the same basic raw materials, processed under the same basic specifications and procedures, and produced with the same equipment. Lot identity shall be maintained throughout the manufacturing cycle where each production lot of parts should be a group identified by a common manufacturing record through all significant manufacturing operations, including the final assembly operation. The final assembly operation should be considered the last major assembly operation such as molding, rather than painting or marking, for example.

4.6.3 Group A inspection.

4.6.3.1 ER coils. Group A inspection shall consist of the inspections specified in table VIII, in the order shown.

4.6.3.1.1 Subgroup 1 tests. Subgroup 1 tests shall be performed on a production lot basis on 100 percent of the product supplied under this specification. Coils failing the tests of subgroup 1 shall be removed from the lot. If during the 100 percent inspection, screening requires more than 5 percent of the coils to be discarded, the entire lot shall be rejected.

TABLE VII. Qualification inspection.

Inspection	Requirement paragraph	Method paragraph	Number of sample units to be inspected 1/	Number of defectives allowed
Group IA (all samples)				
Thermal shock	3.6	4.8.3	All units (except group III)	N/A
Winding Continuity	3.11	4.8.8		
Dielectric withstanding voltage	3.8	4.8.5		
Barometric pressure (when applicable)	3.9	4.8.6		
Insulation resistance	3.10	4.8.7		
Electrical characteristics (initial)				
Inductance	3.7.1	4.8.4.1		
Q of coils	3.7.2	4.8.4.2		
Self-resonant frequency	3.7.3	4.8.4.3		
DC resistance	3.7.6	4.8.4.6		
Group IB (all samples)				
Other electrical characteristics (see 3.1)			All units (except group III)	0
Percent coupling (when specified)	3.7.4	4.8.4.4		
Incremental current inductance change (when specified)	3.7.5	4.8.4.5		
Visual and mechanical inspection	3.1,3.4,3.5, 3.23,3.24	4.6.1.1, 4.8.1		
Group II				
Life	3.21	4.8.18	102	1
Group III			6	0
Solderability 2/	3.16	4.8.13		
Group IIIA				
Resistance to Soldering Heat	3.14	4.8.11	6	0
Electrical characteristics (final)				
Inductance	3.7.1	4.8.4.1		
Q of coils	3.7.2	4.8.4.2		
Group IV			10	1
Low-temperature operation	3.17	4.8.15		
Temperature Rise	3.12	4.8.9		
Overload 3/	3.13	4.8.10		
High-temperature exposure	3.25	4.8.20		
Electrical characteristics (final)				
Inductance	3.7.1	4.8.4.1		
Q of coils	3.7.2	4.8.4.2		
Self-resonant frequency	3.7.3	4.8.4.3		
DC resistance	3.7.6	4.8.4.6		
Group V			10	
Vibration	3.18	4.8.15		
Shock (specified pulse)	3.19	4.8.16		
Moisture Resistance	3.20	4.8.17		
Electrical characteristics (final)				
Inductance	3.7.1	4.8.4.1		
Q of coils	3.7.2	4.8.4.2		

See footnotes at end of table.

TABLE VII. Qualification inspection - Continued.

Inspection	Requirement paragraph	Method paragraph	Number of sample units to be inspected 1/	Number of defectives allowed
Group VI Bond strength	3.15	4.8.12	20	1
Group VII Fungus 4/	3.22	4.8.19	10	0

1/ Combined submission shall be in accordance with Appendix A (see ~~30.1.2~~ A.3.1.2).
2/ The units shall be clean units that have not been subjected to any other test.
3/ After the overload test is performed, a period of 24 hours shall elapse prior to taking electrical characteristics (final) measurements.
4/ The fungus requirement is either by certification or performance.

TABLE VIII. Group A inspection.

Inspection	Requirement paragraph	Method paragraph	Sampling plan
Subgroup 1			
Thermal shock	3.6	4.8.3	100% inspection
Electrical characteristics 1/			
Inductance	3.7.1	4.8.4.1	100% inspection
Q of coils	3.7.2	4.8.4.2	100% inspection
Subgroup 2			
Self-resonant frequency	3.7.3	4.8.4.3	Table IX Plan A
DC resistance	3.7.6	4.8.4.6	
Visual and mechanical inspection (external) 2/	3.1,3.4,3.5, 3.23,3.24	4.6.1.1, 4.8.1	Table IX Plan B

1/ Coils shall meet the specified initial inductance and Q values (see 3.7.1 and 3.7.2, respectively).

2/ The manufacturer may request the deletion of the subgroup 2, visual and mechanical examination, provided an in-line or process control system for assessing and assuring the visual and mechanical requirements are met, can be validated and approved by the qualifying activity. Deletion of this examination does not relieve the manufacturer from meeting these requirements.

TABLE IX. Group A sampling plan.

Lot size	Sample size	
	Plan A	Plan B
1 to 13	100%	100%
14 to 125	100%	13
126 to 150	125	13
151 to 280	125	20
281 to 500	125	29
501 to 1,200	125	34
1,201 to 3,200	125	42
3,201 to 10,000	125	50
10,001 to 35,000	294	60
35,001 to 150,000	294	74
150,001 to 500,000	345	90
500,001 and over	435	102

4.6.3.1.2 Subgroup 2 tests. For each required sample plan size, a sample of parts shall be randomly selected in accordance with table IX. If one or more total defects are found, the lot shall be rescreened for the affected parameter(s) and defects shall be removed. After rescreening and removal of defects, a new sample of parts shall be randomly selected in accordance with table IX. If one or more total defects are found in the second sample sets, the lot shall be rejected and shall not be supplied to this specification.

4.7 Periodic inspection. Periodic inspection shall consist of group B inspection per table X. Except where the results of this inspection show noncompliance with the applicable requirements (see 6.3), delivery of products which have passed group A inspection shall not be delayed pending the results of these periodic inspections.

4.7.1 Group B inspection. Group B inspection shall consist of the tests specified in table X, in the order shown, and shall be performed on sample units of each core material and selected from lots that have passed group A inspection. Test data obtained shall be reviewed as part of the complete verification of qualification. Coil styles manufactured during that month shall be represented, as far as practical, in at least the approximate ratio of production.

4.7.1.1 Sampling plan.

4.7.1.1.1 Monthly (subgroup 1). Test samples shall be selected from each core material produced during a one-month period. These samples shall be accumulated and placed on the life test as specified in 4.8.18, once a month, for the full 10,000-hour life test period. The test sample size shall be determined by the manufacturer so that the unit hours generated meet the maintenance of qualification requirements specified for the qualified FRL (see 4.4.4). In any event, a minimum of five samples shall be selected from each core material. As far as is practicable, the inductance values tested during maintenance period shall be representative of the core material produced during this period. The accumulated data shall be used for maintenance and extension of FR qualification.

4.7.1.1.2 Yearly (subgroup 2). Every year, 12 sample units from each core material shall be inspected, per table X. No more than one (1) defective is allowed from this sample lot.

4.7.1.1.3 Yearly (subgroup 3). Every year, 12 sample units from each core material shall be inspected, per table X. No defectives are allowed from this sample lot.

4.7.1.1.4 Yearly (subgroup 3A). Every year, 12 sample units from each core material shall be inspected, per table X. No defectives are allowed from this sample lot.

4.7.1.1.5 Yearly (subgroup 4). Every year, 12 sample units from each core material shall be inspected, per table X. No more than one (1) defective is allowed from this sample lot.

TABLE X. Group B inspection.

Inspection	Requirement paragraph	Method paragraph	Number of sample units to be inspected	Number of defectives allowed
Subgroup I (Monthly)				
Life (extended)	3.21	4.8.18	See 4.7.1.1.1	See 4.7.1.1.1
Subgroup 2 (Yearly)				
Thermal shock	3.6	4.8.3	12	1
Dielectric withstanding voltage	3.8	4.8.5		
Barometric pressure (when applicable)	3.9	4.8.6		
Insulation resistance	3.10	4.8.7		
Electrical characteristics (initial)	3.7	4.8.4		
Other electrical characteristics (see 3.1)				
Percent coupling (when specified)	3.7.4	4.8.4.4		
Incremental current inductance change (when specified)	3.7.5	4.8.4.5		
Low-temperature operation	3.17	4.8.14		
Temperature Rise	3.12	4.8.9		
Overload 1/	3.13	4.8.10		
Moisture Resistance	3.20	4.8.17		
Electrical characteristics (final)				
Inductance	3.7.1	4.8.4.1		
Q of coils	3.7.2	4.8.4.2		
High-temperature exposure	3.25	4.8.20		
Electrical characteristics (final)	3.7	4.8.4		
Subgroup 3 (Yearly)				
Solderability	3.16	4.8.13	12	0
Subgroup 3A (Yearly)				
Electrical characteristics (initial)			12	0
Inductance	3.7.1	4.8.4.1		
Q of coils	3.7.2	4.8.4.2		
Resistance to Soldering Heat	3.14	4.8.11		
Electrical characteristics (final)				
Inductance	3.7.1	4.8.4.1		
Q of coils	3.7.2	4.8.4.2		
Subgroup 4 (Yearly)				
Electrical characteristics (initial)	3.7	4.8.4	12	1
Vibration	3.18	4.8.15		
Shock (specified pulse)	3.19	4.8.16		
Electrical characteristics (final)	3.7	4.8.4		

1/ After overload test is performed, a period of 24 hours shall elapse prior to taking electrical characteristics (final) measurements for ferrite core coils only.

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

4.7.1.3 Noncompliance. If a sample fails to pass group B inspection, the manufacturer shall select another group of sample units from the affected core or cores and resubmit them to table X inspection. If a sample from the resubmitted lot fails to pass Group B inspection, the manufacturer shall notify the qualifying activity and the cognizant inspection activity of such failure and take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which are manufactured under essentially the same materials and processes, and which are considered subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action, acceptable to the qualifying and inspection activity, has been taken. After the corrective action has been taken, group B inspection shall be repeated on additional sample units (all tests and examinations, or the test which the original sample failed, at the option of the qualifying activity). Group A inspection may be reinstituted at the option of the qualifying and inspection activity. Final acceptance and shipment shall be withheld until the group B inspection has shown that the corrective action was successful. In the event of failure after Group B reinspection, information concerning the failure shall be furnished to the cognizant qualifying and inspection activity.

4.8 Methods of inspection.

4.8.1 Visual and mechanical inspection.

4.8.1.1 External (Qualification). Coils shall be inspected under 10X magnification power minimum to verify that the weight, materials, external design and construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.1, 3.4, 3.5, 3.23, 3.24).

4.8.1.2 External (Group A). Coils shall be inspected under 10X magnification minimum to verify that external design and construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.1, 3.4, 3.5, 3.23, 3.24).

4.8.1.3 Internal (Qualification only). Coils shall be inspected to verify that no catastrophic defects have occurred due to the effects of previous qualification tests. Examples of catastrophic defects include: broken or cracked cores, any windings that have been physically damaged or pulled away from the core, and cores that have lifted from the substrate, as applicable. Real time X-ray is an acceptable method of examination in lieu of dissection or disassembly.

4.8.2 Mounting provisions.

4.8.2.1 SMD coil test handling procedures. When specified in the test procedure, the SMD coil shall be tested while mounted on a test substrate as described in 4.8.2.2. For those test procedures where mounting requirements are unspecified, the SMD coils may be tested unmounted using pressure type or equivalent contacts. The fixtures for unmounted SMD coils shall be specified, as required, in the corresponding specification sheet (see 3.1 and 6.9).

4.8.2.2 Specified mounting. When specified in the test procedure, the SMD coil shall be mounted on a suitable test substrate, which shall be made of a minimum of 96 percent alumina or equivalent, unless otherwise specified in the specification sheet. The test substrate material shall be such that it shall not be the cause of, nor contribute to any failure of an SMD coil in any of the tests for which it may be used. The test substrate shall be prepared with metallized surface land areas. The metallization material shall be compatible with the bonding technique to be
employed and the material used on each coil termination. The method of SMD mounting for the different termination materials shall be as follows:

a. Solderable and solderable/weldable termination materials. Chip coils shall be mounted on the test substrate by soldering the coil terminations directly to the test substrate's metallized land areas in the following manner:

(1) Solder and soldering flux, when applicable, shall be selected to enable the parts to meet the requirements of this specification. It is recommended that solder and soldering flux to be in accordance with IPC J-STD-004, IPC J-STD-005 and IPC J-STD-006.
(2) All SMD coils shall then be placed across the metallized land areas of the test substrate with contact between the coil terminations and substrate land areas only.
(3) The test substrate with all parts in position shall then be placed in or on a suitable heat transfer unit (molten solder, hot plate, reflow oven, etc.) with the temperature maintained at 260◦C +/- 5◦C until the solder melts and reflows forming a homogenous solder connection.

b. Weldable termination materials. SMD coils with weldable terminations shall be mechanically attached to the test substrate and electrically connected by thermo-compression bonding or equivalent the flying lead interconnection between each coil termination and the corresponding test substrate metallized land area. Each interconnecting lead shall be 0.001 inch (0.03 mm) in diameter and made of gold (Au). The coil shall be mechanically mounted by any procedure, which shall not be the cause of or nor contribute to any failures of the coil in any test described herein.

4.8.3 Thermal shock (see 3.6). Coils shall be tested in accordance with method 107 of MIL-STD-202. The following details and exceptions shall apply:

a. Mounting: Coils shall not be mounted. They shall be placed in containers, which allow air circulation among the coils under test.

b. Test condition A-2 (50 cycles) for Qualification and Group B Inspection / Test condition A-1 (25 cycles) for Group A Inspection. Step 3 shall be at the maximum temperature of the class. NOTE: The manufacturer has the option of performing the group A thermal shock test at 125°C for all products supplied to this specification. However, performing the test at a higher temperature than the maximum operating temperature for some QPL coils is at the risk of the manufacturer.

c. After the test, coils shall be inspected as a group for evidence of obvious mechanical or physical damage.

d. Any measurements after cycling shall take place after stabilization at room temperature after at least 24 hours.

4.8.4 Electrical characteristics (see 3.1 and 3.7). Unless specified otherwise, the coils shall be unmounted using pressure type or equivalent contacts on their applicable test fixture (see 4.8.2). The electrical characteristics to be determined shall include inductance, Q, self-resonant frequency, and dc resistance. Additional electrical characteristics shall be measured when specified.

4.8.4.1 Inductance (see 3.7.1). Unless otherwise specified, inductance of coils shall be measured at the frequency(ies) specified (see 3.1). SMD coils shall be tested on a calibrated bridge, impedance analyzer or Q-meter that supports both accurate and repeatable inductance measurements. ~~NOTE: the HP4342A Q-meter is the preferred equipment as the reference standard.~~ Follow the appropriate equipment manufacturer's instructions for operator procedures for equipment calibration (see 4.3.5), test fixture compensation, and inductance measurements. If a Q-meter is used, the test procedures in section B.2 in Appendix B or the equivalent shall be followed.

~~NOTE: The coil manufacturer shall establish the basis for correlation, in relation to inductance measurements.~~

4.8.4.2 Quality Factor (Q) of coils (see 3.7.2). Unless otherwise specified, Q of coils shall be measured at the frequency(ies) specified (see 3.1). SMD coils shall be tested on a calibrated bridge, impedance analyzer or Q-meter that supports both accurate and repeatable Q measurements. NOTE: the HP4342A Q-meter is the preferred equipment as the reference standard. Follow the appropriate equipment manufacturer's instructions for operator procedures for equipment calibration (see 4.3.5), test fixture compensation, and Q measurements. If a Q-meter is used, the test procedures in section B.3 in Appendix B or the equivalent shall be followed.

NOTE: The coil manufacturer shall establish the basis for correlation, in relation to Q measurements.

4.8.4.3 Self-resonant frequency (SRF) (see 3.7.3). Unless otherwise specified, the SRF of coils shall be measured (see 3.1) on a calibrated vector network analyzer, bridge, impedance analyzer or Q-meter that supports both accurate and repeatable SRF measurements. NOTE: the 50-ohm S-parameter method on a vector network analyzer is the preferred method as the reference standard (see section B.4 in Appendix B for further details). Follow the appropriate equipment manufacturer's instructions for operator procedures for equipment calibration (see 4.3.5), test fixture calibration and/or compensation, and SRF measurements. If the impedance/phase method or the absorption method is used, the test procedures in section B.4 in Appendix B or the equivalent shall be followed.

4.8.4.4 Percent coupling (when specified) (see 3.7.4 and 6.9). Unless specified otherwise in 3.1, the test equipment and test frequency for determining the percent coupling of SMD coils is dictated by the inductances to be measured, per table XI. First two (2) SMD coils with the same model number shall be individually measured for inductance ~~in the appropriate test fixture as specified in the specification sheet (see 3.1) or equivalent~~. Next the coil pair shall be tested for inductance where the pair is taped down or otherwise secured in an appropriately sized test fixture such that the bodies of the coils are kept parallel ~~and in contact~~ with each other to ensure maximum coupling.

The inductance values are taken of the two coils, first series aiding (L_{T1}) and then series bucking (L_{T2}) at the frequency specified, per table XI. The applied ac test voltage shall be the lowest voltage across each coil which shall permit the meter to operate satisfactorily. All inductance measurements shall be taken at the same voltage level, so that any saturation effects are taken into account. The percent coupling is then calculated using the following formula:

$$\text{Percent coupling} = \frac{M}{\sqrt{L_1 L_2}} \times 100$$

where:

$$M = \frac{L_{T1} - L_{T2}}{4} = \text{coefficient of mutual inductance in } \mu H.$$

L_{T1} = effective total inductance series aiding (μH) at test frequency, per table XI. Both SMD coils are measured in a series configuration, where both coils share the same magnetic polarity.

L_{T2} = effective total inductance series bucking (μH) at test frequency, per table XI.Both SMD coils are measured in a series configuration, where both coils have the opposite magnetic polarities.

The inductance values L_1 and L_2 in μH are the measured values of the two coils under measurement at the specified frequency in table XI.

L_1 = effective inductance (μH) of first SMD coil at test frequency, per table XI.

L_2 = effective inductance (μH) of second SMD coil at test frequency, per table XI.

TABLE XI. Test equipment for percent coupling.

Nominal Inductance (μH)	Test Frequency (kHz)	Calibrated Test Instrument
≤10.0	100.0	Industry standard precision LCR Meter
>10.0 to ≤100.0	10.0	
>100.0	1.0	

4.8.4.4.1 Percent coupling (alternate method). The percent coupling between two (2) SMD coils is to be determined by measuring the voltage induced in a coil when a voltage is applied to an adjacent coil that share the same model number. In order to maintain reasonable impedance levels, the measurement is to be performed at 100 kHz for nominal inductances of 10.0 µH or less, at 10.0 kHz for nominal inductances less than or equal to 100.0 µH but greater than 10.0 µH, and at 1.0 kHz for inductances greater than 100.0 µH, unless specified otherwise in 3.1. The measurement circuit is shown on figure 1. Inductance shall be measured per subsection 4.8.4.4.

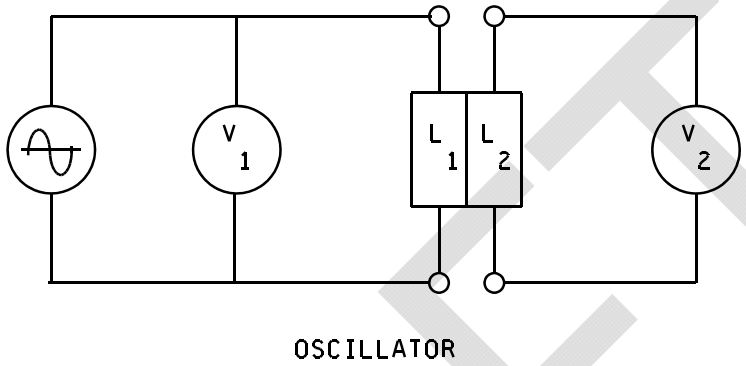

FIGURE 1. Test circuit for percent coupling (alternate method)

Equipment for this test consists of a calibrated signal generator or equivalent, a calibrated multimeter or equivalent, and the appropriate interconnecting wiring and connectors, chosen by the manufacturer.

The coil pair shall be tested for inductance where the pair is taped down or otherwise secured in an appropriately sized test fixture such that the bodies of the coils are kept parallel and in contact with each other to ensure maximum coupling. The applied voltage levels shall be as low as possible to permit reliable readings of V_2. All inductance measurements shall be taken at the same voltage level so that any saturation effects are taken into account.

The percent coupling is to be calculated using the equation:

$$\text{Percent coupling} = \sqrt{\frac{L_1}{L_2}}\,\frac{V_2}{V_1} \times 100$$

Where: L_1 = effective inductance of primary SMD coil at test frequency (see 4.8.4.4)
L_2 = effective inductance of secondary SMD coil at test frequency (see 4.8.4.4)
V_1 = true RMS voltage measured by meter across primary SMD coil
V_2 = true RMS voltage measured by meter across secondary SMD coil

4.8.4.5 Incremental current inductance change (when specified) (see 3.7.5). Incremental current inductance change is the dc current required to cause a change of no more than 5.0 percent (unless specified otherwise) from the inductance measured with zero dc current compared to the inductance measured with the specified value of incremental current (see 3.1). The ac test voltage to be used across the SMD coil for inductance bridge operation shall be determined by the following formula:

$$E = f\sqrt{L}$$

where:

E = voltage (rms) in millivolts (mV)
f = frequency in kilohertz (kHz)
L = nominal value of inductance in microhenries (µH)

This voltage is to be measured with a calibrated multimeter or equivalent connected directly across the SMD coil. This multimeter is disconnected prior to making the inductance measurement.

This test shall be performed using a calibrated precision Impedance Analyzer, LCR Meter or equivalent. ~~The inductance shall be measured in the appropriate test fixture as specified in the specification sheet (see 3.1) or equivalent and shall also be dependent on the size of the SMD coil under test.~~ Unless specified otherwise in 3.1, each measurement is to be performed at 100 kHz for nominal inductances of 10.0 µH or less, at 10.0 kHz for nominal inductances less than or equal to 100.0 µH but greater than 10.0 µH, and at 1.0 kHz for inductances greater than 100.0 µH. The inductance of the coil under test shall be determined and recorded with zero dc current in the coil. The specified value of incremental current shall be applied through the coil and this inductance measurement recorded. The change in inductance between the two values shall be less than 5.0 percent.

$$\triangle L = (L_{\square} - L_{inc}) / L_{\emptyset} * 100 \text{ ~~< 5.0\%~~}$$

where: CHECK THIS FORMULA

$L_{\square}$ = measured inductance (µH) at zero-ampere DC bias current and at test frequency
L_{inc} = measured inductance (µH) at specified incremental current and at test frequency

4.8.4.6 DC resistance (see 3.7.6). DC resistance of coils shall be measured in accordance with method 303 of MIL-STD-202.

4.8.5 Dielectric withstanding voltage (see 3.8). Coils shall be tested in accordance with method 301 of MIL-STD-202. The following details shall apply:

a. Method of mounting: SMD coils shall be mounted on a test substrate by being soldered, welded, or held in place by pressure applied through the contact arm, so the terminals are shorted and accessible to the power source through the ~~metallized land areas~~ conductive traces of the substrate. The contact arm or assembly shall be made of a resilient conducting material connected to ground and shall cover at least the entire surface opposite the terminals. ~~Test fixtures shall be as specified on the applicable specification sheet (see 3.1).~~

b. Magnitude and nature of test voltage: The 60 Hz (nominal) ac test voltage shall be a minimum of 500 volts rms for encapsulated units and 200 volts for conformal coated or open construction units, unless otherwise specified (see 3.1). The time duration for inspection shall be not less than 15 seconds nor more than 30 seconds.

c. Points of application of test voltage: Unless otherwise specified (see 3.1), the test voltage shall be applied between the terminals of the coil connected together and the contact arm.

d. Inspection after test: Coils shall be inspected for evidence of damage resulting from arcing, flashover, breakdown of insulation, or other damage.

4.8.6 Barometric pressure (when applicable) (see 3.9). Coils 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. Method of mounting: SMD coils shall be mounted on a test substrate by being soldered, welded, or held in place by pressure applied through the contact arm, so the terminals are shorted and accessible to the power source through the ~~metallized land areas~~ conductive traces of the substrate. The contact arm or assembly shall be made of a resilient conducting material connected to ground and shall cover at least the entire surface opposite the terminals. ~~Test fixtures shall be as specified on the applicable specification sheet (see 3.1).~~

b. Test condition as specified (see 3.1).

c. Magnitude and nature of test voltage: The 60 Hz (nominal) ac test voltage shall be a minimum of 200 volts rms for encapsulated units and 80 volts for conformal coated or open construction units at an altitude of 70,000 feet above sea level, unless otherwise specified (see 3.1). The time duration for inspection shall be not less than 15 seconds nor more than 30 seconds.

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d. Points of application of test voltage: Unless otherwise specified (see 3.1), the test voltage shall be applied between the terminals of the coil connected together and the contact arm.

e. Inspection after test: Coils shall be inspected for evidence of damage resulting from arcing, flashover, breakdown of insulation, or other damage.

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

a. Method of mounting: SMD coils shall be mounted on a test substrate by being soldered, welded, or held in place by pressure applied through the contact arm, so the terminals are shorted and accessible to the power source through the ~~metallized land areas~~ conductive traces of the substrate. The contact arm or assembly shall be made of a resilient conducting material connected to ground and shall cover at least the entire surface opposite the terminals. ~~Test fixtures shall be as specified on the applicable specification sheet (see 3.1).~~

b. Test condition letter B, except that for coils with a dielectric withstanding test voltage less than 500 volts (see 3.1 and 4.8.5b), test condition letter A shall be used.

c. Points of measurement: Unless otherwise specified (see 3.1), measurements shall be made between insulated points. For chip coils the measurements shall be made between the coil winding and the contact arm.

4.8.8 Winding continuity (see 3.11). All windings of coils shall be tested for electrical continuity by any suitable means that shall not introduce currents in excess of the rated value, or the incremental current value (when specified see 3.1), whichever is less.

4.8.9 Temperature rise (see 3.12). The temperature rise of SMD coils shall be determined as specified in 4.8.9.1. This test shall be performed at the specified ambient temperature and with the rated dc current applied (see 3.1). 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.

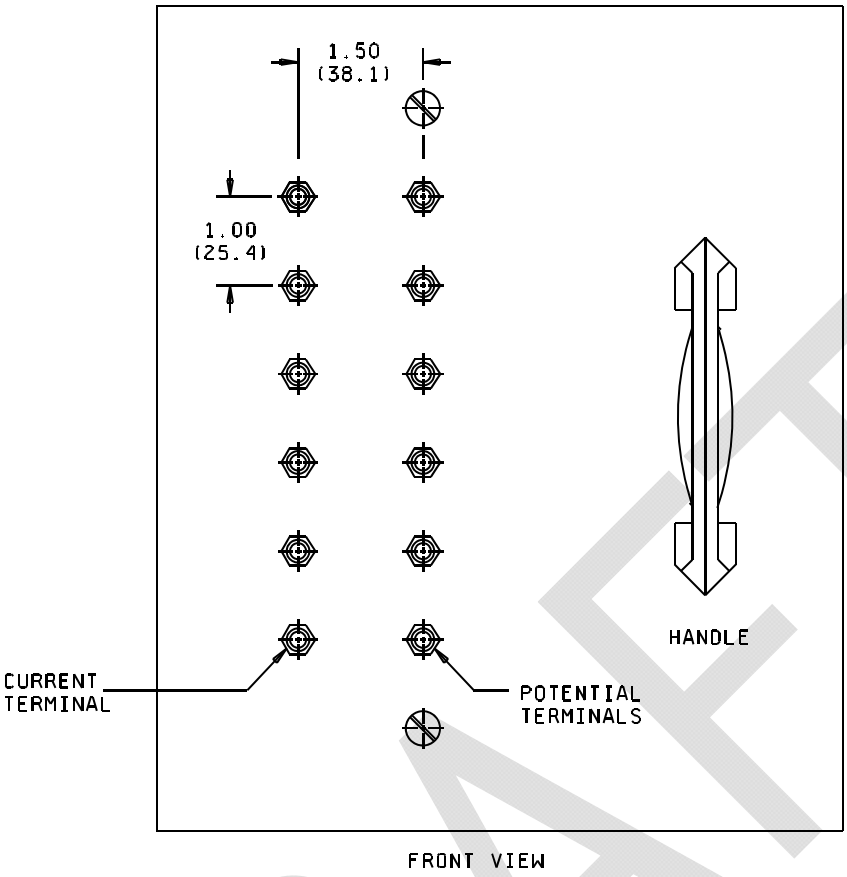
4.8.9.1 Temperature rise determination ~~(see Figure 2)~~. The SMD coil under test shall be mounted on the test substrate (see 4.8.2). The test substrate with the attached coil shall then be placed in a test chamber that allows forced-air circulation to be shut off during testing or has no forced air circulation for heating. The test chamber shall be free of external test-area drafts and external direct thermal radiation. A temperature indicating device with an accuracy of ±0.5°C shall be located in the area surrounding in close proximity to the coil under test, but not where it shall be influenced by the temperature rise of the coil. The test chamber temperature shall then be stabilized at the specified ambient temperature (see 3.1). The dc resistance (r) shall be measured with one-tenth rated direct current applied at the specified ambient temperature (t). When the resistance of the coil is stabilized, the resistance value shall be recorded.

The ammeter-voltmeter method may be used for determining this resistance provided the accuracy of these meters is ±0.5 percent or better and the resistance of the voltmeter is at least 1,000 ohms per volt. A calibrated multimeter or equivalent is preferred. The rated direct current (see 3.1) shall then be applied to the coil under test, using a stable current source such as a storage battery or a DC power supply with internal current limiting. If necessary, forced-air circulation shall be shut off when rated current is applied. When the resistance of the coil under test is stabilized with rated current applied, the resistance (R) and the test chamber temperature (T) shall be recorded. The temperature rise (ΔT) shall be calculated by the following formula:

$$\Delta T = ((R - r)/r) * (t + 234.5) - (T - t)$$

Where:

ΔT = Temperature rise in °C above the specified ambient temperature of the SMD coils under test.
R = Stabilized resistance of coils in ohms with full rated direct current applied at temperature (T + ΔT).
r = Stabilized resistance of coils in ohms with one-tenth of rated direct current applied at ambient temperature (t).
t = Stabilized specified ambient temperature in °C of the coil under test without dc current applied.
T = Ambient temperature in °C (at time forced-air circulation is shut off, if necessary) with rated dc current applied. T shall not differ from t by more than 5°C.



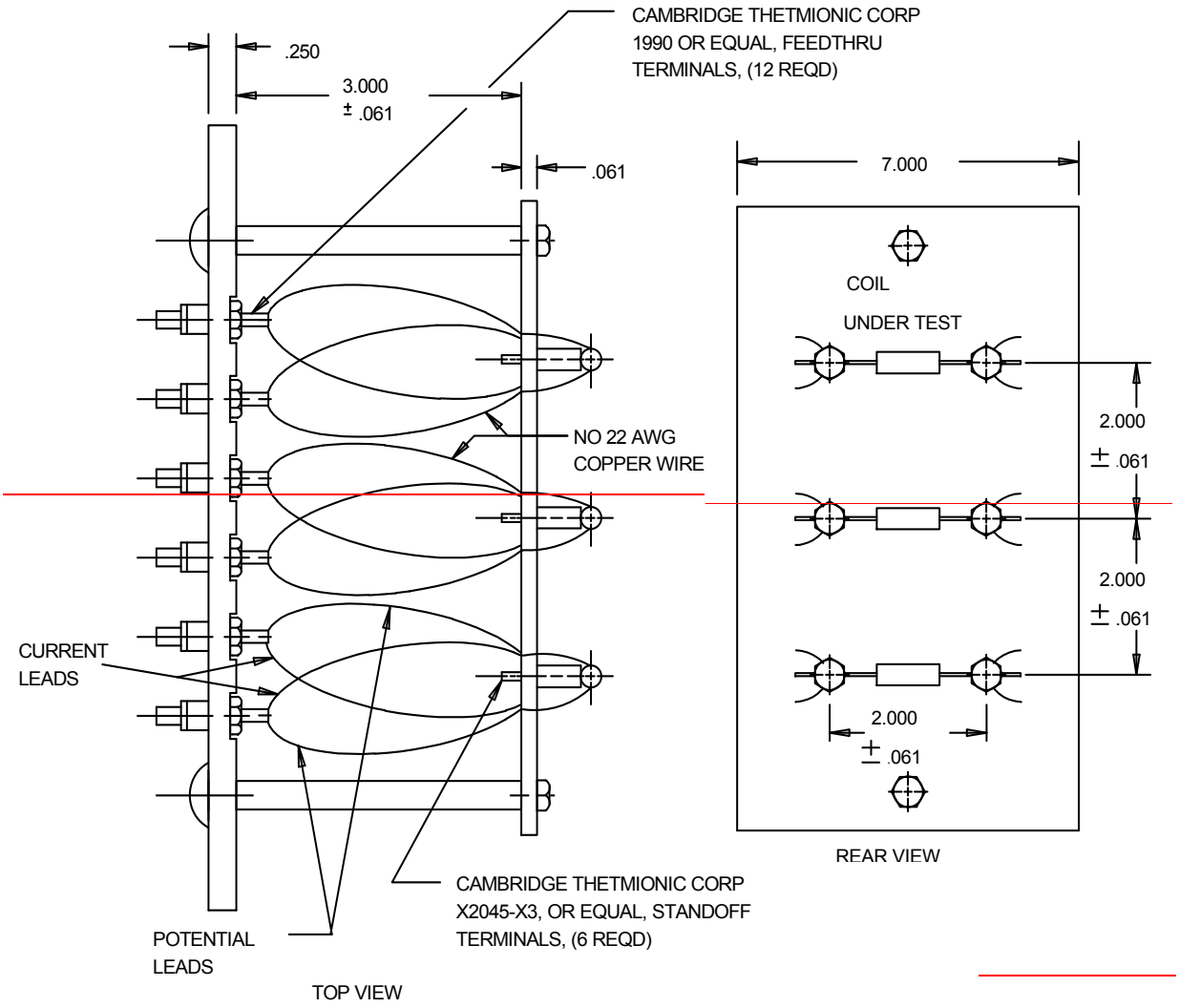
~~NOTES:~~

~~1. Dimensions are in inches.~~

~~2. Unless otherwise specified, tolerance is ± .005 inch (0.13 mm).~~

~~3. Metric equivalents are given for general information only.~~

~~FIGURE 2. Test fixture for temperature rise test on insulated coils or equivalent.~~



Inches	mm
.061	1.55
.250	6.35
2.000	50.80
3.000	76.20
7.000	177.80

NOTES:
1. Dimensions are in inches.
2. Unless otherwise specified, tolerance is ± .005 inch (0.13 mm).
3. Metric equivalents are given for general information only.

FIGURE 2. Test fixture for temperature rise test on SMD coils or equivalent - Continued.

4.8.10 Overload (see 3.13). DC current equivalent to one and one-half times the specified rated current (see 3.1), shall be applied to the windings for 5 minutes at room temperature (+25 +/- 5°C). After the test, coils shall be inspected for evidence of arcing, burning, charring, impairment of any protective coatings, or any other physical or mechanical damage.

4.8.11 Resistance to soldering heat (see 3.14). Terminals to be used for soldered connections shall be tested in accordance with ~~method 210 of MIL-STD-202~~ MIL-STD-202-210. The following details shall apply:

a. Test condition letter – C. How is C defined? Board mounting is not required - Discuss
b. After the test and as soon as the solder terminals have returned to room ambient temperature, the following test shall be made: Visual: There shall be no evidence of solder reflow of internal connections as evidenced by solder flowing from the body of the device.

4.8.12 Bond strength (see 3.15). Coils shall be tested in accordance with method 2011 of MIL-STD-883. The following details apply:

a. Test condition letter: F.
b. Mounting: For components with terminal area on the mounting surface, and finishes A through F, mounting shall be as specified in 4.8.2.2a. For components where terminal areas are on the top or side, and finishes are A, D or E, mounting shall be as specified in 4.8.2.2b.
c. Force: Unless specified otherwise (see 3.1), for solderable units use a force of 2 pounds for encapsulated units or 0.5 pound for open construction or conformal coated units.
d. Inspection after test: Coils shall be inspected for any evidence of physical or mechanical damage.

4.8.13 Solderability (see 3.16). Coils shall be tested according to MIL-STD-202, method 208. Both end terminations shall be immersed completely at the same time.

4.8.14 Low temperature operation (see 3.17). The coil shall be mounted on a substrate as specified in 4.8.2.2. The units shall then be placed in a cold chamber maintained at -55°C +0°C, -5°C. After 1 hour of stabilization at this temperature, full rated continuous dc current (see 3.1) shall be applied for 45 +5, -0 minutes. 15 +5, -0 minutes after the removal of the current, the coils shall be removed from the chamber and maintained at a temperature of 25°C ± 5°C for approximately 24 hours. Coils shall then be inspected for any evidence of cracked cases, impairment of protective coatings, loosening of the windings or terminals, or any other physical or mechanical damage.

4.8.15 Vibration (see 3.18). Coils shall be tested in accordance with 4.8.15.1.

4.8.15.1 Vibration, high frequency. Coils shall be tested in accordance with method 204 of MIL-STD-202. The following details shall apply:

a. Method of mounting. Coils shall be rigidly mounted on appropriate jig fixtures. ~~The coil shall be mounted with the body clamped or cemented to a flat surface. Where used, the cement material shall not extend above the coil body centerline in a vertical plane or beyond the coil body ends in a horizontal plane. In no case shall the coil body be completely encapsulated. These fixtures shall be constructed in a manner to insure that points of the coil-mounting supports shall have the same motion as the vibration test table.~~ The fixtures shall also be of a construction that shall preclude any mechanical resonance in the fixture when subjected to vibration within the test frequency range, and the fixture shall be monitored for these features on the vibration table. In all cases, the coils shall be mounted in relation to the test equipment in such a manner that the stress applied is in the direction which would be considered most detrimental.
b. Test condition D.
c. Inspection after vibration. Coils shall be inspected for any evidence of physical or mechanical damage.

4.8.16 Shock (specified pulse) (see 3.19). Coils shall be tested in accordance with method 213 of MIL-STD-202. The following details shall apply:

a. Method of mounting. Coils shall be rigidly mounted on appropriate jig fixtures. The coil shall be mounted with the body clamped or cemented to a flat surface. Where used, the cement material shall not extend above the coil body centerline in a vertical plane or beyond the coil body ends in a horizontal plane. In no case shall the coil body be completely encapsulated. These fixtures shall be constructed in a manner to insure that points of the coil-mounting supports shall have the same motion as the shock test table. In all cases, the coils shall be mounted in relation to the test equipment in such a manner that the stress applied is in the direction which would be considered most detrimental.

b. Test condition letter I.

c. Inspection after test. Coils shall be inspected for evidence of physical or mechanical damage.

4.8.17 Moisture resistance (see 3.20). Coils shall be tested in accordance with method 106 of MIL-STD-202. The following details and exceptions shall apply:

a. Mounting: As specified in 4.8.2.2.

b. Polarization and loading voltage: No voltage shall be applied.

c. Subcycle: Step 7b shall not be applicable. Step 7a shall be performed during any five of the first eight cycles only.

d. Measurements at high humidity: None.

e. Final measurements: Upon completion of step 6 of the final cycle, the coil shall be removed from the chamber and air-dried for 30 ±15 minutes, then the final measurements shall be made.

f. Inspection after test: Coils shall be inspected for any evidence of electrical or mechanical damage due to corrosion.

4.8.18 Life (see 3.21). Coils shall be tested in accordance with method 108 of MIL-STD-202. The following details and exceptions shall apply:

a. Method of mounting: SMD coil sample units shall be mounted on a test substrate as specified in 4.8.2.2.

b. Ambient test temperature and tolerances unless otherwise specified (see 3.1):

(1) Phenolic core coils: 90°C ± 2°C.

(2) Iron core coils: 90°C ± 2°C.

(3) Ferrite core coils: 90°C ± 2°C.

(4) Ceramic core coils: 90°C ± 2°C.

(5) Other core coils: As specified (see 3.1).

c. Operating conditions: 100 percent rated cyclic loaded conditions (see 3.1), one and one-half hours on and one-half hour off, for the applicable number of hours specified and at the ambient test temperatures. "On time" shall be three-fourths of the total lapsed time.

d. Initial measurements:

(1) Qualification inspection: Measurement of inductance, Q, dc resistance, and self-resonant frequency shall be performed at room temperature prior to subjecting the coils to the specified test temperature. Initial measurements shall be in accordance with the electrical characteristics (initial) requirements of the individual component specification sheet. These initial measurements shall be used as reference in determining degradation limits after exposure to the test temperature for each of the specified test intervals.

(2) Extended life testing: Measurements of inductance and Q shall be performed at room temperature prior to subjecting the coils to the specified test temperature. Initial measurements shall be in accordance with the electrical characteristics (initial) requirements of the individual components specification sheet. These initial measurements shall be used as reference in determining degradation limits after exposure to the test temperature for each of the specified test intervals.

e. Test conditions: Two thousand hours elapsed time for qualification inspection with all samples continued to 10,000 hours. Ten thousand hours for group B FRL inspection.

f. Measurements during test:

(1) Qualification inspection. Measurements of inductance, Q, dc resistance and self-resonant frequency shall be made after 250 hours +48 hours, -0 hours; 500 hours +48 hours, -0 hours; 1,000 hours +48 hours, -0 hours; 2,000 hours +72 hours, -0 hours have elapsed. The coils shall be stabilized at room temperature for a minimum of one-half hour after removal from the test chamber prior to taking measurements. Coils shall remain at room temperature for no greater period of time than necessary to perform the required measurements before return to test chamber.

(2) Extended life test. Coils shall be tested for a period of 10,000 hours +96 hours -0 hours. Inductance and Q shall be measured at the following intervals: 250 hours +48 hours, -0 hours; 500 hours +48 hours, -0 hours; 1,000 hours +48 hours, -0 hours; and 2,000 hours +72 hours, -0 hours, and every 2,000 hours +96 hours, -0 hours thereafter. Final measurements after exposure shall include dc resistance and self-resonant frequency (see 3.1).

g. Degradation limits: Unless otherwise specified, coils shall not exceed the degradation limits specified (see 3.1) for the 250-hour test interval and for succeeding test intervals up to and including the 2,000-hour test interval for the Qualification inspection and up to and including the 10,000-hour test interval for the Extended life test (see 6.5).

h. Inspection after test: Coils shall be inspected for any evidence of physical or mechanical damage.

i. Unless otherwise specified (see 3.1), room temperature and tolerance shall be +25°C +/- 5°C.

4.8.19 Fungus (see 3.22). Unless certification is provided, coils shall be tested in accordance with method 508 of MIL-STD-810.

4.8.20 High-temperature exposure (see 3.25). The chip coils mounted on the test substrate as specified in 4.8.2.2, shall be subjected to the maximum operating temperature (temperature rise (see 4.8.9) plus maximum ambient temperature) +3°C, -2°C continuously for 100 ±4 hours, in a test chamber with forced-air circulation. The units shall then be stabilized at room ambient temperature for 4 to 12 hours.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of material is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. 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. These radio frequency SMD coils are designed for use in radio frequency or similar circuits where the need for resistance to immersion and moisture, reliability, long life, and continuity of operation are necessary.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of the specification, the applicable specification sheet, and the complete PIN (see 1.2.1).

b. Special marking, if required (see 3.1).

c. Packaging requirements (see 5.1).

d. Allowable substitution (see 3.23.3 and 3.23.4).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL No. ## 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 the DLA Land and Maritime, ATTN: DLA Land and Maritime-VQP, PO Box 3990, Columbus, OH 43218-3990, or by e-mail to vqp.chief@dla.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at https://assist.dla.mil.

6.4 Flammability (self-extinguishing material). Material may 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 coil under test.

6.5 Final electrical characteristics. The degradation limits specified for the final electrical characteristics should remain the same for tighter inductance tolerances.

6.6 Tin plated finishes. Tin plating is prohibited (see 3.5.3) 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 Coatings of Tin).

6.7 Metallized termination (see 3.5.2). It should be noted that when pure silver is used for the terminations, silver migration between the terminations may occur under conditions of simultaneous application of high humidity and dc voltage. This produces a troublesome electrical leakage path across the SMD coil. Addition of about 20 percent of palladium to the silver to form an alloy shall retard the tendency toward silver migration. Complete over coating of the silver termination by the lead-tin bonding solder also shall retard the tendency toward silver migration. Addition of about 3 percent of silver to the lead-tin bonding solder shall tend to reduce the leaching of the silver from a silver termination during the solder bonding operation.

6.8 Subject term (key word) listing.

Coil
Radio frequency

6.9 Additional data for preparation of specification sheets. Data submitted for preparation of specification sheets to MIL-PRF-SMD should specify the following in addition to the requirements of section 3.

6.9.1 Positioning of the SMD coil for determination of the percent coupling (see 4.8.4.4 and Figure 3). The orientation of the coil with respect to one another should be specified with regard to an x, y, z coordinate system, where the x-axis is the length, the y-axis is the height, and the axis is the width of the coil (see figure 2).

6.9.2 Chip coil test fixture (see 4.8.2.1). Detailed drawings of the test fixtures should be submitted for inclusion on the specification sheets.

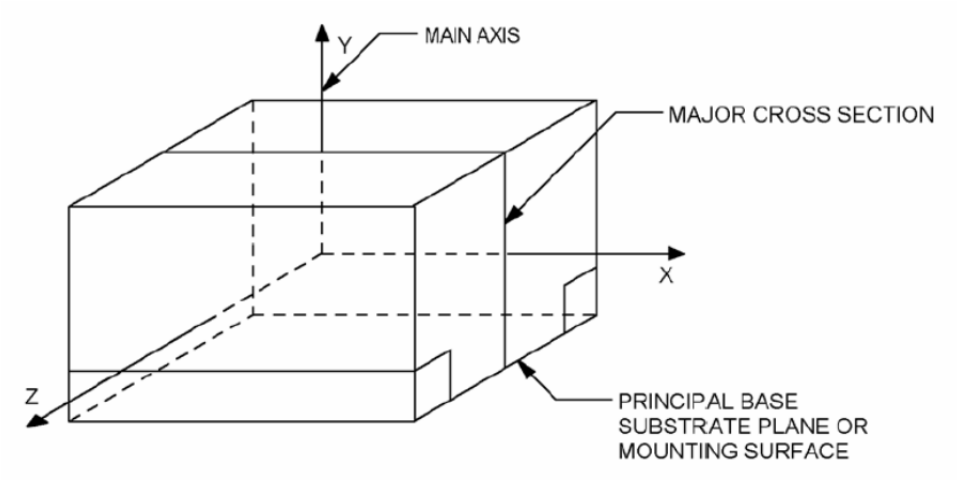


FIGURE 3. Orientation of SMD coils

6.10 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification. As of the dating of this document, the U.S. Environmentally Protection Agency (EPA) is focusing efforts on reducing 31 priority chemicals. The list of chemicals is available on their website at http://epa.gov/epaoswer/hazwaste/minimize/chemlist.htm. Further information is available at the following EPA site: http://epa.gov/epaoswer/hazwaste/minimize/. Included in the EPA list of 31 priority chemicals are cadmium, lead, and mercury. Use of the materials on the list should be minimized or eliminated unless needed to meet the requirements specified herein (see Section 3).

APPENDIX A

PROCEDURE FOR QUALIFICATION INSPECTION

A. SCOPE

A.1 Scope. This appendix details the procedure for submission of samples for qualification inspection of coils covered by this specification. The procedure for extending qualification of the required sample to other coils covered by this specification is also outlined herein. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

A.2 APPLICABLE DOCUMENTS. This section is not applicable to this appendix.

A.3 SUBMISSION

A.3.1 Sample size.

A.3.1.1 Single-type submission. A sample consisting of 152 sample units of each core material, class, and individual inductance value for which qualification is sought shall be submitted. Ten additional sample units shall be submitted for the fungus test if certification is not provided.

A.3.1.2 Combined-type submission. A sample consisting of 152 sample units for each class covered by a single specification sheet for which qualification is sought shall be submitted. All sample units except group III units shall be submitted to the tests of group IA and group IB. Twenty sample units, ten of the lowest inductance value and ten of the highest inductance value, shall be submitted to the tests of groups IV and V. Six sample units of any inductance value shall be submitted to the tests of group III and six of any inductance value to tests of group IIIA, as specified in table VII. Twenty sample units, ten of the lowest inductance value and ten of the highest inductance value shall be submitted to the tests of group VI. One hundred and two sample units, 51 of the lowest inductance value and 51 of the highest inductance value shall be submitted to the test of group II. Ten additional sample units of any inductance value shall be submitted for the fungus test if certification is not provided.

A.3.1.3 Alternate termination finish. When qualification has been granted in accordance with ~~30.1.1~~ A.3.1.1 or ~~30.1.2~~ A.3.1.2and qualification is sought for an alternate termination finish, the following procedures shall be used.

A.3.1.3.1 Single-type submission. A sample of six sample units of the alternate termination finish is required. Submit three sample units to the tests of groups I and II of table VII. Submit the remaining three samples to the tests of group III of table VII.

A.3.1.3.2 Combined-type submission. A sample of nine sample units of the alternate termination finish is required. Submit six sample units (three of the highest and three of the lowest inductance value) to the tests of groups I and II of table VII. Submit the remaining three sample units to the tests of group III of table VII.

A.3.2 Qualification to tighter inductance tolerances. Twenty sample units shall be tested (ten of the lowest inductance value and ten of the highest inductance value of the specified inductance tolerance) for each class covered by a single specification sheet. They shall be submitted to the tests of group IA and visual and mechanical inspection of group IB of table VII.

A.3.3 Description of items. The manufacturer shall submit a detailed description of the SMD coil being submitted for inspection, including materials used for the construction of the coil. After qualification has been granted, no change shall be made in materials, design, or construction without prior notification to the qualifying activity.

A.4 EXTENT OF QUALIFICATION

A.4.1 Single-type. Qualification shall be restricted to the single PIN submitted.

A.4.2 Combined-type submission. Qualification shall be restricted to all of the inductance values covered on a single specification sheet between the values passing qualification inspection.

A.4.3 Termination finishes. The extent of qualification between termination materials shall be as follows in table XIII.

TABLE XII. Extent of Qualification between termination materials

Termination	Will qualify termination
A	A
B	B, ~~C~~, F
C	OBSOLETE
D	D, E
E	D
F	B, ~~C~~

APPENDIX B

ALTERNATE INDUCTANCE & QUALITY FACTOR (Q) & SELF-RESONANT FREQUENCY (SRF) MEASUREMENT PROCEDURES

B. SCOPE

B.1 Scope. This appendix details the alternative measuring procedures for, inductance, quality factor (Q) and self-resonant frequency (SRF) procedures. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

B.2 INDUCTANCE MEASUREMENTS (see 3.7.1 and 4.8.4.1)

B.2.1 Alternate Inductance measurement procedure (inductance less than 10 microhenries). The test may be performed using a Q meter such as the Hewlett Packard (HP) ~~model 260A,~~ HP4342A, ~~HP250B RX-meter,~~ or equivalent at appropriate test frequencies as listed in the instructions for the test equipment. Suitable means shall be used to calibrate the frequency of the Q-meter within ±0.1 percent for the applicable test frequency. Frequencies to be used for testing the various ranges of inductance shall be as follows:

Inductance range, (µH)	Reference test frequency, (MHz)
Less than 0.1	See 3.1
0.1 to 1.0 inclusive	25.0
Above 1.0 to 10.0 inclusive	7.9

Effective inductance shall be determined as follows when using the applicable test fixture (see 4.8.2). The appropriate test fixture shall be inserted in the Q-meter coil terminals. The Q-meter capacitance dial shall be set at 400 picofarads and the vernier capacitance dial at zero. The applicable shorting bar shall be inserted in the clips of the test fixture in such a manner that the terminals rest firmly against the stops, and so that the bar is centered between the test-fixture terminals. The Q-meter shall then be resonated using the frequency dial until a peak reading is obtained. This frequency shall be monitored in order to obtain an accuracy of 0.1 percent. This resonant frequency value in megahertz shall be recorded. The main capacitance dial shall be calibrated periodically in accordance with a routine calibration program for test equipment. The sum of the residual inductance of the Q-meter and the inductance of the test circuit shall be calculated from:

$$L_{cf} = \frac{1}{4\pi^2 f^2 C} - L_b$$

Where:
L_{cf} = Inductance in microhenries of the test fixture and residual inductance of the Q-meter.
F = Frequency in megahertz.
C = Capacitance in microfarads.
L_b = Calculated inductance in microhenries of the shorting bar as determined from the following formula:

$$L_b = 0.002\, l \left(2.303 \log_{10}\left(\frac{4l}{d}\right) - 1 + \mu\sigma + \frac{d}{2l}\right)$$

Where:
σ = a quantity as a function of X and if σ is between 0.000 and 0.007, σ can be considered negligible.

$$X = 0.1405d\sqrt{\frac{\mu f}{\rho}}$$

Where:
l = Length of wire (cm).
d = Diameter of cross section (cm).
μ = Permeability of the material of the wire: μ = 1 for brass or copper.
p = Volume resistivity of wire in microhm-centimeters.
f = Frequency in hertz.

The shorting bar shall then be removed and the Q-meter frequency shall be set to the frequencies above. The L-C dial of the Q-meter shall then be turned until the resonance meter indicates a peak reading. The inductance (Ld) shall be read directly on the L-C dial, using the inductance scale and the specified effective inductance (see 3.1) of the coil calculated from the formula:

$$L = L_d - L_{cf}$$

Where:
L = Effective inductance in microhenries of coils.
L_d = Inductance dial reading in microhenries.
L_{cf} = Correction factor for inductance of test fixture and residual inductance of the Q-meter in microhenries.

B.2.2 Alternate Inductance measurement procedure (inductance greater than or equal to 10 microhenries). Test as specified in 10.1, except no allowance are made for residual inductance of Q-meter and inductance of test fixture. Frequencies to be used for testing various ranges of inductance shall be as follows:

Inductance range, (μH)	Reference test frequency, (MHz)
Above 10.0 to 100.0, inclusive---------- ----------	2.5
Above 100.0 to 1,000.0, inclusive ---------- -------	0.790
Above 1,000.0 to 10,000.0, inclusive ---------- --	0.250
Above 10,000.0 to 100,000.0, inclusive ----------	0.079

B.3 QUALITY FACTOR (Q) MEASUREMENTS (see 3.7.2 and 4.8.4.2)

B.3.1 Alternate Q measurement procedure. The test shall be performed using a Q meter (see 3.7.2) such as Hewlett Packard model ~~260A~~, HP4342A, or equivalent. Suitable means shall be used to calibrate the frequency dial of the Q meter and the Q-standard within 0.1 percent of the applicable test frequency. Frequencies to be used for testing the various ranges of inductance shall be as specified in B.2.1 and B.2.2. The appropriate test fixture, as applicable, (see 4.8.2) shall be assembled to the coil terminals of the Q meter, with the side showing the test fixture letter facing the capacitance terminals. The unit under test shall then be inserted into the test clip in such a manner that the terminations are straight and rest firmly on the pads, and so that the unit is centered between the terminals. The Q shall then be read on the Q voltmeter.

B.4 SRF MEASUREMENTS (see 3.7.3 and 4.8.4.3)

B.4.1 Alternate SRF measurement procedure (#1). Unshielded coils shall be placed in the field of a variable-frequency oscillator, such as McGraw-Edison Model 159 LF megacycle meter, or equivalent. The oscillator shall include a device for indicating the relative amount of power absorbed from the field (e.g., a grid-dip meter). Units shall be suspended or supported a minimum of 1.0 inch (2.54 mm) from any surface other than the test-fixture supports or oscillator coil. The frequency of the oscillator shall be varied through the frequency range near the self-resonant frequency specified (see 3.1). At any frequency in the

frequency range where an abrupt increase in power absorption is indicated, the coupling between the oscillator coil and the unit under test shall be decreased, by increasing the separation between the coils, until a moderate dip in grid current results when tuning to this resonance. This frequency shall be considered the self-resonant frequency of the unit, and shall be accurately determined by suitable means to within ±5 percent. A check shall be made for spurious indications due to a resonance not associated with the unit under test, by removing the unit from the field (at frequencies below 2.5 MHz, any suitable method may be used).

~~B.3.2 Alternate SRF measurement procedure (#2). When coils under test cannot be resonated by the method specified in B.3.1, the test shall be performed using the instruments specified in section B.1 of this Appendix or equivalent. The coil shall be mounted in the appropriate test fixture (see 3.1 and 4.8.2). The tuning capacitor of the Q-meter shall then be set to approximately 400 pF, and the Q-circuit shall be resonated by adjusting the oscillator frequency of the Q-meter. The unit under test shall then be replaced with a shielded comparison inductor having an inductance about 4 percent of the unit under test, or a coil that will resonate in the Q-circuit at a frequency about 10 times the initial resonant frequency. The Q-meter shall then be set to a frequency approximately 10 times the initial resonant frequency, and the Q-circuit shall then be resonated at this new frequency. (This factor of 10 is based on the distributed capacitance of the unit under test being in the region of 4 pF, which is common for small coils. Higher distributed capacitances will lower the resonant frequency of the unit under test, and a factor smaller than 10 will prevail.) The unit under test shall then be connected across the capacitance terminals of the Q-meter, taking care to avoid coupling between the unit under test and the comparison coils. The Q-circuit shall then be re-resonated by means of the Q-tuning capacitor or the vernier tuning capacitor, observing whether the capacitance has to be increased or decreased from its previous value, in order to restore resonance. If the capacitance has to be increased, the oscillator frequency shall be increased by 10 to 20 percent. If the capacitance has to be decreased, the oscillator frequency shall be decreased by the same amount. The unit under test shall then be disconnected from the Q-meter, and the Q-circuit shall be resonated to the new frequency by means of the Q-tuning capacitor. The previous procedure shall then be repeated, while at the same time changing the oscillator frequency by smaller increments as it approaches the resonant frequency of the unit under test, until the frequency reaches a value at which the Q-circuit capacitance is unchanged when the unit under test is connected or disconnected. The self-resonant frequency of the unit under test will then be the frequency of the oscillator and shall be accurately determined to within ±0.2 percent.~~

Custodians:
Army - CR
Navy - EC
Air Force - 85
DLA - CC

Preparing activity:
DLA - CC

Review activities:
Army - AR, CR4, MI
Navy - AS, CG, MC, OS,
Air Force - 19, 99
NASA – N/A
Other - MDA

(Project 5950-2014-041)