MILITARY SPECIFICATION

FILTERS AND CAPACITORS, RADIO FREQUENCY/ ELECTROMAGNETIC INTERFERENCE SUPPRESSION, GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification covers the general requirements for low-pass filter and capacitors used to suppress radio frequency/electromagnetic interference. Filters furnished to the requirements of this specification shall contain shunting ceramic capacitors and series inductors (FSC 5915). Capacitors furnished to the requirements of this specification shall contain shunting ceramic capacitors (FSC 5910). For the purposes of this specification feed-thru capacitor types (C circuit configuration) shall be referred to herein as a filter. Passband power may be alternating current (ac) and/or direct current (dc) and the filter shall be used primarily in the reduction of broadband radio frequency interference. This specification provides for two levels of product assurance requirements. Filters covered by this specification shall be capable of operation over the temperature range of -55° to +125°C.

1.2 Classification.

1.2.1 Military part number. Filters specified herein (see 3.1) shall be identified by a military part number which shall consist of the basic number of the specification sheet and a coded number. The part number shall be coded to provide information concerning case finish and product assurance level. The military part number shall be in the following format:

M28861/01-	001	T	S
Specification number indicating MIL-F-28861/01	Dash number (1.2.1.1)	Case finish (1.2.1.2)	Product assurance level (1.2.1.3)

1.2.1.1 Dash number. The dash number shall be as specified (see 3.1).

1.2.1.2 Case finish. The case finish is identified by a single letter in accordance with table I.

1.2.1.3 Product assurance level. This specification provides for two levels of quality and reliability assurance, class B and class S (see 3.4). The product assurance level is identified by a single letter in accordance with table II.

1.2.2 Style. The style (see 3.1) is identified by the two letter symbol "FS" followed by a two digit number. The letters identify radio frequency/electromagnetic interference suppression filters and the two digits represent a voltage rating, envelope size and configuration.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Naval Electronic Systems Command, ATTN: ELEX 8111, Washington, DC 20360 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

TABLE I. Case finish.

Symbol	Finish
T	Tin-plated/tin-lead plated
S	Silver-plated
G	Gold-plated (class S only)

TABLE II. Product assurance level.

Symbol	Level
S	Class S
B	Class B

2. APPLICABLE DOCUMENTS

2.1 Government specifications and standards. Unless otherwise specified, the following specifications and standards, of the issue listed in that issue of the Department of Defense Index of Specifications and Standards specified in the solicitation, form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

FF-S-85 - Screw, Cap, Slotted and Hexagon Head.
FF-S-92 - Screw, Machine: Slotted, Cross-Recessed or Hexagon Head.
J-W-1177 - Wire, Magnet, Electrical.
QQ-C-533 - Copper-beryllium Alloy Strip (Copper Alloy Numbers 170 and 172).
QQ-N-290 - Nickel Plating (Electrodeposited).
QQ-S-365 - Silver Plating, Electrodeposited; General Requirements For.
QQ-S-571 - Solder, Tin Alloy; Tin-lead Alloy; and Lead Alloy.
QQ-S-781 - Strapping, Steel, and Seals.
PPP-B-566 - Box, Folding, Paperboard.
PPP-B-585 - Boxes, Wood, Wirebound.
PPP-B-601 - Boxes, Wood, Cleated-Plywood.
PPP-B-621 - Boxes, Wood, Nailed and Lock-Corner.
PPP-B-636 - Boxes, Shipping, Fiberboard.
PPP-B-676 - Boxes, Setup.

MILITARY

MIL-P-116 - Preservation, Methods Of.
MIL-C-123 - Capacitors, Fixed, Ceramic Dielectric (Temperature Stable and General Purpose), High Reliability, General Specification For.
MIL-T-10727 - Tin Plating, Electrodeposited or Hot-dipped, For Ferrous and Nonferrous Metals.
MIL-C-14550 - Copper Plating, (Electrodeposited).
MIL-G-45204 - Gold Plating, Electrodeposited.
MIL-P-81728 - Plating, Tin-Lead (Electrodeposited).

STANDARDS

FEDERAL

FED-STD-H28 - Screw-Thread Standards for Federal Services.

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129 - Marking for Shipment and Storage.
MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
MIL-STD-220 - Method of Insertion-Loss Measurement.
MIL-STD-790 - Reliability Assurance Program For Electronic Parts Specifications.

MIL-STD-794 - Parts and Equipment, Procedures For Packaging and Packing of.
MIL-STD-1285 - Marking of Electrical and Electronic Parts.
MIL-STD-45662- Calibration Systems Requirements.

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

2.2 Other publications. The following document(s) form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D92-78 - Flash and Fire Points by Cleveland Open Cup.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103).

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

RS-469 - Standard Test Method for Destructive Physical Analysis of High Reliability Ceramic Monolithic Capacitors.

(Application for copies should be addressed to the Electronics Industries Association, 2001 Eye Street, N.W., Washington, DC 20006).

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies).

2.3 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 shall take precedence.

3. REQUIREMENTS

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

3.2 Qualification. Filters furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.4 and 6.2). In addition, for class S filters, the manufacturer shall obtain certification from the qualifying activity that the reliability assurance requirements of 4.1.1 have been met and are being maintained.

3.3 Baseline documentation (class S filters only). Prior to granting of qualification approval, baseline documentation (see appendix B) shall be approved by the qualifying activity. No changes in material, design, construction, or testing of the products qualified, except as specifically allowed by the baseline, shall be made without changing documentation and receiving approval of the qualifying activity.

3.4 Product assurance requirements. Two levels of filter quality and reliability assurance are provided for in this specification. Classes S and B filters shall be those which have been subjected to and passed all applicable requirements, test and inspections detailed herein, including qualification and quality conformance inspection requirements for the specified class. Class S is the highest product assurance level of this specification and is intended for space applications.

3.4.1 Reliability (class S filters only). A reliability assurance program for class S filters furnished under this specification shall be established and maintained in accordance with the procedures and requirements specified in MIL-STD-790 with details specified in 4.1.1.

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

3.5.1 Impregnating and potting compounds. Compounds used in the impregnating and potting of filters shall be chemically inactive with respect to the filter unit and case (see 3.6.2). The compound either in the state of original application or as a result of having aged, shall have no adverse effect on the performance of the filter.

3.6 Design and construction. Filters shall be of the design, construction, and physical dimensions specified (see 3.1). Class S filters shall be of the design, construction, and physical dimensions approved by the qualifying activity to the approved baseline documentation.

3.6.1 Design. The design shall be such that none of the components of the filter are overstressed during operation as electrically and mechanically specified herein. No degradation, unless allowed for herein, shall occur during any 100-percent screens specified herein. The electrical design shall meet the specified electrical characteristics at all operating temperatures, voltages, currents, or any combinations thereof as specified herein. The insertion loss requirements between any two adjacent specified frequencies shall be that of the lower of the two frequencies unless otherwise specified.

3.6.2 Case. Hermetically sealed filters shall be enclosed in metallic cases with glass seals, or equivalent and shall be capable of passing the seal test. No adjunct sealers or additives of any type shall be added to glass seals for class S filters. Nonhermetically sealed filters shall be enclosed in metallic cases with potted seals. The case shall protect the filter components from damage under all test conditions specified and prevent leakage of impregnant or filling compound. All metallic surfaces shall be free from insulating protective finishes except as specified.

3.6.3 Finish. All exposed metallic surfaces shall be suitably protected against corrosion by plating, lead-alloy coating, or other means. The finish shall:

a. Provide good electrical contact when used as a terminal or conductor.

b. Have uniform texture and appearance.

c. Be adherent.

d. Be free from blisters, pinholes, and other defects that may affect the protective value of coating.

e. The undercoat shall be in accordance with class 4 of MIL-C-14550.

3.6.3.1 Tin-plated. When specified (see 1.2.1.2 and 3.1) tin plating shall be in accordance with MIL-T-10727.

3.6.3.2 Silver-plated. When specified (see 1.2.1.2 and 3.1) silver plating shall be in accordance with QQ-S-365.

3.6.3.3 Gold-plated (class S filters only). When specified (see 1.2.1.2 and 3.1) gold plating shall be in accordance with MIL-G-45204, type II, grade C. The undercoat shall be in accordance with QQ-N-290.

3.6.3.4 Tin-lead plated. When specified (see 1.2.1.2 and 3.1) tin-lead plating shall be in accordance with MIL-P-81728.

3.6.4 Threaded parts. Unless otherwise specified (see 3.1), all threaded parts shall be in accordance with FED-STD-H28. Where practical, all threads shall be in conformity with course-thread series. Where a special diameter pitch combination is required, the thread shall be of American National Form and of any pitch between 16 and 56 (inclusive) which is used in the fine thread series. Screws shall conform to FF-S-85 or FF-S-92, as applicable.

3.6.4.1 Engagement of threaded parts. The length of all threaded parts and thread reliefs shall be as specified (see 3.1).

3.6.5 Inductive elements. Unless otherwise specified, the wire used when winding inductors shall be type K or type M as specified in J-W-1177 and shall have a minimum wire diameter of 0.004 inches (0.10 mm). Inductors shall be inspected to ensure that the wire is not kinked or nicked and that the insulation is continuous. Cores and ferrite beads shall be 100-percent inspected for chipped coating, cracks, chips, and material cracks and chips for class S filters only.

3.6.6 Capacitor elements (class S filters only). Capacitor elements used in the construction of class S filters shall be manufactured and tested to MIL-C-123. When examined in accordance with 4.6.27, capacitors shall meet the requirements of RS-469. When a capacitor is required for a filter design and it is not available as a MIL-C-123 QPL product, an alternate class S equivalent ceramic capacitor may be used provided the following conditions are met:

a. Capacitors shall meet the applicable requirements of MIL-C-123 except for qualification.

b. Capacitors shall be manufactured with lot control, in-process controls, and the groups A and B screening inspections of MIL-C-123.

c. The conditions listed above shall be specified to an approved baseline documentation.

3.6.6.1 Tubular capacitors. Tubular capacitors shall be inspected for the requirements of appendix E.

3.6.7 Construction (class S filters only).

3.6.7.1 Soldering. When soldering ceramic capacitors and glass seals, heat shall be applied in such a way that it causes an even radial distribution over the surface. Methods such as preheat, slow heating, uniform heating, and limiting the maximum temperature shall be employed to minimize the occurrence of thermally induced cracks, crazing, chipping, or other physical damage. The same precautions used in heating shall be applied in cooling down the device. The solder joint where the internal wire exits through a glass seal and all other solder joints on "solder-in" style filters shall be made with solder per QQ-S-571 having a liquid point not less than 260°C or as specified (see 3.3). Solder and soldering shall be controlled to the approved baseline documentation.

3.6.7.2 Potting (when applicable). Inductive elements shall be potted to at least 90 percent of their height so that the potting makes intimate contact with the case.

3.6.7.3 Control. All construction techniques and methods shall be to the approved baseline documentation (see 3.3) and shall not be changed without the approval of the qualifying activity.

3.6.8 Weight (when applicable). Filters shall be of the weight specified (see 3.1).

3.7 Visual inspection (class S filters only). Filters shall be examined for anomalies as specified in 4.6.1.2.

3.8 Thermal shock and voltage conditioning. When filters are tested as specified in 4.6.2, they shall meet the following requirements:

Insulation resistance (+125°C) - - - Shall meet initial requirements (see 3.1).

3.9 Dielectric withstanding voltage. When filters are tested as specified in 4.6.3, there shall be no breakdown, flashover, or impairment of any characteristics sufficient to cause failure of the filter.

3.10 Capacitance to ground. When filters are tested as specified in 4.6.4, the capacitance to ground shall be as specified (see 3.1).

3.11 Insertion loss. When filters are tested as specified in 4.6.5, the insertion loss shall be as specified (see 3.1).

3.12 Voltage drop. When filters are tested as specified in 4.6.6, the voltage drop shall be as specified (see 3.1).

3.13 DC resistance. When filters are tested as specified in 4.6.7, the dc resistance shall be as specified (see 3.1).

3.14 Radiographic inspection (class S filters only). When filters are tested as specified in 4.6.8, radiographic examination shall not disclose evidence of any defects listed in 4.6.8.

3.15 Seal (when applicable). When filters are tested as specified in 4.6.9, for the fine leak test, the leakage rate shall not exceed the maximum leakage rate as specified (see 3.1). When filters are tested as specified in 4.6.9, for the gross leak test, there shall be no continuous stream of bubbles emanating from the filter, nor shall there be any evidence of leakage of compound from the body of the filter.

3.16 Voltage and temperature limits of capacitance. When filters are tested as specified in 4.6.10, the change in capacitance shall not exceed the value specified (see 3.1).

3.17 Temperature rise. When filters are tested as specified in 4.6.11, the temperature rise shall be as specified (see 3.1).

3.18 Barometric pressure (reduced). When filters are tested as specified in 4.6.12, there shall be no breakdown, flashover, or impairments of any characteristics sufficient to cause failure of the filter.

3.19 Insulation resistance. When filters are tested as specified in 4.6.13, the insulation resistance shall not be less than specified (see 3.1).

3.20 Current overload. When filters are tested as specified in 4.6.14, there shall be no evidence of physical damage. After the test, filters shall meet the following requirements:

Insulation resistance (+25°C) - - - Shall meet initial requirements (see 3.1).
Voltage drop - - - - - - - - - - - Shall meet initial requirements (see 3.1).

3.21 Resistance to solvents. When filters are tested as specified in 4.6.15, there shall be no evidence of physical damage and the marking shall remain legible.

3.22 Vibration (high frequency). When filters are tested as specified in 4.6.16, there shall be no intermittent, open or short-circuiting, and no physical damage to the filter. After the test, filters shall meet the following requirement:

Insertion loss (+25°C)- - - Shall meet initial requirements (see 3.1).

3.23 Thermal shock and immersion. When filters are tested as specified in 4.6.17, filters shall meet the following requirements after the test:

Visual inspection - - - There shall be no evidence of breakdown, flashover, or other physical damage. In addition, there shall be no more than 10 percent corrosion of the terminal hardware or mounting surface and marking shall remain legible.
Insulation resistance (+25°C) - - - - - - - - Shall meet initial requirements (see 3.1).
Insertion loss - - - - - Shall meet initial requirements (see 3.1).

3.24 Resistance to soldering heat. When filters are tested as specified in 4.6.18, there shall be no evidence of internal or external damage. After the test, filters shall meet the following requirements:

Insertion loss (+25°C) - - - - - - Shall meet initial requirements (see 3.1).

Insulation resistance (25°C) - - - Shall meet initial requirements (see 3.1).

3.25 Salt spray (corrosion). When filters are tested as specified in 4.6.19, there shall be no harmful or extensive corrosion and at least 90 percent of any exposed metallic surfaces of the filter shall be protected by the finish. In addition, the marking shall remain legible.

3.26 Destructive physical analysis (DPA) (class S filters only). When filters are examined as specified in 4.6.20, the filters shall meet the requirements of appendix D.

3.27 Shock (specified pulse). When filters are tested as specified in 4.6.21, there shall be no evidence of intermittent, open or short-circuiting, and no physical damage to the filter. After the test, filters shall meet the following requirement:

Insertion loss (+25°C)- - - Shall meet initial requirements (see 3.1).

3.28 Terminal strength. When filters are tested as specified in 4.6.22, no part of the terminals shall loosen or rupture and no other damage shall result.

3.29 Moisture resistance. When filters are tested as specified in 4.6.23, filters shall meet the following requirements:

Visual inspection - - - There shall be no evidence of breakdown, flashover, or other physical damage. In addition, there shall be no more than 10 percent corrosion of the terminal hardware or mounting surface, and marking shall remain legible after the test.
Insulation resistance (+25°C) - - - - - - - - Shall meet initial requirements (see 3.1).
Capacitance - - - - - - - Shall meet initial requirements (see 3.1).
Insertion loss - - - - - - Shall meet initial requirements (see 3.1).

3.30 Solderability (when applicable).

3.30.1 Solderability of terminals. When filters are tested as specified in 4.6.24.1, the dipped surface of the terminals shall be at least 95 percent covered with continuous solder coating. The remaining 5 percent of the terminal surface may show only small pinholes or voids and these shall not be concentrated in one area. Bare base metal and areas where the solder dip fails to cover the original coating are indications of poor solderability, and shall be cause for rejection.

3.30.2 Solderability of mounting termination (when applicable). When filters are tested as specified in 4.6.24.2, the joint shall be at least 95 percent covered with continuous solder coating. There shall be no evidence of leaching (loss of metallization). After the test, filters shall meet the following requirements:

Insulation resistance (+25°C) - - - Shall meet initial requirements (see 3.1).
Capacitance - - - - - - - - - - - - - Shall meet initial requirements (see 3.1).

3.31 Life. When filters are tested as specified in 4.6.25, filters shall meet the following requirements:

Visual inspection - - - There shall be no evidence of breakdown, flashover, or other physical damage, and marking shall remain legible.
Insulation resistance (+125°C and +25°C)- - - Shall meet initial requirements (see 3.1).
Insertion loss - - - - - - Shall meet initial requirements (see 3.1).

3.32 Flashpoint of impregnant or potting compound. The manufacturer shall certify that the flashpoint of the impregnant or potting compound are not lower than 165°C, or perform the test specified in 4.6.26.

3.33 Marking.

3.33.1 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 military specifications. Accordingly, items acquired to, and meeting all of the criteria specified herein and in applicable detail specifications shall bear the certification mark "JAN" except that items too small to bear the certification mark "JAN" shall bear the letter "J". 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 detail 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 detail specifications, the manufacturer shall remove 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 No. 504,860 for the certification mark "JAN".

3.33.2 Full marking. Each filter shall be marked in accordance with method I of MIL-STD-1285 with the following information:

a. JAN marking.

b. Military part number.

c. Manufacturer's source code.

d. Date code and lot symbol.

e. Voltage rating.

f. Current rating.

g. Terminal identification or circuit diagram (Non-symmetrical filters only).

h. Maximum operating power frequency (for ac rated filters only).

3.33.3 Minimum marking. When the physical size of the filter precludes the marking of the information in 3.34.2, the minimum marking required shall be as specified in the specification sheet. In those cases where full marking requirements are not on the filter, the full marking shall be marked on the unit package.

3.34 Workmanship. Filters shall be processed in such a manner as to be uniform in quality and shall be free from cold soldering, corrosion, pits, dents, cracks, rough sharp edges, misalinements, and other defects that will affect life, serviceability, or appearance.

4. QUALITY ASSURANCE PROVISIONS

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

4.1.1 Reliability assurance program (class S filters only). A reliability assurance program shall be established and maintained in accordance with MIL-STD-790. The following shall apply:

a. The manufacturer shall be able to identify the time period during which the final production operation was performed on each item of product prior to final test. The date or lot code marked on each part shall be identified to an inspection lot.

b. The requirement for traceability of materials as defined in 4.5.3.2b shall apply and documented in the baseline.

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

4.2 Classification of inspection. The inspection specified herein shall be classified as follows:

a. Qualification inspection (see 4.4).

b. In-process inspection and quality conformance inspection (see 4.5).

4.3 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in the "GENERAL REQUIREMENTS" of MIL-STD-202 except the temperature shall be 18° to 30°C, and the relative humidity shall not exceed 75 percent. In cases of dispute, the referee temperature shall be 25° ±3°C. Unless otherwise specified, the accuracy of all test voltages, currents, or resistances shall be within ±2 percent of that specified.

4.3.1 Reference measurements. When requirements are based on comparative measurements made before and after conditioning, the reference measurement shall be considered the last measurement made at 25° ±3°C prior to conditioning. Unless reference measurements have been made within 30 days prior to the beginning of conditioning, they shall be repeated.

4.4 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.2) on sample units produced with equipment and procedures normally used in production.

4.4.1 Sample. The number of sample units comprising a sample of filters to be submitted for qualification inspection shall be as specified in table III and appendix A and C for class B and S filters, respectively.

4.4.2 Test routine. Qualification samples shall be subjected to the tests of table III. All sample units shall be subjected to the tests of group I. The sample filters shall then be divided into four groups and subjected to the tests of groups II, III, IV, and V, in the order shown for the specific class of filter being qualified (class S or B).

4.4.3 Failures. Failures in excess of those allowed in table III shall be cause for refusal to grant qualification.

4.4.4 Retention of qualification.

4.4.4.1 Class B filters. To retain qualification, the contractor shall forward a report at 12-month intervals to the qualifying activity. The qualifying activity shall establish the initial reporting date. The report shall consist of:

a. A summary of the results of the tests performed for inspection of product for delivery (group A), indicating as a minimum the number of lots that have passed and the number that have failed. The results of tests of all reworked lots shall be identified and accounted for.

b. A summary of the results of tests performed for periodic inspection (group B), including the number and mode of failures. The summary shall include results of all periodic inspection tests performed and completed during the 12-month period. If the summary of the test results indicates nonconformance with specification requirements, and corrective action acceptable to the qualifying activity has not been taken, action may be taken to remove the failing product from the qualified products list.

If the summary of test results indicates nonconformance with specification requirements, and corrective action acceptable to the qualifying activity has not been taken, action may be taken to remove the failing product from the qualified products list.

Failure to submit the report within 30 days after the end of each 12-month period may result in loss of qualification for the product. In addition to the periodic submission of inspection data, the contractor shall immediately notify the qualifying activity at any time during the 12-month period that the inspection data indicates failure of the qualified product to meet the requirements of this specification.

In the event that no production occurred during the reporting period, a report shall be submitted certifying that the company still has the capabilities and facilities necessary to produce the item. If during two consecutive reporting periods there has been no production, the manufacturer may be required, at the discretion of the qualifying activity, to submit his qualified products to testing in accordance with the qualification inspection requirements.

4.4.4.2 Class S filters. To retain qualification for class S filters, the manufacturer shall forward a report at 12-month intervals to the qualifying activity. The qualifying activity shall establish the initial reporting date. The report shall include the following:

a. A list of all device types for which the manufacturer has qualification, showing the total number of lots completing quality conformance inspection during the reporting period.

b. Certification that the manufacturer still has the capabilities and facilities necessary to produce these items to the qualified tests.

c. The number of lots which failed lot-by-lot testing.

d. For failed lots the following information is required:

(1) Identification of the lots by inspection lot identification, date and lot code, part number, and date of completion of group B testing.

(2) The percent defective of the thermal shock and voltage conditioning screen.

(3) The results of groups A and B testing (i.e., pass or fail).

(4) For failed groups, the number and mode of all failures.

(5) All lots withdrawn shall be counted as failed lots in the report.

If the summary of test results indicates nonconformance with specification requirements, and corrective action acceptable to the qualifying activity has not been taken, action may be taken to remove the failing product from the qualified products list.

Failure to submit the report within 30 days after the end of each 12-month period may result in loss of qualification for the product. In addition to the periodic submission of inspection data, the contractor shall immediately notify the qualifying activity at any time during the 12-month period that the inspection data indicates failure of the qualified product to meet the requirements of this specification.

In the event that no production occurred during the reporting period, a report shall be submitted certifying that the company still has the capabilities and facilities necessary to produce the item. If during two consecutive reporting periods there has been no production, the manufacturer may be required, at the discretion of the qualifying activity, to submit his qualified products to testing in accordance with the qualification inspection requirements.

4.4.4.2.1 Records. Test records shall be in accordance with the format in MIL-STD-790. The report shall also include certification that the design and construction of the product was verified and found to be identical to the class S filter for which qualification aproval was valid. The manufacturer shall maintain the DPA samples, x-ray films, and group B samples for a minimum of 5 years.

TABLE III. Qualification inspection.

Inspection	Class B	Class S	Requirement paragraph	Test method paragraph	Number of sample units, Class B	Number of sample units, Class S	Number of failures, Class B	Number of failures, Class S
Group I								
Thermal shock and voltage conditioning	X	X	3.8	4.6.2	All sample units	All sample units	Not applicable	Not applicable
Dielectric withstnading voltage	X	X	3.9	4.6.3				
Insulation resistance (at +25°C)	X	X	3.19	4.6.13				
Capacitance to ground	X	X	3.10	4.6.4				
Insertion loss	X	X	3.11	4.6.5				
DC resistance 1/	X	X	3.13	4.6.7				
DC voltage drop 1/	X	X	3.12	4.6.6.2				
Radiographic inspection	-	X	3.14	4.6.8				
Seal (when applicable)	X	X	3.15	4.6.9				
Visual and mechanical inspection	X	X	3.5, 3.6, 3.33 and 3.34	4.6.6.1				
Group II								
Voltage and temperature limits of capacitance (when applicable)	X	X	3.16	4.6.10	10	10	1	0
Insertion loss (at temperature)	X	X	3.11	4.6.5.1				
AC voltage drop (when applicable)	X	X	3.12	4.6.6.1				
Temperature rise	X	X	3.17	4.6.11				
Barometric pressure (reduced)	X	X	3.18	4.6.12				
Insulation resistance	X	X	3.19	4.6.13				
Current overload	X	X	3.20	4.6.14				
Resistance to solvents	X	X	3.21	4.6.15				
Group III								
Vibration (high frequency)	X	X	3.22	4.6.16	10	10	1	0
Thermal shock and immersion	X	X	3.23	4.6.17				
Seal (when applicable)	X	X	3.15	4.6.9				
Resistance to soldering heat	X	X	3.24	4.6.18				
Salt spray (corrosion)	X	X	3.25	4.6.19				
Radiographic inspection	-	X	3.14	4.6.8				
Destructive physical analysis (2 sample units only)	-	X	3.26	4.6.20				
Group IV								
Shock (specified pulse)	X	X	3.27	4.6.21	10	10	1	0
Therminal strength	X	X	3.28	4.6.22				
Moisture resistance	X	X	3.29	4.6.23				
Seal (when applicable)	X	X	3.15	4.6.9				
Radiographic inspection	-	X	3.14	4.6.8				
Destructive physical analysis (2 sample units only)	-	X	3.26	4.6.20				
Group V								
Solderability (5 samples only)	X	X	3.30	4.6.24	10	22	1	0
Life	X	X	3.31	4.6.25				

1/ The contractor has the option of performing either the dc voltage drop test or dc resistance test.

4.5 In-process inspection and quality conformance inspection.

4.5.1 In-process inspection (class S filters only). Each production lot shall be inspected in accordance with table IV. Other screening examinations may be applied at the option of the manufacturer, as documented and approved by the baseline documentation.

TABLE IV. In-process inspection (class S filters only).

Inspection	Requirement paragraph	Test method paragraph
Ceramic capacitor Visual inspection	3.6.6 3.7	4.6.27 4.6.1.2

4.5.1.1 Rework of class S filters. Rework of class S filters is not allowed unless the rework procedure has been documented and approved on the baseline documentation. Once a capacitor has been soldered in place, it shall not be reworked.

4.5.2 Inspection of product for delivery.

4.5.2.1 Class B filters. Inspection of product for delivery shall consist of group A inspection.

4.5.2.2 Class S filters. Inspection of product for delivery shall consist of groups A and B inspections.

4.5.3 Inspection lot.

4.5.3.1 Class B filters. An inspection lot shall consist of all filters of a single part number, produced under essentially the same conditions, and offered for inspection at one time.

4.5.3.2 Class S filters. An inspection lot for class S filters shall be of one design, as specified in the baseline documentation. As a minimum requirement, the lot shall consist of all the filters of a single part number representing one design and processed as a single lot through all manufacturing steps on the same equipment, to the same baseline/revision, and identified with the same date and lot code designation. In addition, the lot shall conform to the following:

a. Capacitors used in each filter of an inspection lot shall be traceable to one part number and one lot date code (LDC).

b. Each element, such as toroids, ferrite beads, finished cases, end seals, and wire lugs used in the design of the filter shall be from a single manufacturer and traceable to a single lot date code.

c. Solder for each application shall be of a uniform composition from a single supplier.

d. All single process operations shall be done during one continuous run without changes in temperature, pressure, or other processing controls.

e. A lot identifying number shall be assigned at the time the lot is assembled. This identifying number (LDC) shall be maintained through acceptance.

f. The manufacturer shall maintain records on each lot date code. The manufacturer shall record when in-process controls and groups A and B inspections start and when they have been completed.

g. Maximum lot size for broadband type filters shall be 500 pieces.

h. Maximum lot size for high-frequency filters (3 dB cut-off frequency (fc) > 500 kHz) shall be 2,000 pieces.

4.5.4 Group A inspection.

4.5.4.1 Class B filters. Filters shall be subjected to the tests in table V in the order shown, for class B devices. Subgroup 1 tests shall be performed on 100-percent of the product supplied under this specification to the extent specified. Filters failing the tests of subgroup 1 shall be removed from the lot. Lots having more than 10-percent total rejects shall not be furnished on the contract or purchase order. Failures from the seal test shall be removed from the lot and shall not be counted as rejects. Statistical sampling and inspection for subgroup 2 shall be in accordance with MIL-STD-105 for general inspection level II. The acceptable quality level (AQL) shall be as specified in table V.

4.5.4.1.1 Rejected lots (subgroup 2). If an inspection lot is rejected, the contractor may rework the lot to correct the defects, or screen out the defective units, and resubmit the reworked lot for inspection. Resubmitted lots shall be inspected, using tightened inspection of MIL-STD-105.

4.5.4.2 Class S filters. Filters shall be subjected to the tests specified in table V, in the order shown, for class S devices. Subgroup 1 tests shall be performed on 100 percent of the product supplied under this specification. For the thermal shock, voltage conditioning, insulation resistance and dielectric withstanding tests the percent defective allowed (PDA) for each test shall be 2 percent maximum (Note: During the last 50 hours of the voltage conditioning test the percent defective allowed shall be 0.2 percent maximum, see 4.6.2.2.2e). For the capacitance, voltage drop, and insertion loss tests the PDA shall be 3 percent maximum. Lots having more than 10 percent total rejects shall not be furnished on contracts. Failures from the radiographic inspection and seal test shall be removed from the lot and shall not be counted as rejects. Statistical sampling and inspection for subgroup 2 shall be in accordance with MIL-STD-105 for general inspection level II, except that no failures shall be allowed. The acceptance quality level (AQL) shall be as specified in table V.

4.5.4.2.1 Rejected lots (subgroup 2). Any sample failure in subgroup 2 tests shall require a 100 percent reinspection of the lot for those tests that the parts failed.

TABLE V. Group A inspection.

Inspection	Classs		Requirement paragraph	Test method paragraph	AQL (percent) defective)	
	B	S			Major	Minor
Subgroup 1						
Thermal shock and voltage conditioning	X	X	3.8	4.6.2	100 % inspection	
Dielectric withstanding voltage	X	X	3.9	4.6.3		
Insulation resistance (at +25°C)	X	X	3.19	4.6.13		
Capacitance to ground	X	X	3.10	4.6.4		
Insertion loss	X	X	3.11	4.6.5		
DC resistance 1/	X	X	3.13	4.6.7		
DC voltage drop 1/	X	X	3.12	4.6.6.2		
Radiographic inspection	-	X	3.14	4.6.8		
Seal (when applicable)	X	X	3.15	4.6.9		
Subgroup 2						
Visual and mechanical inspection	X	X	3.5, 3.6, 3.33, and 3.34	4.6.1.1	1.0	4.0

1/ The contractor has the option of performing either the dc voltage drop test or dc resistance test.

4.5.6 Group B inspection. Group B inspection shall consist of the inspections specified in table VI in the order shown. For class B filters, the group B inspection shall be made on sample units selected at random from inspection lots which have passed group A inspection. For class S filters, the group B inspection shall be performed on sample units selected at random from the inspection lot that has passed group A inspection.

4.5.6.1 Sampling plan.

4.5.6.1.2 Class B filters.

4.5.6.1.2.1 Monthly. Every month, 10 sample units of the highest current rating for each style shall be subjected to the tests of group I.

4.5.6.1.2.2 Quarterly. Every quarter, 15 sample units shall be subjected to the tests of group II. The ten samples submitted for the subgroup 1 tests shall be of the highest current rating for each style. Five sample units of any current rating for each style shall be subjected to the tests of subgroup 2.

4.5.6.1.2.3 Semiannually. Every 6 months, 10 sample units of any current rating for each style shall be subjected to the tests of group III.

4.5.6.1.3 Class S filters. Samples shall be submitted for group B inspection in accordance with table VI. The samples shall be divided into groups as specified in table VI and subjected to the specified tests.

4.5.6.2 Failures. If the number of failures exceed the number allowed in table VI, the sample shall be considered to have failed.

4.5.6.3 Disposition of sample units. Sample units which have been subjected to group B inspection shall not be delivered on the contract or purchase order. The samples shall be maintained with relative data and traceability for not less than 5 years.

4.5.6.4 Noncompliance.

4.5.6.4.1 Class B filters. If a sample 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 were manufactured under essentially the same conditions, with essentially the same materials, processes, etc., 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 activity has been taken. After the corrective action has been taken, group B inspection shall be repeated on additional sample units (all inspections, or the inspection which the original sample failed, at the option of the qualifying activity). Group A inspection may be reinstituted; however, 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 reinspection, information concerning the failure shall be furnished to the cognizant inspection activity and the qualifying activity.

4.5.6.4.2 Class S filters. If an inspection lot fails to pass group B inspection, the inspection lot shall not be delivered on the contract or purchase order. The manufacturer shall notify the qualifying activity and cognizant inspection activity of the failure and take corrective action on the materials or processes, or both as warranted. A failure analysis (see 4.5.6.4.2.1) shall be performed on the failing product and forwarded to the qualifying activity. A copy of the results shall be maintained by the manufacturer. If three successive lots of any style of filter or three successive lots of a single style of filter fail quality conformance testing (groups A and B), the qualifying activity shall be notified within 96 hours and the qualifying activity, at its discretion, may remove the failing product from the qualified products list.

4.5.6.4.2.1 Failure analysis. If any of the sample units subjected to the group B tests fail during testing, a detailed failure analysis shall be conducted to establish the cause of failure and the corrective actions that would eliminate subsequent failures of a similar type. A failure is categorized as lot oriented if its occurrence is apparently related to an identified lot or lots. A failure is categorized as not lot oriented if its occurrence is random and it cannot be related to a specific lot or lots. Each failure is further identified as screenable or not screenable from the completed production items. If the failure analysis shows that the failure mechanism is screenable, the entire failed lot may be screened and the group B test in which the failure occurred shall be repeated. If a failure occurs during the second group B test, the entire production lot shall be rejected. If the

failure mechanism is screenable, all prior and subsequent production lots that may contain the identified failure mechanism shall also be screened. Except as may be stated otherwise in the detailed requirements for the specific part type (see 3.6), if the failure mechanism is lot oriented and not screenable, all production lots that may contain the identified failure mechanism shall be rejected unless other disposition is directed by the contracting officer and qualifying activity.

4.5.7 Certification. The manufacturer shall certify with each order of parts, that the applicable quality conformance tests were successfully completed.

4.5.8 Inspection of packaging. The sampling and inspection of the preservation and interior package marking shall be in accordance with the groups A and B quality conformance inspection requirements of MIL-P-116. The sampling and inspection of the packing and marking for shipment and storage shall be in accordance with quality assurance provisions of the applicable container specification and the marking requirements of MIL-STD-129.

TABLE VI. Group B inspection.

Inspection	Class B	Class S	Requirement paragraph	Test method paragraph	Number of sample units to be inspected: Class B	Number of sample units to be inspected: Class S	Number of failures permitted: Class B	Number of failures permitted: Class S
Group I								
AC voltage drop (when applicable)	X	X	3.12	4.6.6.1	10	5	1	0
Voltage and temperature limits of capacitance	X	X	3.16	4.6.10				
Insertion loss (at temperature)	X	X	3.11	4.6.5.1				
Barometric pressure (reduced)	X	X	3.18	4.6.12				
Temperature rise	X	X	3.17	4.6.11				
Current overload	X	X	3.20	4.6.14				
Terminal strength	X	X	3.28	4.6.22				
Thermal shock and immersion	X	X	3.23	4.6.17				
Destructive physical analysis (2 samples only)	-	X	3.26	4.6.20				
Group II								
Subgroup 1 2/								
Solderability (5 samples only)	X	X	3.30	4.6.24	10	1/ 22		0
Life	X	X	3.31	4.6.25				
Subgroup 2								
Resistance to soldering heat	X	X	3.24	4.6.18	5	5	1	0
Resistance to solvents	X	X	3.21	4.6.15				
Salt spray (corrosion)	X	X	3.25	4.6.19				
Radiographic inspection	-	X	3.14	4.6.8				
Destructive physical analysis (2 samples only)	-	X	3.26	4.6.20				
Group III								
Shock (specified pulse)	X	X	3.27	4.6.21	10	5	1	0
Vibration (high frequency)	X	X	3.22	4.6.16				
Moisture resistance	X	X	3.29	4.6.23				
Seal (when applicable)	X	X	3.15	4.6.9				
Radiographic inspection		X	3.14	4.6.8				
Destructive physical analysis (2 samples only)	-	X	3.26	4.6.20				

1/ The number of samples submitted for the life test shall be 10 percent of the lot submitted for group A inspection with the maximum number of samples being 22 filters and the minimum number of samples being 5 filters.
2/ Samples submitted for solderability test shall also be submitted to the life test.

4.6 Methods of inspection.

4.6.1 Visual inspection.

4.6.1.1 External visual and mechanical inspection. Filters shall be examined to verify that the materials, design, construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.1, 3.5, 3.6, 3.33, and 3.34).

4.6.1.2 Visual inspection (class S filters only). Each element and subassembly shall be visually inspected under 10-power magnification. Elements and subassemblies exhibiting any of the anomalies listed below shall be removed from the lot and identified as rejects.

a. Discoidal capacitors.

(1) Cracks or buckling in the ceramic dielectric.

(2) Chips, voids, or pinholes in the ceramic dielectric that exceed 0.010 inch (0.25 mm) in its major dimension and penetrate to within one dielectric thickness of a buried electrode.

(3) Termination metallization, leaching, or lifting.

(4) Heavy metallic surface marks that reduce the termination clearance to less than 75 percent of the radial distance between the inner and outer terminations.

(5) Foreign material or contamination.

(6) Pretinned discoidal capacitors only.

(a) Solder balls, spikes, splash, or loose solder.

(b) Solder flux.

b. Tubular capacitors.

(1) Ceramic tubes - Each ceramic tube shall be inspected with bright illumination from the side prior to electrode position or painting for cracks, voids, pinholes, or ceramic chipouts, voids, pinholes, or chipouts that reduce the dielectric thickness by greater than 20 percent.

(2) Electrode termination/ceramic tube - Pinholes or voids in the electrode termination that are concentrated in one area and exceed 5 percent of each electrode area. Lifting, peeling, or cracks in the termination. The ceramic tube and metallized area shall be inspected for the defects specified in 4.6.1.2.a.(6)(a).

c. Magnetics.

(1) Ferrite beads - Broken or cracked ferrites. Chipouts exceeding 10 percent of the cross-sectional area.

(2) Coil - Broken or cracked cores, sharp kinks, bends, or nicks that reduce the diameter of the wire 10 percent.

d. Housing (case) - Burrs, damaged threads, flaking of plating, or dents.

e. Subassembly and precap inspection prior to potting.

(1) Excessive solder or bridging between inner and outer electrodes that reduce the termination clearance to less than 75 percent of the radial distance between the inner and outer terminations.

(2) Solder balls, solder spikes, solder splash, or loose solder.

(3) Solder flux.

(4) Coil or ferrite bead shall be examined for anomalies listed in 4.6.1.2c.

(5) Contamination which may affect proper operation.

(6) Damage or plating defects on the case.

(7) Lead damage.

(8) Cracks or other damage to the ceramic tube.

(9) Coil or ferrite bead is not insulated or touching side of case.

(10) Coil wire or ferrite bead and filter center conductor are positioned such that they are able to touch the side of the case during vibration or shock.

(11) Capacitor disc is not tilted more than 10 degrees.

(12) Solder fillet around either the inner circumference and the outer circumference of the capacitors less than 240 degrees.

(13) For eyelet terminals, the feed-thru connection wire not being visible from the external side of the eyelet.

4.6.2 Thermal shock and voltage conditioning (see 3.8). Filters shall be subjected to the tests of 4.6.2.1 and 4.6.2.2.

4.6.2.1 Thermal shock. Filters shall be tested as specified in method 107 of MIL-STD-202. The following exception shall apply:

a. Test condition - A, except that in step 3, sample units shall be tested at +125°C.

b. Mounting (class S filters only). Filters shall be mounted in a thru-hole and torqued in place on a rigid metal plate to the specified value (see 3.1). (Note: Not applicable to solder-in types).

c. Measurements during the test (class S filters only). At completion of or during the final cycle and before the filter is removed from the plate, measure and record insulation resistance at +125°C.

4.6.2.2 Voltage conditioning.

4.6.2.2.1 Class B filters. Filters shall be tested as specified in method 108 of MIL-STD-202. The following details and exceptions shall apply:

a. Test temperature and tolerance - +125 ±3°C.

b. Operating conditions:

(1) DC rated filter - 2X rated voltage for 164 ±4 hours.

(2) For filters with ac and dc ratings, or ac ratings only. Apply 1.2X rated ac voltage at maximum rated frequency for 164 ±4 hours.

c. Measurements after the test:

(1) After completion of the voltage conditioning and while remaining at +125°C, the insulation resistance shall be measured as specified in 4.6.13.

4.6.2.2.2 Class S filters.

a. Test temperature and tolerance- 125° ±3°C.

b. Operating conditions.

(1) DC rated filter - 2X rated voltage.

(2) Filters with ac and dc ratings, or ac ratings only - 1.2X rated ac voltage at maximum rated frequency.

(3) Polarity of voltage - The polarity of the voltage shall be positive on the case during the first 24 to 72 hours and then reversed to negative on the case for the remaining portion of the test.

c. Mounting - Filters shall be mounted in accordance with 4.6.2.1b. The method of electrically contacting the case and one terminal of the filter must be adequate to ensure that all the filters will be properly conditioned.

d. Test circuit - The test circuit shall be equivalent to that shown on figure 1. The maximum series resistance with each filter shall be 5.00 ohms. The fuse shall have a maximum rating of 0.25 ampere. The power supply shall be capable of supplying five times the maximum current rating of the fuse.

e. Test duration - Filters shall be conditioned for a minimum of 168 hours and a maximum of 264 hours. The voltage conditioning may be terminated at any time during the 168 to 264 hours time interval provided that failures (blown fuses or less than 95 percent applied voltage) meet the requirements for 0.2 percent defective allowable during the last 50 hours. Filters that cause fuses to blow shall be considered as failures. Any filter that causes a blown fuse shall be tested for insulation resistance and dielectric withstanding voltage as specified in 4.6.13 and 4.6.3, respectively. If the filter meets the initial requirements for insulation resistance and dielectric withstanding voltage, the filter shall be rejected but shall not count against the percent defective allowed.

f. Measurements after test - After completion of the voltage conditioning and while at +125°C, the insulation resistance shall be measured as specified in 4.6.13.

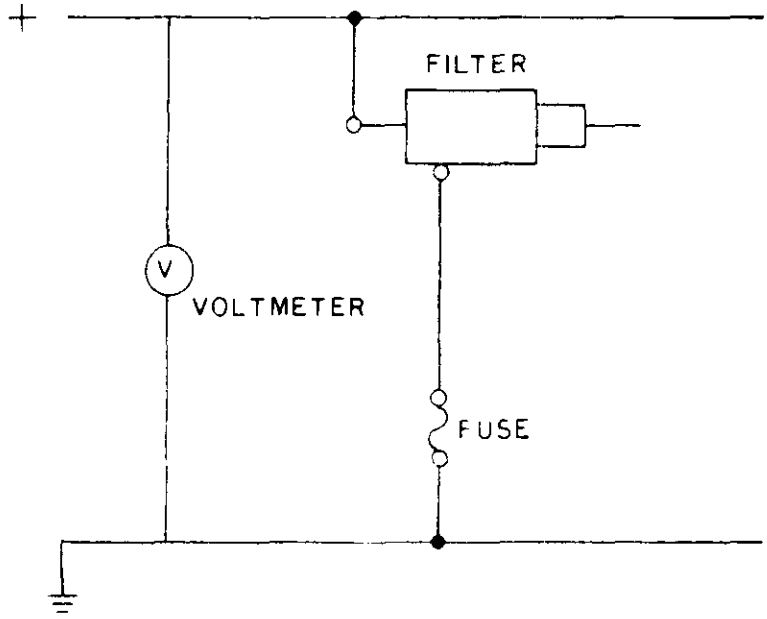


FIGURE 1. Voltage conditioning test circuit for class S filters.

4.6.3 Dielectric withstanding voltage (see 3.9). Filters shall be tested in accordance with method 301 of MIL-STD-202. The following details and exceptions shall apply:

a. Test voltage - Unless otherwise specified (see 3.1), the test voltage shall be as follows:

(1) DC rated filters- 2.5X rated voltage.

(2) For filters with ac and dc ratings, or ac ratings only- 2.8X rated rms voltage.

b. Duration of application of test voltage - 5 seconds minimum, 1-minute maximum.

c. Points of application of the test voltage - The test voltage shall be applied between either terminal and ground (case).

d. Charging current- 50 mA maximum, 30 mA minimum.

e. The sensitivity of the breakdown test equipment shall be sufficient to indicate breakdown when at least 0.5 milliamperes of leakage current flows through the filter under test.

4.6.4 Capacitance to ground (see 3.10). Capacitance to ground shall be measured in accordance with method 305 of MIL-STD-202. The following details shall apply:

a. Test frequency- 1,000 ±100 Hz.

b. Measurement voltage- 0.1 to 1.2 volts rms.

(Note: Following a dielectric withstanding voltage or insulation resistance test, the capacitance measurement may be delayed for a period of up to 24 hours).

4.6.5 Insertion loss (at 25°C) (see 3.11). Filters shall be tested in accordance with MIL-STD-220 or to an approved equivalent at load and at no-load as specified (see 3.1). With only the 10 dB pads, adapters and fixture in the circuit, 0 dB reference shall have no more than ±1 dB error and the measurements shall be accurate to within ±3 dB over the specified frequency to 1 GHz.

4.6.5.1 Insertion loss (at temperature). This test may be conducted in conjunction with the capacitance (temperature and voltage) provided the insertion loss is read before the dc bias is applied at each temperature. Filters shall be tested as follows:

a. The filters shall be located with an appropriate adaptor in a temperature chamber.

b. Load and no-load measurements shall be made at -55°C, 25°C, and +125°C. Measurements shall be taken at a sufficient number of frequencies to plot a curve of insertion loss versus frequency over the specified frequency range for each temperature. Alternatively, photographs of the display of a spectrum analyzer or chart recordings may be used.

4.6.6 Voltage drop (see 3.12).

4.6.6.1 Voltage drop for ac filters. The voltage drop is the difference between the input voltage to the filter and the output voltage of the filter when the filter is carrying rated current at rated voltage, with a resistive load at maximum rated frequency (see 3.1). The method of voltage measurement is shown on figure 2. Measurements shall be made by using equipment which will enable voltage differences of less than 0.1 volt to be read.

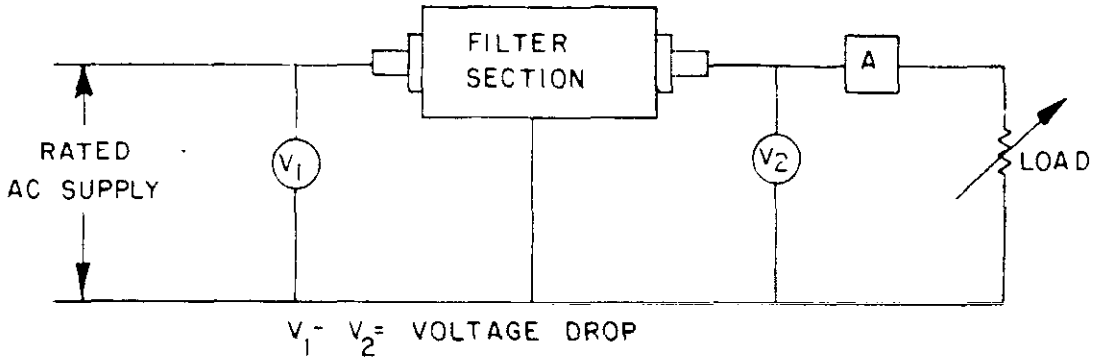


FIGURE 2. AC filters; measurement of voltage drop.

4.6.6.2 Voltage drop for dc filters. The voltage drop shall be determined in accordance with figure 3. Measurements shall be made by using a dc reading meter with the filter carrying rated current at rated voltage.

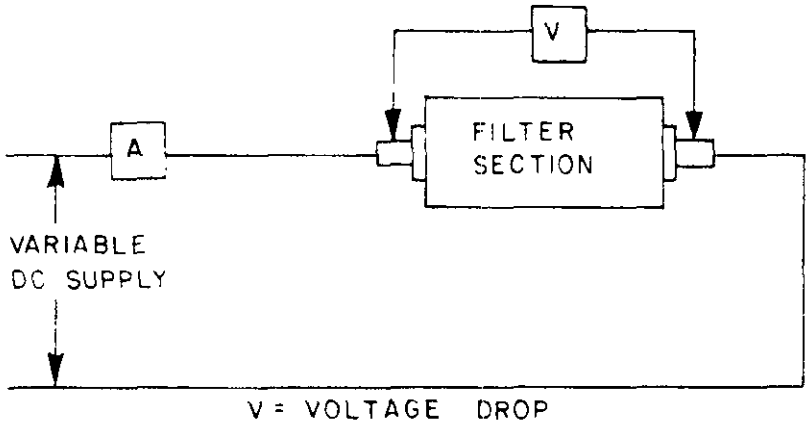


FIGURE 3. DC filters; measurement of series-element voltage drop at rated current.

4.6.7 DC resistance (see 3.13). Filters shall be tested in accordance with MIL-STD-202, method 303. Test is optional when a dc voltage drop test is performed.

4.6.8 Radiographic inspection (see 3.14). Filters shall be tested in accordance with method 209 of MIL-STD-202. The following details and exceptions shall apply:

a. Radiographic quality - The radiograph shall render a clear sharp image of the penetrameter.

b. Image quality indicator - A radiograph of the penetrameter shall be included on each radiograph film. The penetrameter may be made from a sample filter of the same type as the filter being radiographed, with an AWG number 48 tungsten wire mounted across the filter body.

c. Positions of specimen - Two views normal to the major axis of the part shall be taken. One view shall be 90 degrees from the other.

d. Evaluation of images - Special kinds of viewing equipment - magnifying glass. Magnification - 10X.

e. Examination - The filter examination shall include, but not be limited to, inspection for faulty lead connections, misalinement of internal parts, solder defects, and physical damage of electrical elements. Typical filter construction of a circuit filter is shown on figure 4.

(1) Extraneous material.

(a) The sum total of all major dimensions of loose metallic particles (solder balls) in a single isolated compartment shall not exceed 0.010 inches (0.25 mm) (see figures 4a, 4d, and 4g).

(b) There shall be no solder splash on the winding or the capacitor. For defect example, see figures 4b and 4d.

(c) There shall be evidence of a 240° minimum solder joint between capacitor and case. For defect example, see figure 4c.

(d) There shall be no metallic objects bridging the coil to the capacitor nor contact between coil and capacitor. For defect example, see figures 4e and 4f.

(e) There shall be no solder bridge or metallic objects between the capacitor and the ferrite bead. For defect example, see figure 4g.

(2) Internal damage - There shall be no nicks, gouges, cracks, or other imperfections in the wire, core, capacitor, or other internal elements. For defect example, see figures 4h, 4i, 4j, and 4k.

(3) Alinement of internal elements - The capacitor element shall be properly seated within its defined location and shall not be tilted or misalined more than 10 degrees with respect to the case centerline. For defect example, see figure 4ℓ.

(4) Bonds - There shall be no evidence of improper bonding (defective welds) on internal lead connections.

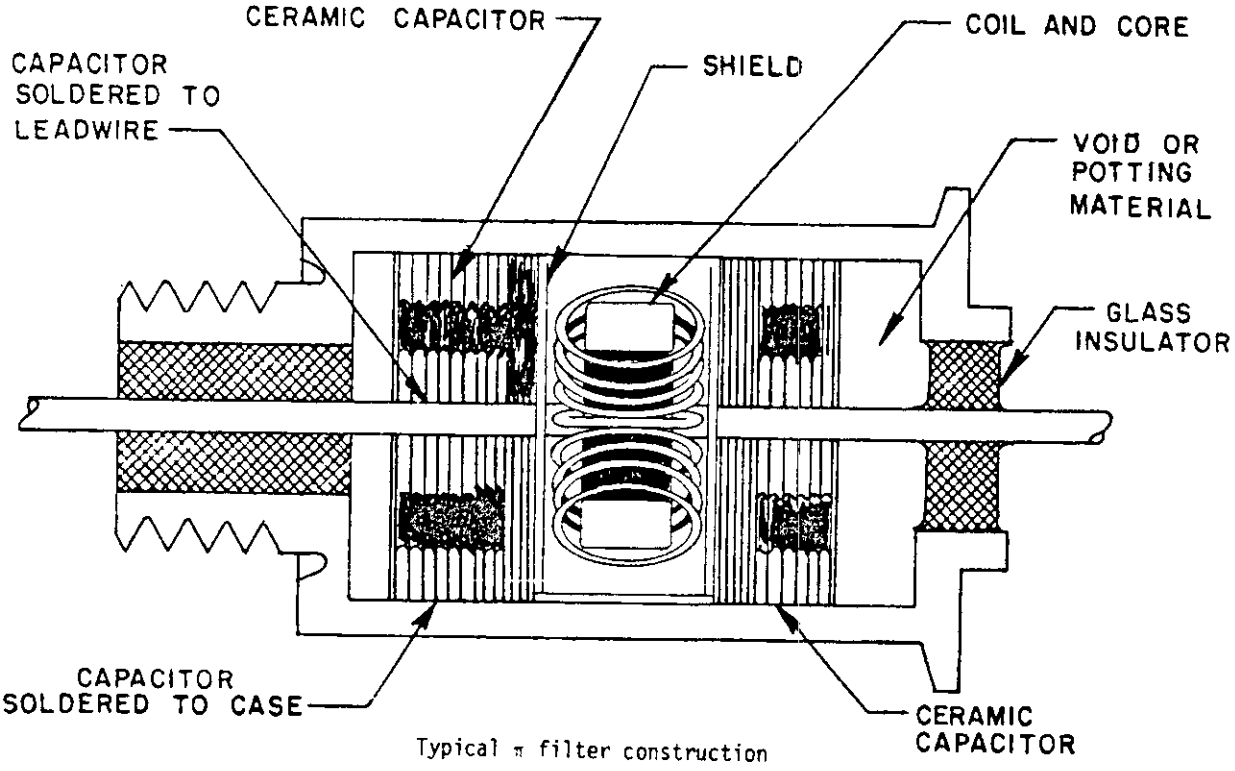
4.6.9 Seal (hermetic filters only) (see 3.15). Filters shall be tested in accordance with method 112 of MIL-STD-202. The following details shall apply:

a. Class B filters. Filters shall be tested in accordance with test condition A or D.

b. Class S filters. Filters shall be tested in accordance with test condition C, procedure IIIa. Following this test, filters shall be tested in accordance with test condition A or D.

4.6.10 Voltage and temperature limits of capacitance (see 3.16). This test may be performed in conjunction with the insertion-loss (at temperature) test, see 4.6.5.1. The test conditions and capacitance measurements shall be in accordance with 4.6.4, except that the chamber temperature shall be accurate to ±2°C. After an initial capacitance measurement at +25°C, a dc voltage equivalent to the rated dc voltage or 1.4 times the rated rms voltage shall be applied to the filters as the capacitance is measured. (Note: The dc voltage shall not exceed 500 Vdc and the terminals shall be positive with respect to the case.) The capacitance shall then be measured at -55°C, -30°C, +25°C, +85°C, and +125°C. (Note: The filters shall be allowed to stabilize for 30 minutes at each temperature before a measurement is taken).

4.6.11 Temperature rise (see 3.17). Filters shall be suspended by their terminals and energized with rated current at maximum rated frequency (see 3.1) in still air. Lead wires shall be of copper, 6-inches long (152.4 mm), and of the size specified in table VII. After thermal stability has been reached and while the filter is still energized, the maximum hotspot on the filter case shall be determined by the use of thermocouples.



Typical π filter construction

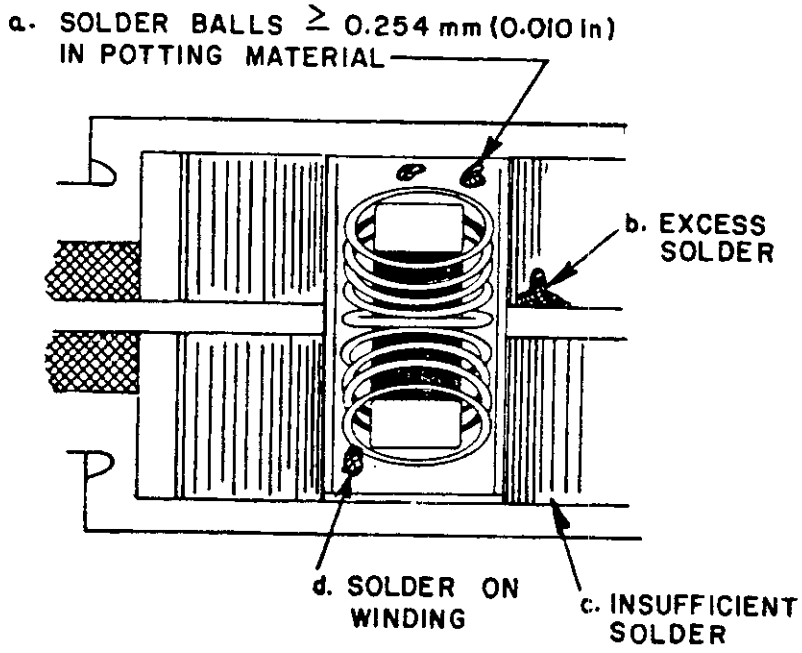


FIGURE 4. Typical π filter construction and examples of unacceptable filter workmanship.

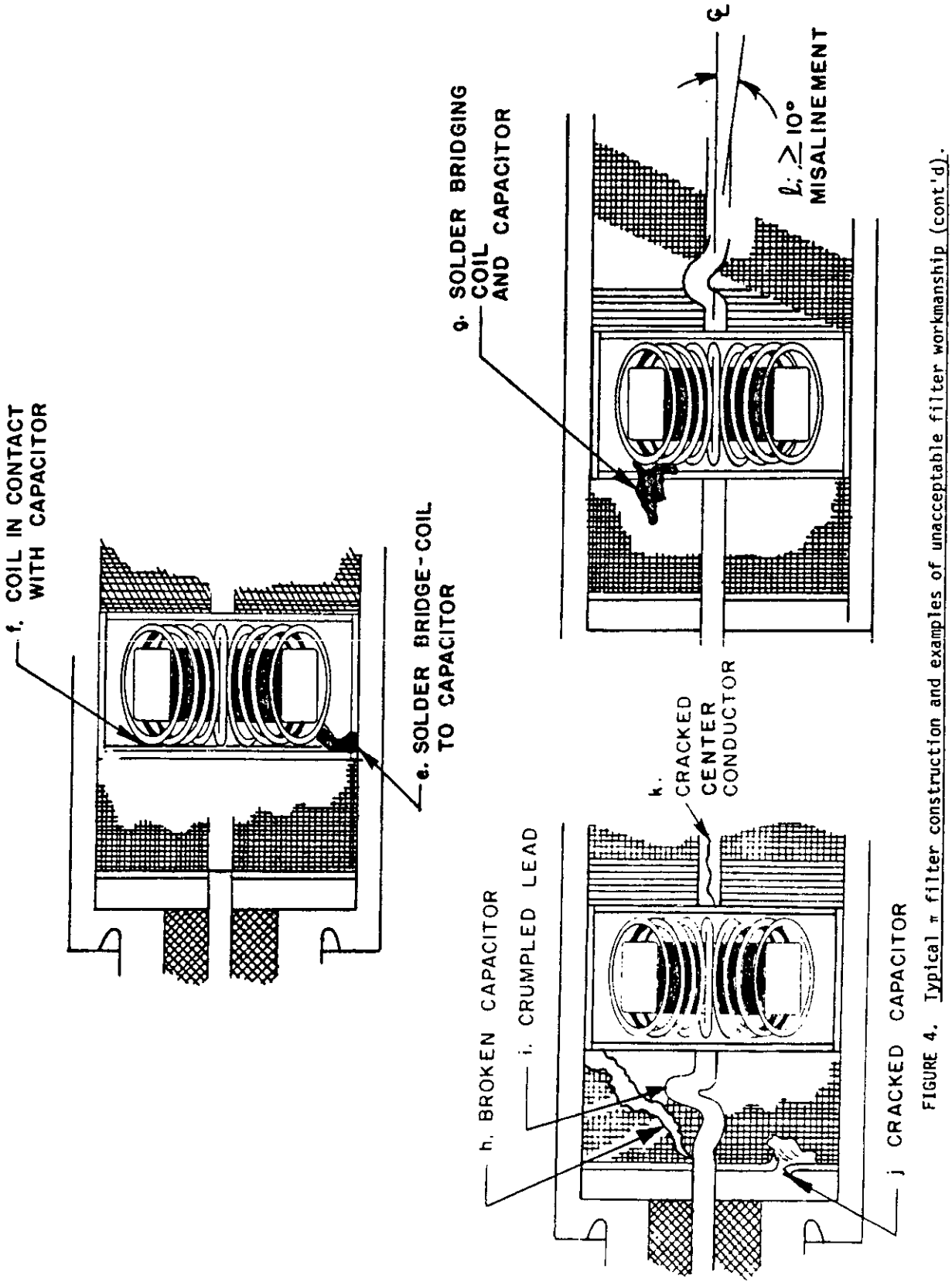


FIGURE 4. Typical π filter construction and examples of unacceptable filter workmanship (cont'd).

TABLE VII. Lead wire sizes.

Rated current of filter	Wire size
Amperes	AWG
Up to 3	24
3+ to 5	22
5+ to 11	20
11+ to 16	18
16+ to 22	16

4.6.12 Barometric pressure (reduced) (see 3.18). Filters shall be tested in accordance with method 105 of MIL-STD-202. The following details shall apply:

a. Method of mounting - Securely fastened by normal mounting means.

b. Test-condition letter - E (150,000 ft).

c. Test during subjection to reduced pressure - Dielectric withstanding voltage as specified, except that the test voltage shall be 125 percent of the rated voltage.

4.6.13 Insulation resistance (terminal to ground) (see 3.19).

4.6.13.1 Insulation resistance (25°C). Filters shall be tested in accordance with method 302, test condition A of MIL-STD-202. The following details and exceptions shall apply:

a. Ambient temperature- 25° ±3°C.

b. Test potential- 100 Vdc or rated dc voltage, whichever is less, applied for 2-minutes maximum.

c. Relative humidity- 20 to 50 percent.

d. Points of measurement - Between either terminal and ground (case).

4.6.13.2 Insulation resistance (125°C). Filters shall be tested in accordance with method 302, test condition A of MIL-STD-202. The following details and exceptions shall apply:

a. Test temperature- +125° ±3°C.

b. Filters shall have been stabilized for 1-hour minimum at +125°C with rated voltage applied.

c. Insulation resistance distribution (class S filters only) - following the voltage conditioning test specified in the group A inspection and measurement of insulation resistance at +125° as specified in 4.6.13.2a and 4.6.13.2b, a mean and standard deviation shall be calculated for the lot based on the first 50 pieces that meet the minimum insulation resistance requirement. All remaining parts in the lot that have an insulation resistance value less than 3 sigma below the mean shall not be delivered. These units may, at the optional of the manufacturer, be used for group B tests. (Note: Only parts failing the minimum insulation resistance requirement shall be counted as part of the percent defective allowed.)

d. Test potential - Rated dc voltage.

e. At the manufacturer's option, measurements at 125°C can be made of the dc leakage current at the specified test voltage. The equivalent insulation resistance can then be calculated.

4.6.14 Current overload (see 3.20). Filters shall be suspended by their conductors in free air. A current equal to 140 percent of rated current at maximum rated frequency shall then be applied for 15 minutes minimum. After the filter has returned to room temperature, the insulation resistance (at +25°C) and voltage drop shall be measured as specified in 4.6.13.1 and 4.6.6, respectively. Filters shall be visually inspected for evidence of physical damage.

4.6.15 Resistance to solvents (see 3.21). Filters shall be tested in accordance with method 215 of MIL-STD-202. The following details shall apply:

a. The marked portion of the filter body shall be brushed.

b. Filters shall be visually inspected for evidence of mechanical damage and legibility of marking.

4.6.16 Vibration (high frequency) (see 3.22). Filters shall be tested in accordance with method 204 of MIL-STD-202. The following details and exceptions shall apply:

a. Mounting of specimens - Filters shall be rigidly mounted by the body.

b. Electrical load - Rated voltage and current shall be applied continuously during vibration.

c. Test condition - E (50 G's) except the frequency range shall be 20 to 3,000 Hz.

d. Test during vibration to determine intermittent open or short circuiting.

e. Examination after test - Filters shall be inspected for evidence of physical damage.

f. Measurements after test - Filters shall be subjected to the insertion-loss test (see 4.6.5).

4.6.17 Thermal shock and immersion (see 3.23).

4.6.17.1 Thermal shock. Filters shall be tested in accordance with method 107 of MIL-STD-202. The following details and exceptions shall apply:

a. Test condition.

(1) Class B - Test condition A, except step 3 temperature shall be +125° +3°, -0°C.

(2) Class S - Test condition A-1, except step 3 temperature shall be +125° +3°, -0°C.

b. Measurements before and after cycling - Not applicable.

4.6.17.2 Immersion. Following thermal shock, filters shall be tested in accordance with method 104 of MIL-STD-202. The following details shall apply:

a. Test condition - A.

b. Measurements after final cycle - Dielectric withstanding voltage with 90 percent of the voltage specified in 4.6.3 applied for 5 ±1 seconds, insulation resistance (at +25°C), and insertion loss as specified in 4.6.13 and 4.6.5, respectively.

c. Visual inspection - After the test, filters shall be visually inspected for corrosion and obliteration of marking.

4.6.18 Resistance to soldering heat (see 3.24). Filters shall be tested in accordance with method 210 of MIL-STD-202, the following details shall apply:

a. Depth of immersion in the molten solder shall be to a point 0.0625 ±0.03125 inch (1.59 ±0.79 mm) from the case.

b. Test condition letter - B.

c. Cooling time prior to final examinations and measurements - 15 minutes minimum. Insertion loss (25°C) and insulation resistance (25°C) shall be measured in accordance with 4.6.5 and 4.6.13 respectively, 1-hour (minimum) after immersion.

4.6.19 Salt spray (corrosion) (see 3.25). Filters shall be tested in accordance with method 101 of MIL-STD-202. The following details and exceptions shall apply:

a. Test condition - A (96 hours).

b. Visual inspection - After completion of the test, filters shall be visually inspected for corrosion and obliteration of marking.

4.6.20 Destructive physical analysis (see 3.26). Filters shall be inspected in accordance with appendix D of this specification.

4.6.21 Shock (specified pulse) (see 3.27). Filters shall be tested in accordance with method 213 of MIL-STD-202. The following details and exceptions shall apply:

a. Mounting - Securely fastened by normal mounting means, when applicable, leads and connecting wires must be supported to prevent damage to the filter.

b. Test condition.

(1) Class B filters - Test condition I (100 G's).

(2) Class S filters - Test condition F (1,500 G's).

c. Electrical load during shock - During the test, a potential of 100 percent of rated voltage shall be applied between the terminals and case.

d. Measurements during test - Monitor for intermittent open- or short-circuiting.

e. Measurements after the test - Filters shall be subjected to the insertion-loss test (see 4.6.5).

4.6.22 Terminal strength (see 3.28). Filters shall be tested in accordance with method 211 of MIL-STD-202. The following details and exceptions shall apply:

a. Test condition - A (pull test).

b. Applied force - 5 pounds.

c. Inspection after test - Filters shall be visually inspected for evidence of loosening or rupturing of the terminals.

4.6.23 Moisture resistance (see 3.29). Filters shall be tested in accordance with MIL-STD-202, method 107, test condition A (except at step 3 temperature shall be +125° +3°, -0°C) and no measurements shall be made before and after cycling. Filters shall then be tested in accordance with method 106 of MIL-STD-202. The following details and exceptions shall apply:

a. Mounting - Securely fastened by normal mounting means.

b. Initial measurements - Not applicable.

c. Polarization voltage - During steps 1 to 6, inclusive, a dc potential of 100 volts or rated voltage, whichever is less shall be applied between the terminals and case. The potential applied to the terminals shall be positive with respect to the case.

d. Final measurements - Following the 24-hour conditioning period, dielectric withstanding voltage with 90 percent of the voltage specified in 4.6.3 applied for 5 ±1 seconds, insulation resistance (at +25°C), and insertion loss shall be measured as specified in 4.6.13 and 4.6.5, respectively.

e. Visual inspection - After the test, filters shall be visually inspected for corrosion and obliteration of marking.

4.6.24 Solderability (see 3.30).

4.6.24.1 Solderability of terminals. Filters shall be tested in accordance with method 208 of MIL-STD-202. The following details and exceptions shall apply:

a. Number of terminations to be tested - 2.

b. Special preparations of terminations - None.

4.6.24.2 Solderability of mounting termination (when applicable). Filters shall be tested as follows: (Note: The terminal solderability test (see 4.6.24.1) should be done with the filters already soldered to the test coupon; however, if the size of the solder pot or variations in the terminal preclude this sequence, the terminal solderability may be done first.

a. Filters shall be soldered to the test coupon shown on figure 5. The filters shall be soldered with an iron at 253° ±7°C using SN62WRMAP3 solder per QQ-S-571. The test coupon shall be preheated to 100° ±7°C. Heat should be applied to the coupon first in the immediate vicinity of the filter. The tip of the iron should then be moved so that it comes in contact with the edge of the filter for no more than 5 seconds or until a smooth solder fillet has been established around the filter. This sequence will be repeated with each filter.

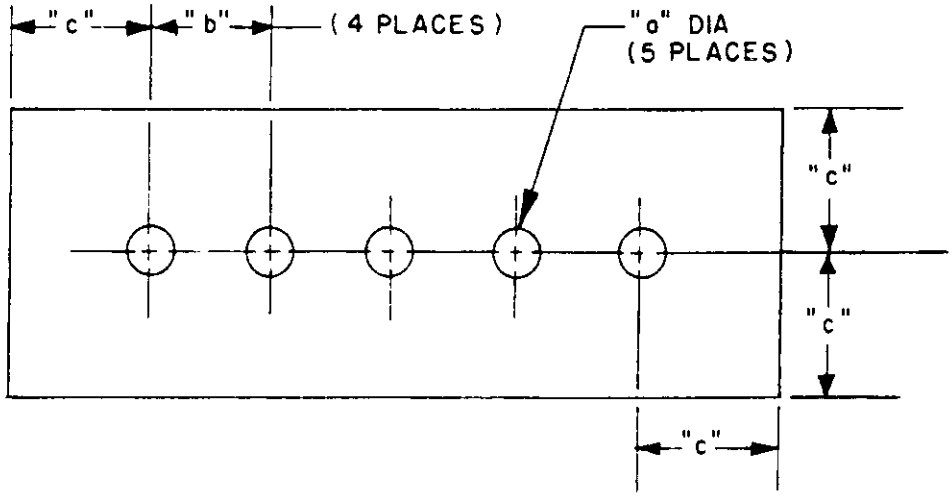


FIGURE 5. Test coupon for solderability of mounting terminations.

b. Test coupon - Shall be in accordance with figure 5 and as follows:

(1) Material - Beryllium copper per QQ-C-533, ALY (170), 0.014 ±0.002 inch (0.36 ±0.05 mm) thick.

(2) Finish - Copper plate per MIL-C-14550, class 4 and tin plate per MIL-T-10727, type I, 0.0002 inch (0.0051 mm) thick.

(3) Dimensions - In accordance with figure 5 and as follows:

"a" = recommended mounting hole diameter as specified (see 3.1).

"b" = 2 times the maximum filter body diameter.

"c" = "b" or 0.50 inch (12.70 mm), whichever is greater.

c. Measurements after test - Insulation resistance (25°C) and capacitance shall be measured as specified in 4.6.13.1 and 4.6.4 while the filters are on the test coupon.

4.6.25 Life (see 3.31). Filters shall be tested in accordance with method 108 of MIL-STD-202. The following details and exceptions shall apply:

a. The filters shall be separated from each other by a distance of not less than 1 inch (25.4 mm) during measurements.

b. Test temperature and tolerance- +125° ±3°C.

c. Mounting - Class S filters shall be mounted as specified in 4.6.2.1b. Class B filters shall be suspended by their terminals during the test.

d. Test condition letter - D (1,000 hours).

e. Filters shall be energized with rated current at maximum rated frequency.

f. During the test, radiant shields may be placed between units so that overheating of one unit will not affect a nearby unit.

g. Test voltage - For filters with ac and dc ratings or ac ratings only, the test voltage shall be 1.2 times rated ac voltage. Filters with only dc ratings shall be tested at 2.0 times the rated dc voltage.

h. After the life test, dielectric withstanding voltage with 90 percent of the specified voltage applied for 5 ±1 seconds, and insulation resistance (+25° and +125°C), and insertion loss shall be measured as specified in 4.6.3, 4.6.13, and 4.6.5, respectively.

4.6.26 Flashpoint of impregnant or potting compound (see 3.32). Unless certification is furnished, the flashpoint of the impregnant or potting compound shall be measured as specified in ASTM D92-78.

4.6.27 Ceramic capacitor sectioning (see 3.6.6). For each lot date code of parts (class S filters only). Prior to capacitor installation (into the filter), five capacitors shall be randomly selected for each capacitor type and be prepared and examined to the requirements of RS-469.

5. PACKAGING

5.1 Preservation. Preservation shall be level A or C, as specified (see 6.1).

5.1.1 Level A.

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

5.1.1.2 Drying. Filters and capacitors shall be dried in accordance wth MIL-P-116.

5.1.1.3 Preservative application. Contact preservatives shall not be used.

5.1.1.4 Unit packs. Each filter and capacitor shall be individually unit packed in accordance with the methods of MIL-P-116 specified herein insuring compliance with the applicable requirements of that specification.

5.1.1.4.1 Hermetically sealed filters and capacitors. These items shall be presesrved in accordance with method III of MIL-P-116.

5.1.1.4.2 Nonhermetically sealed filters and capacitors. These items shall be preserved in accordance with submethod IA-8 of MIL-P-116.

5.1.1.5 Intermediate packs. Filters and capacitors, packaged as specified in 5.1.1.4, shall be placed in intermediate containers conforming to PPP-B-566 or PPP-B-676. Intermediate containers shall be uniform in size, shape, and quantities, shall be of minimum tare and cube and shall contain multiples of five unit packs, not to exceed 100 unit packs. No intermediate packs are required when the total quantity shipped to a single destination is less than 100 unit packs.

5.1.2 Level C. The level C preservation for filters and capacitors shall conform to the MIL-STD-794 requirements for this level.

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

5.2.1 Level A. The packaged filters and capacitors shall be packed in fiberboard containers conforming to PPP-B-636, class weather resistant, style optional, special requirements. The requirements for box closure waterproofing and reinforcing shall be in accordance with method V of the PPP-B-636 appendix.

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

5.2.3 Level C. The level C packing for filters and capacitors shall conform to the MIL-STD-794 requirements for this level.

5.3 Marking. In addition to any special or other identification marking required by the contract (see 6.1), each unit, intermediate and exterior container shall be marked in accordance with MIL-STD-129.

5.4 General.

5.4.1 Exterior containers. Exterior containers (see 5.2.1, 5.2.2, and 5.2.3) shall be of a minimum tare and cube consistent with the protection required and shall contain equal quantities of identical stock numbered items to the greatest extent practicable.

5.4.2 Packaging inspection. The inspection of these packaging requirements shall be in accordance with 4.5.8.

5.4.3 Army acquisitions.

5.4.3.1 Level A unit and intermediate packs. Submethod IC-1 of MIL-P-116 shall be used in lieu of method III. All unit and intermediate containers shall be either weather (or water) resistant or overwrapped with waterproof barrier materials (see 5.1.1.4.1 and 5.1.1.5).

5.4.3.2 Level A and level B packing. For level A packing the fiberboard containers shall not be banded but shall be placed in a close fitting box conforming to PPP-B-601, overseas type; PPP-B-621, class 2, style 4 or PPP-B-585, class 3, style 2 or 3. Closure and strapping shall be in accordance with applicable container specification except that metal strapping shall conform to QQ-S-781, type I, finish A. When the gross weight exceeds 200 pounds or the container length and width is 48 x 24 inches or more and the weight exceeds 100 pounds, 3 x 4 inch skids (laid flat) shall be applied in accordance with the requirements of the container specification. If not described in the container specification, the skids shall be applied in a manner which will adequately support the item and facilitate the use of material handling equipment. For level B packing, fiberboard boxes shall be weather resistant as specified in level A and the containers shall be banded (see 5.2.1 and 5.2.2).

6. NOTES

6.1 Ordering data. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Title, number, and date of the applicable specification sheet and the complete military part number (see 3.1).

c. Levels of preservation and packing required (see 5.1 and 5.2).

d. If special or other identification marking is required (see 5.3).

e. Number of unit packs, if other than specified in 5.1.1.4.

f. Class of fiber (see 5.2.1 and 5.2.2).

g. Whether copies of x-ray films and photographs of destructive physical analysis (DPA) samples are required (class S filters only).

6.2 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable qualified products list 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 Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the qualified products list is the Naval Electronic Systems Command, ELEX 8111, Washington DC; however, information pertaining to qualification of products may be obtained from the Defense Electronics Supply Center (DESC-E), Dayton, Ohio 45444.

6.2.1 Copies of SD-6, "Provisions Governing Qualification" may be obtained upon application to Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

6.3 Solder coating. It is intended that solder coatings on terminals withstand extended storage without deterioration of soldering qualities or appreciable increase in resistance. Pure-tin coatings usually do not store satisfactorily.

6.4 Application data.

6.4.1 Configuration. Best attenuation in the stop-band can be achieved if an inductor faces a low impedance and if a capacitor faces a high impedance; however, since these are rarely perfectly suited to the application, it may be necessary to reverse this rule or to sacrifice attenuation in order to eliminate resonance. In cases where the impedance will vary considerably, filters with one or two additional stages may be used to ensure adequate attenuation under all possible conditions. The attenuation of filters manufactured with inductors and ceramic capacitors is affected by temperature, current, and voltage so these factors must be considered when the filter is designed into the system.

6.5 Installation methods (recommended).

6.5.1 Mounting the filter to the chassis. The device shall be treated as heat and mechanically sensitive. Heat sink the filter when soldering on leads.

6.5.1.1 Threaded filters with flat(s). It is intended that these filters be mounted in a "D" hole using a washer, a nut and a torque wrench. Caution: Do not grip the filter body more than finger tight. If there is an undercut on the filter thread adjacent to the mounting surface, the bulkhead material must be thicker than the undercut. The mounting torque shall be as specified in the appropriate specification sheet.

6.5.1.2 Threaded filters with a hex body or a hex top seal. If flat(s) are provided, these filters may be assembled as in 6.5.1.1. These filters may be mounted in a plain hole using a nut, a washer, a torque wrench, and a plain wrench. Preferably the plain wrench should be used to steady the filter while the torque wrench should be used to tighten the nut. If the hole in the chassis is threaded the filter should be mounted with a torque wrench.

6.5.1.3 Solder-in style.

6.5.1.3.1 Solder preform method. A fluxed solder preform of Sn 63 solder can be fitted into the subassembly. The subassembly and filter can then be preheated to 125°C for 5 minutes to reduce thermal shock of the ceramic material. To complete the soldering operation, heat may then be applied to the subassembly, in the immediate vicinity of the filter, with sufficient magnitude to reflow the solder preform. This may be accomplished with a controlled temperature source. Care should be taken to supply the heat via the subassembly, rather than heating the filter directly and only for the time required to make a good solder connection. Cool the assembly slowly by gradually returning it to room temperature.

6.5.1.3.2 Solder paste method. This second method is useful where there is a danger of damage to closely packed components or very heat sensitive parts. A bismuth solder alloy paste composed of 43 percent tin, 43 percent lead, and 14 percent bismuth melts at around 152°C and effective soldering can be achieved with it. This material, which is obtainable as a solder cream, can be applied by brush, or by hypodermic syringe and then heated in a static or tunnel oven for approximately a 40-minute period at 160°C to the joint. Cool the assembly slowly (see 6.5.1.3.1).

6.5.2 Soldering to the filter leads (all styles). All solder connections made to the terminals of the filter should be performed with solder that is liquid at temperatures less than 232°C, and soldering heat applied only long enough to make a good solder connection. Use a heat sink on the lead next to the filter body. Preheating the filters to 125°C for 5 minutes is recommended when possible to prevent thermal shock of the ceramic materials. Do not bend or twist the leads or terminals of the filters as this will result in cracked seals or ceramic capacitors.

Custodians:
Army - ER
Navy - EC
Air Force - 11
NASA - NA

Review activities:
Army - AR, MI
Air Force - 17, 85, 99
DLA - ES

User activities:
Army - ME, AT, AV
Navy - CG, MC, AS, OS, SH
Air Force - 19

Agent:
DLA - ES

Preparing activity:
Navy - EC

(Project 5915-0219)

APPENDIX A

PROCEDURE FOR QUALIFICATION INSPECTION FOR CLASS B FILTERS

10. SCOPE

10.1 Scope. This appendix details the procedure for submission of samples, with related data, for qualification inspection of class B filters covered by this specification. The procedure for extending qualification is also outlined herein. This Appendix is a mandatory part of the specification. The information contained herein is intended for compliance only.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. SUBMISSION

30.1 Sample. A sample consisting of 40 specimens of each filter for which qualification is sought shall be submitted. Each sample shall be accompanied with the following information:

a. Attenuation curve in accordance with MIL-STD-220.

b. Certification as to the flashpoint of the impregnant or potting compound based on the Cleveland-cup process (see 4.6.26).

c. Schematic diagram of the filter, including nominal values of the components.

30.2 Certification of material. When submitting samples for qualification, the manufacturer shall submit certification, in duplicate, that the materials used in the filters are in accordance with the applicable specification requirements.

30.3 Description of items. The manufacturer shall submit a detailed description of the filters being submitted for tests, including the type and quantity of impregnant, material, thickness, and applied finish of case, and details of terminal.

40. EXTENT OF QUALIFICATION

40.1 Extent of qualification. Extent of qualification shall only be applicable for filters of the same style. Qualification for one filter may be the basis for qualification of another filter as indicated below:

a. Voltage rating - Extent of qualification shall be restricted to filters of the same voltage rating.

b. Current rating - Qualification of the lowest current rating and highest current rating for a given style will extent qualification for all intermediate current ratings.

c. Circuit configuration - As indicated in table VIII.

TABLE VIII. Extent of qualification for circuit configurations.

Qualification of circuit configuration	Will qualify circuit configuration
C	C
L1	L1, L2, C
L2	L2, L1, C
π	π, L1, L2, C

As a requisite for extension of qualification, the product involved must be manufactured using the same facilities, processes, and materials as the product originally submitted for qualification.

APPENDIX B

GUIDELINES FOR THE IMPLEMENTATION OF CERTIFICATION OF CLASS S FILTERS

10. SCOPE

10.1 Scope. This appendix provides guidelines to the certification team for the implementation of class S certification of manufacturing facilities. These guidelines will establish a uniform approach by the certification team in the assessment of the manufacturer's capability to consistently produce class S filters by providing instructions for assuring process control, applicable test methods, and records. A checklist is included for the use of the certification team (see table IX). This appendix is a mandatory part of the specification. The information contained herein is intended for compliance only.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. INSTRUCTIONS

30.1 Baseline documentation. At the time of the initial survey, a baseline shall be established. It is not intended that the manufacturer divulge proprietary information. Each manufacturer shall provide a detailed process flow chart which shall include as a minimum the following:

a. All major process steps and inspection points by descriptive title, document number, and revision.

b. The identification of all critical manufacturing and inspection steps as determined by the manufacturer in conjunction with the audit team at the time of baseline approval.

30.2 Changes to baseline documentation.

a. Minor changes. Any subsequent departure from the approved flow chart (i.e., additions or deletions), or changes to the revision status of those processes or inspections deemed critical are allowed provided they do not violate the changes prohibited by section B (major changes). These minor changes shall be described in general terms to the audit team during subsequent audits. This action shall result in an update of the baseline document.

b. Major changes. No changes (i.e., substitutions) shall be allowed in the following areas without prior review and approval of the qualifying activity. In these areas, partial or total requalification may be required as determined by the qualifying activity.

(1) Filter characteristics.

(2) Capacitor and installation.

(3) Inductor design and installation.

(4) Wire.

(5) Solder/solder preforms.

(6) Case design.

(7) Potting/impregnants and installation.

(8) End seals.

(9) Manufacturing methods and inspections.

30.3 Audits. An initial audit and subsequent periodic audits (every 2 years minimum). The audit shall include, but not be limited to all of the items on the checklist plus MIL-STD-790 requirements. The result of any additional items that are assessed shall be added to the checklist for record purposes.

a. The audit team shall review the product assurance program plan and the manufacturing flow chart for adequacy and completeness prior to the audit of the manufacturing facilities and should be used as a baseline/reference during the course of the audit.

b. The audit team shall verify that all measuring and test equipment is functioning and calibrated. They shall also verify that test measuring procedures and equipment are sufficiently accurate for the required test.

c. For recertification, the audit team shall check 12 months of records for the item being recertified. In addition, the location of the equipment and the adequacy of the operating procedure shall be checked and whenever practical, operations utilizing the equipment and procedures witnessed.

TABLE IX. Certification checklist procedure.

Check item 1/	Inspection	Satisfactory action
a. Flow chart.		
(1) Critical processes identified with revision.		
(2) Critical inspection identified with revision.		
(3) Nonproprietary documents furnished.		
(4) Screens/inspection points identified.		
b. Baseline shall describe as a minimum the following which shall include part numbers.		
(1) Filter part number/characteristics.		
(2) Capacitor.		
(3) Inductor.		
(4) Solder/solder preforms.		
(5) End seals.		
(6) Wire type/size.		
(7) Potting/encapsulant material.		
(8) Case.		
c. Lot control plan.		
d. Traceability plan.		
e. Training plan for personnel.		
f. Nondestructive testing.		
g. Destructive testing.		
h. Verification of MIL-STD-790 requirments.		
i. Equipment calibration.		
j. Record maintainability.		
k. Reporting plan.		

1/ The audit team shall insure that adequate documentation, trained personnel, equipment, and visual aids are in evidence to perform the certification checklist procedure.

APPENDIX C

PROCEDURE FOR QUALIFICATION INSPECTION FOR CLASS S FILTERS

10. SCOPE

10.1 Scope. This appendix details the procedure for submission of samples, with related data, for qualification of class S filters covered by this specification. The qualification inspection is intended to have the manufacturer demonstrate that he has the ability to build the most difficult filter he manufacturers and that each lot will receive groups A and B tests (lot-by-lot qualification verification). This appendix is a mandatory part of the specification. The information contained herein is intended for compliance only.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. SUBMISSION

30.1 Single part-number submission. A sample of 52 specimens of each filter for which qualification is sought shall be submitted. Each sample shall be accompanied with the following information:

a. Attenuation curve in accordance with MIL-STD-220.

b. Certification as to the flashpoint of the impregnant or potting compound based on the Cleveland-cup process (see 4.6.26), or a minimum of 200-cubic centimeters of the impregnant used in the filters.

c. Schematic diagram of the filter, including nominal values of components.

d. Baseline documentation as required by MIL-F-28861 and appendix B.

30.2 Certification of material. When submitting samples for qualification, the manufacturer shall submit certification, in duplicate, that the materials used in the filters are in accordance with the applicable specification requirements.

30.3 Description of items. The manufacturer shall submit a detailed description of the filters being submitted for test, including the type and quantity of impregnant, material, thickness, and applied finish of case, and details of the terminal.

40. EXTENT OF QUALIFICATION

40.1 Extent of qualification. Extent of qualification shall only be applicable for filters of the same style. Qualification for one filter may be the basis for qualification of another filter as indicated below:

a. Voltage rating - Extent of qualification shall be restricted to filters of the same voltage rating.

b. Current rating - Qualification of the lowest current rating and highest current rating for a given style and circuit configuration will extent qualification for all intermediate current ratings.

c. Circuit configuration - As indicated in table X.

TABLE X. Extent of qualification for circuit configuration.

Qualification of circuit configuration	Will qualify circuit configuration
C	C
L1	L1, L2, C
L2	L2, L1, C
π	π, L1, L2, C

As a requisite for extension of qualification, the product involved must be manufactured using the same facilities, processes, and materials as the product originally submitted for qualification. In addition, extension of qualification shall be documented in the baseline documentation.

APPENDIX D

GUIDELINES FOR DESTRUCTIVE PHYSICAL ANALYSIS (DPA) OF CLASS S FILTERS

10. SCOPE

10.1 Scope. This appendix provides a means of characterizing the internal structual features of filters using ceramic capacitors. The method to be used for cross sectioning and inspection are described. Applications of these methods will insure uniform preparation and analysis. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance only.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. PROCEDURE

30.1 Sample selection. A sample or samples shall be randomly selected from those units that have not failed any previous tests.

30.2 X-ray review. Review x-ray negatives prior to sample preparation, for internal component location and anomalies that can be highlighted during cross sectioning.

30.3 Sample preparation.

30.3.1 Cleaning prior to mounting. Each DPA sample shall be cleaned prior to mounting. Each filter shall be swabbed with a cotton swab saturated with isopropyl alcohol. The filters shall then be allowed to air dry for 3 minutes prior to mounting.

30.3.2 Mounting. The filters shall be mounted such that they will be ground from the outside diameter toward the inside diameter resulting in a cross-sectioned plane parallel to the longitudinal axis.

30.3.3 Specimen grinding. Once the mounted filters have fully cured, they shall be ground and polished down to a depth which exposes the center of the terminals, (usually the filter center). This will be the final section plane. The filter, however, should be continuously examined during grinding to observe any possible anomalies before reaching the final section plane. Specimen grinding shall conform to the procedures detailed in RS-469 with the following exceptions:

a. 180-grit paper may be used to rough grind down through the filters outer case.

b. It is very important that once the inner diameter of the case is pierced the filter cross-section shall be inspected for voids, cavities, and possible unsupported elements. If any of these occur at this grinding stage or any time thereafter, the voids shall be filled with mounting material and allowed to properly cure before continuing. Cavity filling shall be accomplished by injection or preferably by vacuum back filling techniques. Care shall be taken so as to prevent stress cracking of the capacitor by using fine grit paper that is wetted during grinding.

c. The mounts shall be checked periodically during grinding to ensure no air pockets or unsupported elements have appeared.

d. The samples may be sectioned using a grinding method as described in RS-469. This is only permissable after the internal cavities of the filter have been back filled with the mounting compound.

30.3.4 Specimen polishing. Specimen polishing shall conform to the procedures detailed in RS-469.

APPENDIX D

30.4 Visual inspection. All exposed surfaces of the filter shall be inspected for the following characteristics at a minimum magnification of 30 power. The lot is suspect if the DPA samples contain filters which exhibit the following anomalies:

a. Cracked ceramic - Cracks in the ceramic dielectric of the capacitor that encompasses two or more adjacent layers, or cracks which extend across plates to the outer surface.

b. Solder - Solder and center conductor connection between periphery of capacitor and case, loose retainer rings due to improper solder reflow, insufficient solder in feed-thru terminals or capacitor eyelet that permits loose feed-thru wire.

c. Alinement - Greater than 10 degrees misalinement of the capacitive element.

d. Cracked inductor core/inductor winding not protected from shorting to case.

e. Missing insulators.

f. The sum total of all major dimensions of loose metallic particles (solder balls) in a single isolated compartment shall not exceed 0.010 inches (0.25 mm).

g. Potting - Insufficient potting which allows any movement of any internal element or potting fill less than the minimum required (see 3.6.7.2).

h. Gross delaminations or voids in accordance with RS-469.

(Note: Damage caused by the DPA operations shall not be cause for lot rejection).

APPENDIX E

PROCEDURE FOR INSPECTION OF TERMINATED TUBULAR CAPACITORS

10. SCOPE

10.1 Scope. This appendix details the procedure for inspection of tubular capacitors prior to assembly into class S filters. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance only.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. DEFINITIONS

30.1 Dielectric thickness. The distance between any two adjacent electrodes through a ceramic medium, or the distance between a ceramic surface and any adjacent electrode within or on the opposite surface of the ceramic.

30.2 Electrode. A conducting material either applied to the surface or sandwiched between ceramic layers.

30.3 Terminating material (termination). An electrode applied to the surface of a ceramic capacitor so that electrical contact or mechanical bonding may be achieved with the capacitor.

30.4 Insulation gap. Any designed gap that separates two electrodes occupying the same cylindrical plane.

30.5 Out of round. The difference between the major outside diameter and the minor outside diameter of a tube that is not perfectly round, measured at any point along the length of the tube.

30.6 Camber. A measure of the amount by which the center of a tube (along its length) deviates from a straight line.

30.7 Wall thickness. The distance between the inner and outer radius of a tube at any point along its length and circumference.

40. INSPECTION.

40.1 Screening inspection. 100 percent of each lot of tubular capacitors shall be inspected at 10X magnification for the following defects:

a. There shall be no bare spots in the terminating material that are greater than 0.015 inches (0.38 mm) across in any direction.

b. There shall be no terminating material that reduces the insulating band by more than 15 percent on the outer diameter insulating band(s), or on any insulating band that separates terminating patterns having substantially different potentials.

c. There shall be no visible evidence of chips, pinholes, or scalloping that reduces the dielectric thickness or the width of the insulation band by more than 25 percent.

d. There shall be no visible evidence of cracks, delaminations, or voids in the ceramic.

e. There shall be no blisters or fractures in the terminating material.

f. There shall be no extraneous material attached to the capacitor that is more than 0.003 inches (0.08 mm) across in any direction.

40.2 Sampling inspection. Each lot of tubular capacitors shall be inspected in accordance with MIL-STD-105 for a single sampling plan for normal inspection, general inspection level II with a 0.1 percent AQL, for all dimensions including out of round and camber as specified in the baseline documentation.

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