

MIL-C-23183B

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~~SUPERSEDING~~

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MILITARY SPECIFICATION

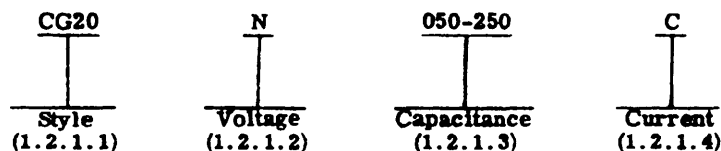
CAPACITORS, FIXED OR VARIABLE, VACUUM OR GAS DIELECTRIC,
GENERAL SPECIFICATION FORThis specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

- * 1.1 Scope. This specification covers the general requirements for fixed or variable, vacuum or gas dielectric capacitors which are intended for use in high voltage applications in military equipment and are rated for use over the temperature range of -55°C to $+85^{\circ}\text{C}$, -55°C to $+100^{\circ}\text{C}$, -55°C to $+125^{\circ}\text{C}$, or 0°C to $+85^{\circ}\text{C}$, as applicable (see 3.1).

1.2 Classification.

- 1.2.1 Type designation. The type designation shall be in the following form, and as specified (see 3.1 and 6.2):



- * 1.2.1.1 Style. The style is identified by the two letter symbol "CG" followed by a two-digit number; the letters identify vacuum or gas dielectric, fixed or variable capacitors; the number identifies general shape of the case. Each style designation may include a family of case sizes.
- * 1.2.1.2 Voltage. The voltage rating, expressed in kilovolts (kV), is identified by a single letter in accordance with Table I. The kilovolt rating is the peak value of voltage at 60 Hz unless otherwise specified (see 3.1).

TABLE I. Peak rated voltage.

Symbol	Voltage	Symbol	Voltage	Symbol	Voltage	Symbol	Voltage
	kV		kV		kV		kV
B - - -	2	G - - -	10	N - - -	30	T - - -	55
C - - -	3	H - - -	12.5	P - - -	35	U - - -	40
E - - -	5	J - - -	15	R - - -	45	V - - -	6
F - - -	7.5	L - - -	20				

1.2.1.3 Capacitance.

- 1.2.1.3.1 For fixed capacitors. The nominal capacitance of fixed capacitors expressed in picofarads (pF) has a tolerance of ± 10 percent, and is identified by a three-digit number; the first two digits represent significant figures and the last digit specifies the number of zeros to follow.

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1.2.1.3.2 For variable capacitors. The capacitance range expressed in picofarads is identified by two three-digit numbers separated by a dash. The first number identifies the low end of the capacitance range which may be less than, or equal to, the value indicated. The second number identifies the upper end of the capacitance range which may be greater than, or equal to, the value indicated. Both numbers are in accordance with 1.2.1.3.1.

- * 1.2.1.4 Current. The maximum current, expressed in amperes, for which a unit is rated, is identified by a single letter in accordance with table II. The current rating is given as a root mean square (rms) value of a sinusoidal waveform and rated at 16 MHz unless otherwise specified (see 3.1).

TABLE II. Current rating.

Symbol	Current	Symbol	Current
	Amperes		Amperes
A - - -	10	M - - -	60
C - - -	20	N - - -	75
E - - -	30	P - - -	100
G - - -	40	Q - - -	125
H - - -	42	R - - -	45
K - - -	50	S - - -	150

* 2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATIONS

MILITARY

- MIL-C-39028 - Capacitors, Packaging of.
MIL-C-45062 - Calibration Systems Requirements.

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

STANDARDS

MILITARY

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
MIL-STD-454 - Standard General Requirements for Electronic Equipment.
MIL-STD-1285 - Marking of Electrical and Electronics Parts.

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

2.2 Other publications. The following document forms a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

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NATIONAL BUREAU OF STANDARDS

Handbook H28 - Screw-Thread Standards for Federal Services.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.)

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheets. In the event of any conflict between the requirements of this specification and the specification sheets, the latter shall govern (see 6.1).

3.2 Qualification. Capacitors 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).

* 3.3 Material. The material shall be as specified herein. However, when a definite material is not specified, a material shall be used which will enable the capacitors to meet the performance requirements of this specification and be compatible with the RF fields encountered in use. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

* 3.3.1 Metals. Exposed metals shall be of the corrosion resistant type or shall be plated or treated to resist corrosion (see 3.15). All sharp edges shall be broken, filed or ground down.

* 3.3.2 Dielectric gases (when applicable). Dielectric gases shall be nontoxic, noncombustible, and nonexplosive in all electrical and environmental conditions.

3.4 Design and construction. Capacitors shall be of the design, construction, and physical dimensions specified (see 3.1).

* 3.4.1 Threaded parts. All threaded parts shall be in accordance with Handbook H28.

3.4.1.1 Engagement of threaded parts. All threaded parts shall engage by at least three full threads.

3.4.1.2 Locking of screw-thread assemblies. All screw-thread assemblies shall be rendered resistant to loosening under shock and vibration. Lockwashers shall be provided under all plain nuts. Freezing of internal pieces or evidence of loose foreign particles shall be cause for rejection.

* 3.5 Dielectric withstanding voltage. When tested as specified in 4.6.2, capacitors shall show no evidence of damage, arcing, or breakdown. In addition, no barnacle ^{1/} effect shall occur during the five-minute hold period.

3.6 Capacitance. When measured as specified in 4.6.3, the capacitance shall be within the following limits:

Fixed capacitors: ± 10 percent of nominal value.

Variable capacitors:

Minimum capacitance - Less than or equal to value specified (see 3.1).

Maximum capacitance - Greater than or equal to value specified (see 3.1).

* 3.7 Leakage current. When tested as specified in 4.6.4, the direct current (dc) leakage shall not exceed 10 microamps in either direction.

* 3.8 Dissipation factor (DF). When measured as specified in 4.6.5, the dissipation factor shall be not more than 0.001.

^{1/} A barnacle is a self-healing, nonsustained, momentary breakdown.

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- * **3.9 Mechanical adjustments (variable capacitors only, see 3.1).** When tested in accordance with 4.6.6, capacitors shall be within the following limits:

- (a) Capacitors with tuning assembly:

- (1) End-stops (when applicable) - End-stops shall withstand the torque specified (see 3.1).
- (2) Tuning shaft - Maximum torque shall be within the limits specified (see 3.1).

- (b) Capacitors without tuning assembly - Maximum push or pull force, as applicable, shall be within the limits specified (see 3.1).

- * **3.10 Capacitance change versus rotation (variable capacitors with tuning assembly only, see 3.1).** When tested as specified in 4.6.7, the capacitance change shall be substantially uniform with rotation. There shall be no capacitance reversals. Capacitance of the units shall be within 10 percent of the nominal value of the curve (see 3.1) except a deviation of two percent of the rated maximum capacitance value shall be allowed at the nonlinear portion of the curve near minimum capacitance. Where a table of capacitance versus shaft turns is given, capacitance shall be within the limits specified.

- * **3.11 Resistance to solvents.** When capacitors are tested as specified in 4.6.8, marking shall remain legible and shall not smear or rub off.

- * **3.12 Thermal shock.** When tested as specified in 4.6.9, there shall be no evidence of mechanical failure.

- * **3.13 Vibration.** When tested as specified in 4.6.10, there shall be no mechanical damage or momentary, intermittent arcing or breakdown.

3.14 Shock (specified pulse). When tested as specified in 4.6.11, there shall be no mechanical damage or momentary, intermittent arcing or breakdown.

3.15 Salt spray (corrosion). When tested as specified in 4.6.12, there shall be no harmful or extensive corrosion, and at least 90 percent of any exposed metallic surface of the capacitor shall be protected by the finish. The marking shall remain legible. There shall be no impairment of the rotational adjusting mechanism.

- * **3.16 Capacitance change with temperature.** When measured as specified in 4.6.13, the absolute value of the capacitance change with temperature shall not exceed 1.1 percent over the applicable operating temperature range (see 3.1).

3.17 Rated load. When tested as specified in 4.6.14, the hot spot surface temperature shall not exceed 85°C for glass enclosures or 125°C for ceramic enclosures. Unless otherwise specified, capacitance shall not vary more than ±1.0 percent (see 3.1).

- * **3.18 Life (variable capacitors only).** When tested as specified in 4.6.15, there shall be no damage to the bellows. After cycling, dielectric withstanding voltage, mechanical adjustments and capacitance change versus rotation, when applicable, shall be as specified in 3.5, 3.9, and 3.10, respectively.

- * **3.19 Marking.** Marking of capacitors shall conform to method I of MIL-STD-1285 and shall include the type designation, date code or date, unit serial number, manufacturer's name, capacitance in picofarads (pF) (nominal with tolerance or range, as applicable), peak rated voltage in kV, current rating (RMS amps at 16 mHz (see 6.2)) and JAN brand. The date code shall consist of the year and week. For example: The third week of 1972 would be 7203. Paper labels shall not be used. Other markings which in any way interfere with, obscure, or confuse those specified herein, are prohibited. Each capacitor shall be legibly marked with smear resistant ink that will withstand the environmental conditions specified herein. The marking shall remain legible after all tests. All marking (except serial number) shall be on the ceramic or glass envelope.

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EXAMPLE:

CG20N050-250C	-	Type designation (variable capacitor)
or		
CG10N060M	-	Type designation (fixed capacitor)
7205 or 11 Feb 72	-	Date code or date
967654	-	Unit serial number (location optional)
XXXXXX	-	Manufacturer's name
50-250 pF	-	Capacitance range (variable)
or		
350 pF $\pm 10\%$	-	Capacitance and tolerance (fixed)
20 kV	-	Peak rated voltage at 60 Hz
20 amps	-	RMS current at 16 mHz
JAN	-	JAN brand

3.19.1 "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 electrical equipment, namely, resistors, capacitors, electron tubes and the like, procured by, or manufactured for use by, or for the Government in accordance with standard Government specifications. Accordingly, capacitors procured to, and meeting all of, the criteria specified herein and in applicable specification sheets shall bear the certification mark "JAN", except that capacitors too small to bear the certification mark "JAN" shall bear the letter "J". Capacitors furnished under contracts or orders which either permit or require deviation from the conditions or requirements specified herein and in applicable specification sheets shall not bear "JAN" or "J". In the event a capacitor sample fails to meet the requirements of this specification and the applicable specification sheets, the manufacturer shall remove the "JAN" or "J" from the sample tested and also from all capacitors represented by the sample. The United States Government has obtained Certificate of Registration No. 504,860 for the certification mark "JAN".

3.20 Workmanship. Capacitors shall be processed in such a manner as to be uniform in quality and shall be free from corrosion, cracks, rough edges, chips, and other defects that will affect life, serviceability, or appearance.

3.20.1 Soldering. Solder and soldering shall be in accordance with requirement 5, Soldering Requirements for Electronic Equipment in MIL-STD-454.

* 3.20.2 Seal (glass-to-metal only, see 3.1). When examined as specified in 4.6.1, seals shall be within the following limits:

(a) Color:

- (1) There shall be no black seals or seal colors outside the range of light straw to deep red, inclusive.
- (2) Color shall not extend into the glass envelope more than 25 percent of the seal width, or 0.063 inch, whichever is less.

(b) Shale (parting of the glass and the metal) - Shale width shall not exceed 25 percent of seal width.

(c) Cracks - There shall be no spent external circumferential or moon cracks more than 25 percent of the seal width from the glass edge, or more than 0.004 inch, whichever is less.

(d) Bubbles:

- (1) Bubbles shall not exceed one-third of the seal width.
- (2) A single bubble shall not exceed one-sixth of the seal circumference.
- (3) Combined length of all bubbles shall not exceed one-third of the seal circumference.

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- (e) Combinations - A combination of the above defects shall not exceed 33 percent of the seal width.
- (f) Splits in feather edge - There shall be no split of more than 25 percent of the seal width.

• 3.20.3 Plated surfaces and bearings. When tested as specified in 4.6.1.1, there shall be no trace of cyanide plating solution on the plated surfaces or bearings. Bearings shall be examined for excessive wear or binding.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier 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 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 supplier. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with MIL-C-45062.

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

- (a) Qualification inspection (see 4.4). ^{1/}
- (b) Quality conformance inspection (see 4.5).

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

4.4 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3) on sample units produced with equipment and procedures normally used in production.

4.4.1 Sample size. The number of capacitors to be subjected to qualification inspection shall be as specified in the appendix to this specification.

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

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

4.4.4 Retention of qualification. To retain qualification, the supplier shall forward a report at 6-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.

^{1/} Application for qualification tests shall be made in accordance with "Provisions Governing Qualification" (see 6.2 and 6.3).

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TABLE I. Qualification inspection.

Examination or test	Requirement paragraph	Method paragraph	Number of sample units to be inspected	Number of defectives permitted ¹		
<u>Group I</u>						
Visual and mechanical examination	3.1 and 3.3		1 ³ / ₄	0		
Materials -----	through 3.3.2	4.6.1				
Design and construction -----	3.1 and 3.4	4.6.1				
Marking ² / ₄ -----	through 3.4.1.2	4.6.1				
Workmanship -----	3.19 and 3.19.1	4.6.1	8	0		
	3.20 through 3.20.3	4.6.1				
Dielectric withstanding voltage --	3.5	4.6.2				
Capacitance -----	3.6	4.6.3				
Leakage current -----	3.7	4.6.4				
Dissipation factor -----	3.8	4.6.5				
Mechanical adjustments (variable capacitors only) -----	3.9	4.6.6				
Visual and mechanical examination (internal) -----	3.1, 3.3 through 3.4.1.2, 3.20 through 3.20.3	4.6.1				
Capacitance change vs rotation (variable capacitors with tuning assembly only) -----	3.10	4.6.7	1	1		
Resistance to solvents -----	3.11	4.6.8				
<u>Group II</u>						
Thermal shock -----	3.12	4.6.9	4	0		
Vibration -----	3.13	4.6.10				
Shock (specified pulse) -----	3.14	4.6.11				
Salt spray (corrosion) -----	3.15	4.6.12				
Dielectric withstanding voltage --	3.5	4.6.2	4	0		
Capacitance -----	3.6	4.6.3				
Dissipation factor -----	3.8	4.6.5				
Mechanical adjustments (variable capacitors only) -----	3.9	4.6.6	4	1		
<u>Group III</u>						
Capacitance change with temperature -----	3.16	4.6.13				
Rated load -----	3.17	4.6.14				
Life (variable capacitors only) --	3.18	4.6.15				

^{1/} A sample unit having one or more defects will be considered as one defective.

^{2/} Marking defects are based on visual examination only and will be charged only for illegible, incomplete, or incorrect marking. Any subsequent electrical defects will not be used as a basis for determining marking defects.

^{3/} One sample shall be selected from the group of 8 for the visual and mechanical examination.

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- (b) A summary of the results of tests performed for qualification verification inspection (Group B), including the number and mode of failures. The summary shall include results of all qualification verification inspection tests performed and completed during the 6-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.

Failure to submit the report within 30 days after the end of each 6-month period may result in loss of qualification for the product. In addition to the periodic submission of inspection data, the supplier shall immediately notify the qualifying activity at any time during the 6-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 3 consecutive reporting periods there has been no production, the manufacturer may be required, at the discretion of the qualifying activity, to submit a representative product of each type to testing in accordance with the qualification inspection requirements.

4.5 Quality conformance inspection.

4.5.1 Inspection of product for delivery. Inspection of product for delivery shall consist of group A inspection.

4.5.1.1 Inspection lot. An inspection lot shall consist of all capacitors of the same dielectric material, fixed or variable, the same case material having voltage ratings within a range of 10,000 volts, and current ratings within a range of 20 amperes produced under essentially the same conditions, and offered for inspection at one time.

4.5.1.2 Group A inspection. Group A inspection shall consist of the examinations and tests specified in table II, in the order shown. Subgroup 1 inspection shall be performed on each capacitor.

TABLE II. Group A inspection.

Examination or test	Requirement paragraph	Method paragraph	AQL (percent defective) Major
Subgroup 1 (100 percent)			
Marking 1/ - - - - -	3.19 and 3.19.1	4.6.1	N/A 100 percent inspection
Workmanship - - - - -	3.20 through 3.20.3	4.6.1	
Dielectric withstanding voltage - - - - -	3.5	4.6.2	
Capacitance - - - - -	3.6	4.6.3	
Leakage current - - - - -	3.7	4.6.4	
Dissipation factor - - - - -	3.8	4.6.5	
Mechanical adjustments (variable capacitors only) - - - - -	3.9	4.6.6	

See footnote at end of table.

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TABLE II. Group A inspection. - Continued

Examination or test	Requirement paragraph	Method paragraph	AQL (percent defective) Major
<u>Subgroup 2</u>			
Visual and mechanical examination			2.5 percent
Materials (external only) - - - - -	3.1, 3.3 and 3.3.1	4.6.1	
Design and construction - - - - -	3.1, 3.4 through 3.4.1.2	4.6.1	
Thermal shock - - - - -	3.12	4.6.9	
Rated load - - - - -	3.17	4.6.14	
Capacitance change with temperature - - - - -	3.16	4.6.13	
Mechanical adjustments (variable capacitors only) - - - - -	3.9	4.6.6	
Capacitance change vs rotation (variable capacitors with tuning assembly only) - - - - -	3.10	4.6.7	

1/ Marking defects are based on visual examination only and will be charged for illegible, incomplete, or incorrect marking. Any subsequent electrical defects shall not be used as the basis for determining marking defects.

4.5.1.2.1 Sampling plan. Statistical sampling for subgroup 2 and inspection shall be in accordance with MIL-STD-105 for general inspection level II. The acceptable quality levels (AQL) shall be as specified in table II. Major defects shall be as defined in MIL-STD-105.

4.5.1.2.2 Rejected lots. If an inspection lot is rejected, the supplier may rework it to correct the defects, or screen out the defective units, and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

4.5.2 Qualification verification inspection. Qualification verification inspection shall consist of group B. Except where the results of these inspections show noncompliance with the applicable requirements (see 4.5.2.1.4), delivery of products which have passed group A shall not be delayed pending the results of these qualification verification inspections.

4.5.2.1 Group B inspection. Group B inspection shall consist of the tests specified in table III, in the order shown for each subgroup. Group B inspection shall be made on sample units selected from inspection lots which have passed the group A inspection.

4.5.2.1.1 Sampling plan. Four sample units shall be selected from the initial production of capacitors processed for acceptance at the start of the contract, and thence from each 6-month's production. The sample units shall be subdivided as specified for each subgroup in table III.

4.5.2.1.2 Defectives. If the number of defectives exceed the number allowed in table III, the sample shall be considered to have failed.

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

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TABLE III. Group B inspection.

Examination or test	Requirement paragraph	Test paragraph	Number of sample units to be inspected	Number of defectives permitted ^{1/}
Subgroup 1				
Vibration - - - - -	3.13	4.6.10	2	0
Shock (specified pulse) - - - - -	3.14	4.6.11		
Dielectric withstanding voltage - -	3.5	4.6.2		
Capacitance - - - - -	3.6	4.6.3		
Leakage current - - - - -	3.7	4.6.4		
Dissipation factor - - - - -	3.8	4.6.5		
Mechanical adjustments (variable capacitors only) - - - - -	3.9	4.6.6		
Capacitance change vs rotation (variable capacitors with tuning assembly only) - - - - -	3.10	4.6.7		
Resistance to solvents - - - - -	3.11	4.6.8		
Visual and mechanical examination (internal) - - - - -	3.1, 3.3 through 3.4.1.2, 3.20 through 3.20.3	4.6.1		
Subgroup 2				
Salt spray (corrosion) - - - - -	3.15	4.6.12	2	
Life (variable capacitors only) - -	3.18	4.6.15		

^{1/} Failure of a capacitor in one or more tests of a subgroup will be charged as a single defective.

4.5.2.1.4 Noncompliance. If a sample fails to pass group B inspection, the supplier shall 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 of the product shall be discontinued until corrective action, acceptable to the Government, has been taken. After the corrective action has been taken, group B inspection shall be repeated on additional sample units (all inspection, or the inspection which the original sample failed, at the option of the Government). Group A inspection may be reinstituted; however, final acceptance shall be withheld until the group B reinspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure and the corrective action taken shall be furnished to the cognizant inspection activity and the qualifying activity.

4.5.3 Inspection of preparation for delivery. Sample packages and packs and the inspection of the preservation-packaging, packing and marking for shipment and storage shall be in accordance with MIL-C-39028.

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4.6 Methods of examination and test.

4.6.1 Visual and mechanical examination. Capacitors 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, 3.3 to 3.4.1.2 incl., and 3.19 to 3.20.2 incl.)

4.6.1.1 Plated surfaces and bearings (see 3.20.3). The plated surfaces shall be tested for presence of cyanide by passing a piece of damp blue litmus paper over the plated surface. (The litmus paper will change color if acids or salts are present.) The presence of cyanide inside the bearing is indicated by a smear with the appearance of oxidized silver that extends over the top of the bearing.

4.6.2 Dielectric withstanding voltage (see 3.5). This test shall be performed in accordance with method 301 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Special conditions - High potential shall be applied at rated minimum, rated maximum, and mid-range capacitance for variable units and dielectric strength shall be measured with Jennings Model JHP-70 tester or equivalent.
- (b) Magnitude of test voltage - See table IV.
- (c) Nature of potential - ac.
- (d) Duration of application of test voltage - Peak test voltage shall be applied at a rate such that no transients would be developed with an overall time limit of one minute; an additional one minute period shall be allowed to clear any barnacles, and a final five minute period having peak test voltage applied with no barnacles allowed.
- (e) Points of application of test voltage - Terminal to terminal.
- (f) Measurement after dielectric withstanding voltage test - Capacitors shall be examined for evidence of damage, arcing, breakdown or barnacles.

TABLE IV. Dielectric withstanding voltage test.

Peak rated voltage of unit (Vr)	Test voltage to be applied (Vt)
Vr equal to and less than 10 kV	Vt = (Vr + 1 kV)
Vr greater than 10 kV but less than 35 kV	Vt = (Vr + 2 kV)
Vr equal to and greater than 35 kV	Vt = (Vr + 5 kV)

NOTE: All ratings are 60 Hz ac peak potential.

4.6.3 Capacitance (see 3.6). Capacitance shall be measured in accordance with method 305 of MIL-STD-202. The following details shall apply:

- (a) Test frequency - 1 kilohertz (kHz) ± 5 percent.
- (b) Limit of accuracy - Shall be within 0.1 percent or 0.1 pF, whichever is greater.

4.6.4 Leakage current (see 3.7). DC leakage current shall be measured with a dc voltage of at least 60 percent of the peak rated voltage applied across the capacitor terminals. Variable capacitors shall be set at the maximum rated capacitance position. Measure and note the dc leakage current; reverse the polarity of the test voltage and again measure the dc current.

4.6.5 Dissipation factor (see 3.8). The dissipation factor shall be determined by a polarized bridge. Measurement accuracy shall be within ± 2 percent. Measurements are to be measured on variable units at the minimum rated capacitance setting at a frequency of 1 kHz.

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4.6.6 Mechanical adjustments (variable capacitors only) (see 3.9).

- (a) Capacitors with tuning assembly (a torque measuring device, of the type indicating the maximum torque encountered, shall be used):
 - (1) End-stops (when applicable) - The tuning shaft of the capacitor shall be turned all the way clockwise and counter-clockwise to the end-stops, applying the specified torque (see 3.1) against each end-stop. After the test, capacitors must meet requirements of 3.9(a)(2).
 - (2) Tuning shaft - The torque required to start and maintain rotation of the rotor for each single turn beginning at maximum rated capacitance and continuing to minimum rated capacitance and back to maximum rated capacitance shall be measured. The rotation shall be at a rate of 10 ± 2 revolutions per minute and shall be stopped and started again for each turn. Each turn shall be interpreted to mean 360 ± 45 degrees. The maximum torque for each turn shall be recorded.
- (b) Capacitors without tuning assembly - The actuating force (pull or push, as applicable, see 3.1) shall be measured for capacitors not equipped with lead screws.

4.6.6.1 For qualification inspection. The test specified in 4.6.6 shall be performed at $25 \pm 3^\circ\text{C}$, low ambient operating temperature $+0^\circ\text{C}$, and high ambient operating temperature $+8^\circ\text{C}$.

4.6.6.2 For quality conformance inspection. For group A inspection, the test specified in 4.6.6 shall be performed at an ambient temperature of $25 \pm 3^\circ\text{C}$. Group B inspection shall be performed at low ambient operating temperature $+3^\circ\text{C}$, and high ambient operating temperature $+8^\circ\text{C}$.

4.6.7 Capacitance change versus rotation (variable capacitors with tuning assembly only) (see 3.10). The capacitance of all variable capacitors shall be measured (see 4.6.3) for each single rotation of the rotor from maximum rated to minimum rated capacitance and the value recorded for each turn shall be tabulated. Each turn shall be interpreted to mean 360 degrees ± 2 degrees. The tolerance of ± 2 degrees shall be noncumulative.

4.6.8 Resistance to solvents (see 3.11). Capacitors shall be tested in accordance with method 215 of MIL-STD-202. The following details shall apply:

- (a) Portion of specimen to be brushed - That portion on which marking is present.
- (b) Number of specimens to be tested - As specified in applicable inspection tables.
- (c) Permissible extent of damage - As specified in 3.19.

4.6.9 Thermal shock (see 3.12). The thermal shock test shall be performed in accordance with method 107 of MIL-STD-202. The following details shall apply:

- (a) Test condition - B.
- (b) Measurements before and after cycling - Not applicable.

4.6.10 Vibration (see 3.13). When specified (see 3.1), capacitors shall be tested in accordance with method 201 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Tests and measurements prior to vibration - Not applicable.
- (b) Mounting - Rigidly mounted by the capacitors normal mounting means.
- (c) Capacitance setting (variables only) - Capacitors will be adjusted to maximum rated capacitance.
- (d) Duration of vibration - Unless otherwise specified (see 3.1), one hour.
- (e) Direction of motion - Unless otherwise specified (see 3.1), only in a plane perpendicular to the axis.
- (f) Measurements during the test - Capacitors shall be monitored for momentary, intermittent arcing or breakdown.
- (g) Electrical-load condition - Rated voltage at 60 Hz to be applied.

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4.6.10.1 Vibration, high frequency (see 3.13). When specified (see 3.1), capacitors shall be tested in accordance with method 204 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Mounting - Rigidly mounted by the capacitors normal mounting means.
- (b) Test condition - As specified (see 3.1). Variables will be tested at maximum rated capacitance setting.
- (c) Duration and direction of motion - As specified (see 3.1).
- (d) Measurements during the test - Capacitors shall be monitored for momentary, intermittent arcing or breakdown.
- (e) Electrical-load condition - Rated voltage at 60 Hz to be applied.

4.6.11 Shock (specified pulse) (see 3.14). Capacitors shall be tested in accordance with method 213 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Mounting - Rigidly mounted by the capacitors normal mounting means.
- (b) Test condition - K. Variables will be tested at maximum rated capacitance setting.
- (c) Measurements during shock - Capacitors shall be monitored for momentary intermittent arcing or breakdown.
- (d) Electrical-load condition - Rated voltage at 60 Hz to be applied.

4.6.12 Salt spray (corrosion) (see 3.15). Capacitors shall be tested in accordance with method 101 of MIL-STD-202. The following details and exceptions shall apply:

- (a) Applicable salt solution - 5 percent.
- (b) Test condition - B.
- (c) Measurements after exposure - Not applicable.

4.6.13 Capacitance change with temperature (see 3.16). The capacitance change with temperature shall be determined as specified.

4.6.13.1 Variable capacitors.

- (a) Measure and record midrange capacitance value at $23 \pm 3^\circ\text{C}$. Identify this value of capacitance as C.
- (b) Place capacitor in chamber at high ambient operating temperature $+3^\circ\text{C}$ (see 3.1).
- (c) Measure and record capacitance. Identify this value of capacitance as C1.
- (d) Place capacitor in chamber at low ambient operating temperature -3°C (see 3.1).
- (e) Measure and record capacitance. Identify this value of capacitance as C2.
- (f) Calculate $C1 - C2$.
- (g) Calculate percent capacitance change with temperature by the formula:

$$\text{Percent change} = \frac{(C1 - C2) 100}{C}$$

4.6.13.2 Fixed capacitors. The same sequence shall be followed as outlined in 4.6.13.1, except that the nominal capacitance (measured as specified in 4.6.3) shall be used in place of the midcapacitance referred to in 4.6.13.1(a).

4.6.14 Rated load (see 3.17). The capacitors, in an ambient temperature of $23 \pm 3^\circ\text{C}$, shall be loaded with proper voltage and current (i.e., the highest voltage that can be applied without exceeding the rated voltage or current by $I = E/Z_c$) at a frequency of 16 megahertz (MHz), unless otherwise specified (see 3.1 or 6.1) and operated under these conditions until a thermal stability is achieved. The temperature will be established by use of thermal-sensitive waxes (with temperature ratings in 10° increments) applied at various strategic areas on the capacitor under test. As the heat advances through the thermal-sensitive wax ranges (115°C , 125°C , 135°C , etc.), they will individually glaze indicating a heat rise to that particular temperature. The final temperature will be somewhere between the highest glazed point and the next unglazed point. During the heat rise,

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a very slight detuning of the resonant tank circuit may occur. Stability will also be verified when the tuning position ceases to change. Nominal radio frequency (rf) current shall be allowed to flow through the capacitor under test for two hours. Note and record stabilization time rise in temperature and capacitance variation. During this test, the capacitor shall be observed for evidence of breakdown or arcing. No heat should be conveyed or conducted to the capacitor from any nearby heat producing devices such as tuning coils.

4.6.15 Life (variable capacitors only) (see 3.18).

4.6.15.1 Capacitors with tuning assembly. Capacitors shall be mounted in such a manner that the shafts are continuously rotated backward and forward. Range of travel (cycle) shall be from maximum rated capacitance to minimum rated capacitance and return. The number of life cycles shall be 12,500, unless otherwise specified (see 3.1), and at a rate of 6 ± 2 cycles per minute. No lubricating or cleaning of the lead screw mechanism shall be allowed during life testing. Gear assemblies or shaft extensions (if applicable) shall be removed prior to test.

4.6.15.2 Capacitors without tuning assembly. Capacitors shall be mounted in such a manner that the plungers are actuated backward and forward. Range of travel (cycle), number and rate of life cycles shall be in accordance with 4.6.15.1. After cycling, dielectric withstanding voltage, mechanical adjustments, and capacitance change versus rotation, when applicable (see 3.1), shall be measured as specified in 4.6.2, 4.6.6 and 4.6.7, respectively.

5. PREPARATION FOR DELIVERY

5.1 Capacitors shall be prepared for delivery in accordance with MIL-C-39028.

6. NOTES

6.1 Ordering data. Procurement 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 part number (see 3.1).
- (c) Number of cycles required for rotational life test (see 4.6.15).
- (d) Frequency of ac source to be used in rated load test, if other than 16 MHz (see 4.6.14).

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 suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the qualified products list is Naval Electronic Systems Command; however, information pertaining to qualification of products may be obtained from Defense Electronics Supply Center (DESC-E), Dayton, Ohio 45401. Applications for qualification tests shall be made in accordance with "Provisions Governing Qualification" (see 6.3).

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

6.4 The margins of this specification are marked with an asterisk 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.

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Custodians:

Army - EL
Navy - EC
Air Force - 11

Review activities:

Army - MU, EL
Navy - EC
Air Force - 11, 17, 80
DSA - ES

User activities:

Army - None
Navy - AS, OS, MC
Air Force - 19

Preparing activity:

Navy - EC

Agent:

DSA - ES

(Project 5910-1009)

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APPENDIX

PROCEDURE FOR QUALIFICATION INSPECTION

10. SCOPE

10.1 This appendix details the procedure for selection of samples and submission of related data for qualification inspection of capacitors covered by this specification. The procedure for extending qualification of the required samples to other capacitors covered by this specification is also outlined herein.

20. SUBMISSION

20.1 Sample. A sample consisting of 8 specimens of the type for which qualification is sought shall be submitted (see 30.1).

20.2 Combined type submission. Two or more types of capacitors, 4 of each type, may be represented in a combined submission. Types are grouped, based on electrical and mechanical similarity, as shown in table V.

20.3 Certification of material. When submitting data for qualification, the manufacturer shall submit certification, in duplicate, that the materials used in his components are in accordance with the applicable specification requirements.

20.3 Description of items.

30. EXTENT OF QUALIFICATION

30.1 Qualification will be restricted to dielectric material, fixed or variable, case material, capacitance values, voltage ratings and current ratings equal to and less than those of the unit submitted. Qualification of unit with gear assembly will also qualify identical unit without gear.

30.1.1 In no event will approval of a fixed capacitor (regardless of ratings involved) be extended to cover a variable unit.

30.2 Combined type submission. Qualification will be restricted as specified in table V.

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TABLE V. Combined qualification submission.

Units to be tested	Quantity	Qualification coverage
CG10N060M CG10N251M	4 ea 4 ea	All CG10s
CG15N501M CG15N102M	4 ea 4 ea	All CG15s
CG20L050-250C CG20L100-500C	4 ea 4 ea	CG20L050-250C CG20L100-500C
CG20J250-501H CG21F100-401G	4 ea 4 ea	CG20J050-201H CG20J100-301H CG20J100-401H CG20J250-501H CG21F100-401G
CG20H250-701K CG20H250-102K	4 ea 4 ea	CG20H250-701K CG20H250-102K
CG30J120-501R CG31J100-501R	4 ea 4 ea	CG30J120-501R CG31J100-501R CG32J120-501N
CG40G150-122R CG44G500-202R	4 ea 4 ea	CG40G150-122R CG42G500-202R CG43G500-202R CG44G500-202R
CG41B100-112M CG41B500-232K	4 ea 4 ea	CG41B100-112M CG41B200-152K CG41B500-232K
CG50U101-152S CG51U200-751S	4 ea 4 ea	CG50U101-152S CG51U200-751S
CG60B200-202H CG60B500-302H	4 ea 4 ea	CG60B200-202H CG60B500-302H
CG63E050-751H CG67C070-102H	4 ea 4 ea	CG60C050-751H CG60C070-102H CG63E050-751H CG64E050-751H CG67C070-102H
CG62C070-971E CG66E050-471G	4 ea 4 ea	CG61V050-461A CG62C070-971E CG65E050-471G CG66E050-471G

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SPECIFICATION ANALYSIS SHEET		Form Approved Budget Bureau No. 22-R255
<p>INSTRUCTIONS: This sheet is to be filled out by personnel, either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments and suggestions submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or serve to amend contractual requirements.</p>		
SPECIFICATION		
ORGANIZATION		
CITY AND STATE	CONTRACT NUMBER	
MATERIAL PROCURED UNDER A <input type="checkbox"/> DIRECT GOVERNMENT CONTRACT <input type="checkbox"/> SUBCONTRACT		
1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE? A. GIVE PARAGRAPH NUMBER AND WORDING.		
B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES		
2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID		
3. IS THE SPECIFICATION RESTRICTIVE? <input type="checkbox"/> YES <input type="checkbox"/> NO (If "yes", in what way?)		
4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)		
SUBMITTED BY (Printed or typed name and activity - Optional)		DATE

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REPLACES EDITION OF 1 OCT 64 WHICH MAY BE USED.

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