| INCH-POUND |

MIL-F-28861
AMENDMENT 6
16 June 1989
SUPERSEDING
AMENDMENT 5
3 February 1988

MILITARY SPECIFICATION

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

This amendment forms a part of MIL-F-28861, dated 17 December 1981, and is approved for use by all Departments and Agencies of the Department of Defense.

PAGE 1

1.1, line 4: Delete "ceramic capacitors" and substitute "ceramic discoidal capacitors".

1.1, line 5: Delete "ceramic capacitors" and substitute "ceramic discoidal capacitors".

PAGE 2

* 2.1, Specifications, Federal: Delete "QQ-C-533" and associated title. Add the following specifications:

"QQ-B-613 - Brass, Leaded and Nonleaded, Flat Products (Plate, Bar, Sheet, and Strip).
QQ-B-626 - Brass, Leaded and Nonleaded Rod, Shapes, Forgings and Flat Product TH Finished Edges (Bar and Strip)."

PAGE 3

3.2, line 3: Delete "for class S filters,".

3.4.1, line 1: Delete "(class S filters only)" and line 2: Delete "class S".

PAGE 4

3.5.1, add the following at the end of the paragraph: "The use of wax is prohibited."

Following 3.5.1, add new paragraph:

"3.5.2 Outgassing (applicable to nonhermetically sealed class S filters only) (see 6.6). When tested as specified in 4.6.28, the polymeric sample shall meet the following requirements:

Total mass loss (TML)- - - - - - - - - - - Shall not exceed 1.0 percent
Volatile condensable material (VCM)- - - Shall not exceed 0.1 percent"

* 3.6.3e, delete and substitute:

"e. The undercoat shall be in accordance with class 4 of MIL-C-14550 except as stated in 3.6.3.3."

3.6.3.1, delete and substitute:

"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 or electro-tin fused."

3.6.3.4, delete and substitute:

"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 or hot-solder dipped (40% to 60% tin per QQ-S-571)."

3.6.6, delete and substitute:

"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 as follows:

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 inspections of MIL-C-123. The group B thermal shock test and subsequent life test shall not be performed.

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

3.6.6.1, delete in its entirety.

3.6.7, delete "(class S filters only)" from title.

3.6.7.1, line 9: Delete "260°C" and substitute "280°C".

3.6.7.1, delete the last sentence and substitute:

"For class S filters, solder and soldering shall be controlled to the approved baseline documentation."

3.6.7.2 delete and substitute:

"3.6.7.2 Potting (when applicable). When potting compound is used to secure the inductive elements, the inductive elements shall be potted to at least 80 percent of their height, so that the potting makes intimate contact with the case."

3.6.7.3, delete title and substitute "Control (class S filters only)."

3.10, delete and substitute:

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

PAGE 6

3.14, delete "(class S filters only)" from title.

3.23, following visual inspection requirement add:

"Dielectric withstanding voltage - - - - As specified in 3.9".

PAGE 7

3.29, following visual inspection requirement add:

"Dielectric withstanding voltage - - - - As specified in 3.9".

3.29, following capacitance requirement add:

"Dissipation factor - - - - Shall meet initial requirements (see 3.1)".

3.30.2, following capacitance requirement add:

"Dissipation factor - - - - Shall meet initial requirements (see 3.1)".

3.31, following visual inspection requirement add:

"Dielectric withstanding voltage - - - - As specified in 3.9".

PAGE 8

4.1.1, delete in its entirety and substitute:

"4.1.1 Reliability assurance program. A reliability assurance program shall be established and maintained in accordance with MIL-STD-790. The following details and exceptions shall apply:

a. An outside capacitor manufacturer with existing MIL-STD-790 approval may supply discoidal capacitors for use in MIL-F-28861 filters, provided that manufacturer's discoidal capacitor line is audited by the qualifying activity to the MIL-STD-790 requirements.

b. The MIL-F-28861 filter manufacturer shall purchase magnet wire and cores. The coil winding operation, however, may be performed outside the filter manufacturer's plant, and is exempt from the MIL-STD-790 requirements."

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TABLE III, group I, delete "Capacitance to ground" and substitute:

"Capacitance to ground and dissipation factor."

TABLE III, groups I, III, and IV, Radiographic inspection, in the class B column: Delete "-" and substitute "X" (3 places).

TABLE III, group I, Visual and mechanical inspection, test method paragraph, delete "4.6.6.1" and substitute "4.6.1.1".

* TABLE III, group V,: Delete "Solderability (5 samples only)".

* TABLE III, add new group VI as follows:

"Group VI							
Solderability - - - - - - -	-X	X	3.30	4.6.24	5	5	0	0."

PAGE 13

4.5.4.1, line 6: Delete "the seal test" and substitute "Radiographic inspection and the seal test".

4.5.4.2, line 7: Delete "0.2 percent maximum," and substitute "0.2 percent maximum or one unit,".

TABLE V, subgroup 1, delete "Capacitance to ground" and substitute "Capacitance to ground and dissipation factor."

TABLE V, subgroup 1: Delete "Insertion loss" and substitute "Insertion loss (at 25°C)".

TABLE V, subgroup 1, Radiographic inspection; in the class B column: Delete "-" and substitute "X".

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TABLE VI, groups II and III, Radiographic inspection; in the class B column: Delete "-" and substitute "X".

* TABLE VI, group II, subgroup 1: Delete reference to footnote 2/ and delete "solderability (5 samples only)".

* TABLE VI, group II, subgroup 2: Delete "Resistance to solvents".

* TABLE VI, group II, add subgroup 3 as follows:

" Subgroup 3

Solderability	X	X	3.30	4.6.24	5	0
Resistance to solvents (4 samples only)	X	X	3.30	4.6.15	5	0"

* TABLE VI, delete footnote 2/.

PAGE 16

4.6.1.2b., delete in its entirety.

PAGE 17

4.6.1.2e.(8), delete in its entirety.

* 4.6.2.2.1c., delete and substitute:

"c. Mounting - Filters should be mounted in such a way that the specified voltage may be applied between the terminals and case.

d. Measurements after the test - Insulation resistance shall be measured as specified in 4.6.13.2 within one hour after completion of voltage conditioning."

PAGE 18

* 4.6.2.2.2e., line 5: Delete "meet the requirements for 0.2 percent defective allowable" and substitute "in the lot do not exceed 0.2 percent or one unit."

4.6.2.2.f, delete and substitute:

"Measurements after test - Insulation resistance shall be measured as specified in 4.6.13.2 within one hour after completion of voltage conditioning."

PAGE 19

4.6.3a(2), delete and substitute:

"(2) For filters with ac and dc ratings - 2.5 x rated dc voltage.
For filters with ac ratings only - 2.8 x rated rms voltage."

4.6.3d: Delete "30 mA minimum".

4.6.4, delete and substitute:

"4.6.4 Capacitance to ground and dissipation factor (see 3.10).

"4.6.4.1 Capacitance to ground. Capacitors shall be tested in accordance with method 305 of MIL-STD-202. The following details and exceptions shall apply:

a. Test frequency - 1 MHz ±100 kHz when the nominal capacitance is 100 pF or less, and 1 kHz ±100 Hz when the nominal capacitance is greater than 100 pF.

b. Voltage - A root-mean-square potential of 1.0 ±0.2 volt when no polarizing voltage is applied.

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

"4.6.4.2 Dissipation factor. Unless otherwise specified (see 3.1), the dissipation factor shall be measured with a capacitance bridge or other suitable method at the frequency and voltage specified in 4.6.4.1. The inherent accuracy of the measurement shall be ±2 percent of the reading plus 0.1 percent dissipation factor (absolute) unless otherwise specified. Suitable measurement techniques shall be used to minimize errors due to the connections between the measuring apparatus and the filter. When testing multi-element filters, the effect of series element impedances on capacitance and dissipation factor readings must be considered. Typically, when measuring high current devices, this effect is insignificant. However, in some cases, the following test modifications may be required:

L filters - orient the filter so that the capacitor faces the test points.

Pi filters - electrically bridge the two live terminals

T filters - electrically bridge the two live terminals. (This will reduce, but not eliminate, the effect)."

PAGE 20

* 4.6.6.2, second sentence, delete and substitute:

"Measurements shall be made by using a dc reading meter with the filter carrying rated current."

4.6.8d., delete and substitute:

"d. Evaluation of images - Special kinds of viewing equipment: magnifying glass of 10X magnification or a 7X optical comparator."

PAGE 21

4.6.11, add the following sentence at the end of the paragraph:

"Lead wires specified in accordance with table VII, shall be the smaller of the wire specified per table VII or the actual lead wire size of the filter terminal."

PAGE 24

TABLE VII, title, add before Lead wire size, "Maximum" and add the following entry at the bottom of the table:

"Amperes	AWG
22+ to 32	14"

4.6.13.1b, delete and substitute:

" b. Test potential - Rated dc voltage, applied for 2 minutes maximum.

Charging current - 50 mA maximum."

4.6.13.1, add the following after d:

"e. At the manufacturer's option, measurements at 25°C can be made of the dc leakage current at the specified test voltage. The equivalent insulation resistance can then be calculated."

4.6.13.2d, add the following sentence:

"Charging current: 50 mA maximum."

PAGE 27

* 4.6.24.2b(1) delete and substitute:

"(1) Material - Brass per QQ-B-626, Alloy 360, 1/2 hard or Brass per QQ-B-613, Alloy 260, 1/2 hard; 0.014 ± 0.002 inch (0.36 ± 0.05 mm) thick."

PAGE 28

Following 4.6.27, add new paragraph:

"4.6.28 Outgassing (applicable to nonhermetically sealed class S filters only) (see 3.5.2)(see 6.6). Samples of any polymeric materials used shall be cut into pieces having 0.38 inch (9.65 mm) maximum dimension. A sample of 100 to 300 milligrams of material shall be weighed and then placed in a vacuum chamber under the following conditions:

Pressure - - - - - - - - - - - -	10^{-6} torr or less.
Temperature of specimen- - - -	Maximum operating temperature of device.
Exposure time- - - - - - - - -	24 hours.

During this exposure, a collector plate 9.7 inches (246.4 mm) in diameter shall be held at 25°C ±1°C near the sample. Immediately upon removal of the specimen and collector plate from the chamber, they shall be weighed. The total mass loss (TML) is sample mass before exposure minus the sample mass after exposure divided by the initial sample mass (expressed in percent change). The volatile condensable material (VCM) is the increase in the weight of the collector plate divided by the mass of sample (expressed in percent)."

PAGE 31

Following 6.5.2, add:

"6.6 Outgassing (option). As an option for inspection to outgassing requirements of 3.5.2, a minimum of 10 grams of each polymeric material in its final processed condition may be submitted to the following NASA installation for outgassing test: Director, Material and Processes Laboratory, EH01, Marshall Space Flight Center, Huntsville, AL 35812. As an alternate, a minimum, a single device utilizing each material may be submitted to Marshall Space Flight Center for outgassing tests in 4.6.28."

PAGE 32

*30.1, first sentence, delete and substitute:

"A sample consisting of 45 specimens of each filter for which qualification is sought shall be submitted."

40.1, add the following subparagraphs:

"d. Capacitance - Capacitance range qualification for a given style and circuit configuration will be restricted to values equal to and less than the capacitance value submitted (for example, qualification of a 5000 pF GMV filter will extend qualification to the 1000 pF GMV filter of the same style and circuit configuration).

e. Product assurance level - Qualification to class S filters will extend qualification to class B filters of the same voltage rating, current rating, capacitance, insertion loss, and physical configuration."

TABLE VIII, add the following entry at the bottom of the table:

"T	T, L_1, L_2"

Following 40.1, add:

"40.1.1 Qualification to alternate case finish. To gain approval of an optional T case finish (e.g. electro-tin fused when originally qualified to hot-solder dipped) or an alternate case finish (e.g. silver, when originally qualified to gold), the following shall be required:

A sample of twenty filters (of the desired case finish) shall be submitted to the group I tests of qualification inspection. This sample shall then be divided and 10 filters each submitted to the group III and group IV tests with one failure allowed on the combined group III and group IV tests. This sample, from any specification sheet of a type as specified in table XI will extend approval (for the desired finish) to all other specification sheets of that type.

TABLE XI. Extent of qualification for case finish.

High frequency bolt types	Broadband types
MIL-F-28861/6	MIL-F-28861/1
MIL-F-28861/7	MIL-F-28861/2
MIL-F-28861/8	MIL-F-28861/3
MIL-F-28861/9	MIL-F-28861/4
MIL-F-28861/10	MIL-F-28861/5
	MIL-F-28861/16
	MIL-F-28861/17

"

PAGE 33

30.2, add the following subparagraph:

"(10) Outgassing requirement (when applicable)."

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TABLE IX, under b. add:

"(9) Outgassing (when applicable).

(10) DPA of ceramic discoidal capacitor, per RS469, and shall meet the minimum dielectric thickness requirement."

PAGE 35

* 30.1, first sentence, delete and substitute:

"30.1 Single part-number submission. A sample of 57 specimens of each filter for which qualification is sought shall be submitted."

30.1, add the following subparagraph:

"e. Certification as to the outgassing requirement (see 3.5.2), when applicable."

Following 30.1, add new paragraph:

"30.1.1 Optional qualification for class S filters. The following option for class S qualification is available to any manufacturer who has a product currently qualified under this specification. Products proposed for qualification under this procedure shall meet the following requirements:

a. Product shall pass the class S product audit.

b. Product shall meet class S designated product control requirements.

c. Product shall meet all the class S requirements and tests of group A and B."

40.1, add the following subparagraph:

"d. Capacitance - Capacitance range qualification for a given style and circuit configuration will be restricted to values equal to and less than the capacitance value submitted (for example, qualification of a 5000 pF GMV filter will extend qualification to the 1000 pF GMV filter of the same style and circuit configuration)."

Following 40.1 add new paragraph:

"40.1.1 Qualification to alternate case finish. To gain approval of an optional T case finish (e.g. electro-tin fused when originally qualified to hot-solder dipped) or an alternate case finish (e.g. gold when originally qualified to hot-solder dipped), the following shall be required:

A sample of twenty filters (of the desired case finish) shall be submitted to the group I tests of qualification inspection. This sample shall then be divided and 10 filters each submitted to the group III and group IV tests with no failure allowed. This sample, from any specification sheet of a type as specified in table XII will extend approval (for the desired finish) to all other specification sheets of that type.

TABLE XII. Extent of qualification for case finish.

High frequency bolt types	Broadband types
MIL-F-28861/6	MIL-F-28861/1
MIL-F-28861/7	MIL-F-28861/2
MIL-F-28861/8	MIL-F-28861/3
MIL-F-28861/9	MIL-F-28861/4
MIL-F-28861/10	MIL-F-28861/5
	MIL-F-28861/16
	MIL-F-28861/17

"

PAGE 37

30.4h: Delete "or voids".

PAGE 38

Appendix E: Delete in its entirety.

NOTE: The margins of this amendment are marked with asterisks to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

CONCLUDING MATERIAL

Custodians:
Army - ER
Navy - EC
Air Force - 85
NASA - NA

Review activities:
Army - AR, MI
Air Force - 11, 99
DLA - ES

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

Preparing activity:
Navy - EC

Agent:
DLA - ES

(Project 59GP-0079)