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6 April 1981
SUPERSEDES
MIL-A-24319A(EC)
10 December 1969

MILITARY SPECIFICATION

ANTENNA WHIP, AS-2537()/SR 10.67 METER (35 FT)

1. SCOPE

1.1 This specification covers the design, performance and testing of a two-piece 35 foot(ft) fiberglass reinforced plastic composite whip-type antenna (hereinafter called the antenna) for use aboard surface ship and shore facilities for general communications purposes. This antenna is designed for transmit and receive operations over the 2.0000 through 29.9999 megahertz(MHz) frequency range and receive only operation over the 10-kilohertz(kHz) to 2.0000 MHz frequency range.

2. APPLICABLE DOCUMENTS

2.1 Government documents. The following documents, of the issue listed in the Department of Defense Index of Specifications and Standards (DoDISS) and its supplements, form a part of this document to the extent specified herein. The date of the applicable DoDISS and supplements thereto shall be as specified in the solicitation.

SPECIFICATIONS

FEDERAL

QQ-N-35	Naval Brass; Rods, Bars, Wire, Shapes, And Forgings And Flat Products With Finished Edges
QQ-C-533	Copper-Beryllium Alloy Strip (Copper Alloy Numbers 170 and-172.)
QQ-B-626	Yellow Brass

MILITARY

MIL-S-901(NAVY)	Shock Test, HI (High Impact); Shipboard Machinery, Equipment and Systems, Requirements for (Navy)
MIL-C-5541	Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-S-8660	Silicone Compound
MIL-R-9300	Resin, Epoxy
MIL-E-16400	Electronic Equipment, Naval Ship and Shore, General Specification for
MIL-E-17555	Electronic and Electrical Equipment, Accessories, and Repair Parts, Packaging and Packing of

STANDARDS

MILITARY

MIL-STD-105	Sampling Procedures and Table for Inspection by Attributes
MIL-STD-109	Quality Assurance Terms and Definitions
MIL-STD-167-1	Mechanical Vibrations of Shipboard Equipment

(Copies of specifications, standards, handbooks, publications and drawings 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 documents form 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.

AMERICAN NATIONAL STANDARDS INSTITUTE

ANSI C29.1 — Electrical Power Insulators, Test Methods for

3. REQUIREMENTS

3.1 General. Equipments shall be in accordance with the provisions of MIL-E-16400, to the extent specified herein.

3.2 First article(s). When specified in the contract, five preproduction samples of the antenna shall be supplied for first article evaluation in accordance with 4.3 prior to commencement of production. These samples shall be completely representative of production equipments.

3.3 Characteristics.

3.3.1 Performance characteristics.

3.3.1.1 Operating frequency range.

3.3.1.1.1 Matched condition. The antenna shall be capable of operating as specified herein over the inclusive frequency range of 2.0000 to 29.9999 MHz and with the AN/URA-( ) selective antenna coupler group and the generic AN/URA-38 antenna coupler group to provide a matched, efficient transmit and receive antenna system.

3.3.1.1.2 Terminated condition. The antenna shall be capable of operating over the inclusive frequency range of 10 kHz to 29.9999 MHz with a 50-ohm termination to provide a receive system sensitivity (operating noise factor) nominally limited by external noise.

3.3.1.2 Feed point impedance. The antenna shall have a feed point impedance within the limits stated in TABLE I, when measured through a 18-inch(in) low inductance feed strap, when configured vertically at the center of a 500-ft minimum radius ground plane with vertically polarized, conducting structures subtending an angle greater than 10 degrees from the antenna mounting point through 1000 ft and when measurements are made in accordance with 4.5.6.

3.3.1.3 One quarter wave length frequency. The antenna shall go through its first series resonance (one quarter wave frequency), as determined by the first R±jo axis crossing, at 6.75 MHz ±0.25 MHz and when measured in accordance with 4.5.7.

3.3.1.4 Radio frequency(RF) power rating. The antenna shall be capable of handling 5 kilowatt(kW) average power and 10 kW peak envelope power(PEP) indefinitely without damage or degradation in performance when measured in accordance with 4.5.8.

TABLE I.A. Nominal impedance vs. frequency (2.0 to 5.0 MHz) with allowable tolerances.

Frequency (MHz)	Resistance (OHMS)	R tolerance	Reactance (OHMS)	X tolerance
2.0	2.50	+0.75 -0.25	-j500	+j100 -j30
3.0	4.00	±0.50	-j300	±j20
4.0	8.00	±0.50	-j180	±j20
5.0	16.00	±0.50	-j100	±j20

TABLE I.B. Nominal impedance (6 to 30 MHz).

Frequency (MHz)	VSWR (50 ohm system)
6	3:1 or less
7	3:1
8	6:1
9	9:1
10	12:1
12	18:1
14	20:1
16	14:1
18	5:1
20	4:1
22	8:1
24	9:1
26	10:1
28	10:1
30	6:1

3.3.2 Physical characteristics.

3.3.2.1 Weight. The antenna shall have a nominal maximum weight of 176.37 pounds(lbs), exclusive of packing, crating and maintenance and installation kits.

3.3.2.2 Size. The antenna shall have a maximum envelope diameter of 12 in a maximum height of 36 ft.

3.3.3 Environmental service conditions.

3.3.3.1 Operating temperature range. The antenna shall have an operating temperature range of that for equipments exposed to weather (unsheltered) of MIL-E-16400 (Range 1).

3.3.3.2 Non-operating temperature range. The antenna shall have a non-operating temperature range of that of equipments exposed to weather (unsheltered) of MIL-E-16400 (Range 1).

3.3.3.3 Salt fog (spray). The antenna shall meet the salt fog (spray) requirements of MIL-E-16400 for exposed equipment.

3.3.3.4 Sunshine. The antenna shall meet the sunshine requirements of MIL-E-16400.

3.3.3.5 Fungus. The antenna shall meet the fungus requirements of MIL-E-16400.

3.3.3.6 Repeated wind loads.

3.3.3.6.1 Spectrum I loadings. The antenna when installed in a vertical position shall withstand 500,000 cycles, in a simulated sea spray environment, of a drag loading due to a 25 knot wind increased to that for 75 knot wind and return (loading spectrum I). The antenna shall not experience structural or electrical degradation which would require replacement in service (see 4.5.16 and 4.5.16.1). Drag coefficients to be employed in calculating wind loads shall be subject to approval by the procuring activity.

3.3.3.6.2 Spectrum II loading. Separately, the antenna when installed in a vertical position shall withstand 1000 cycles of loading from a drag loading corresponding to a 65-knot wind to that for a 125-knot wind and return (loading spectrum II). The antenna shall not experience structural or electrical degradation which would require immediate replacement in service. (See 4.5.16 and 4.15.16.2). Drag coefficients to be employed in calculating wind loads shall be subject to approval by the procuring activity.

3.3.3.6.3 Structural examination-spectrums I and II loading. The antenna shall be capable of passing the structural examination of 4.5.16.3 following spectrum I and II loading.

3.3.3.6.4 Structural examination. The antenna shall be capable of passing the structural examination of 4.5.16.4 at any point in the time sequencing of section four testing. (Note that a sample submitted for purposes of determining compliance with 3.3.3.6.4 will be totally consumed in the examination process.)

3.3.3.7 Wind induced vibrations. The antenna shall be free of sustained, self-induced vibrations at all wind velocities up to and including 125 knots and when tested in accordance with 4.5.15.

3.3.3.8 Nuclear air blast. The antenna shall conform to the nuclear air blast requirements of MIL-E-16400. The peak overpressure, P, shall be 7.2 lbs per square in.(psi) and the peak dynamic pressure, Q, shall be 1.2 psi.

3.3.3.9 Shock. The completely assembled antenna shall be capable of withstanding, in both horizontal and vertical orientation, the Grade I, Type A, class HI (High Impact) shock test for light weight equipment of MIL-S-901 when tested in accordance with 4.5.22.

3.3.3.10 Vibration. The completely assembled antenna shall withstand, in both horizontal and vertical orientation, the type 1 environmental vibration requirements of MIL-STD-167-1. The antenna shall be capable of withstanding 9×10^6 double amplitude cycles or 250 hours, whichever is greater, of resonant dwell vibration at each of the first three resonant frequencies, with maximum exciting table amplitude applied orthogonally to antenna longitudinal axis. Internal conductor continuity for all conductors in both upper and lower sections and from section to section shall be maintained for this time duration.

3.4 Parts, materials and processes.

3.4.1 Parts.

3.4.1.1 Fastener hardware.

3.4.1.1.1 Antenna feed point attachment hardware. Antenna feed point attachment hardware shall be in accordance with FIGURE 1.

3.4.1.1.2 Antenna deck and table base mounting. Antenna deck and table base mounting hardware shall be in accordance with FIGURE 1.

3.4.1.1.3 Upper-to-lower-section locking hardware. Upper-to-lower-section locking hardware shall be in accordance with FIGURE 1.

3.4.2 Materials.

3.4.2.1 Antenna structural materials.

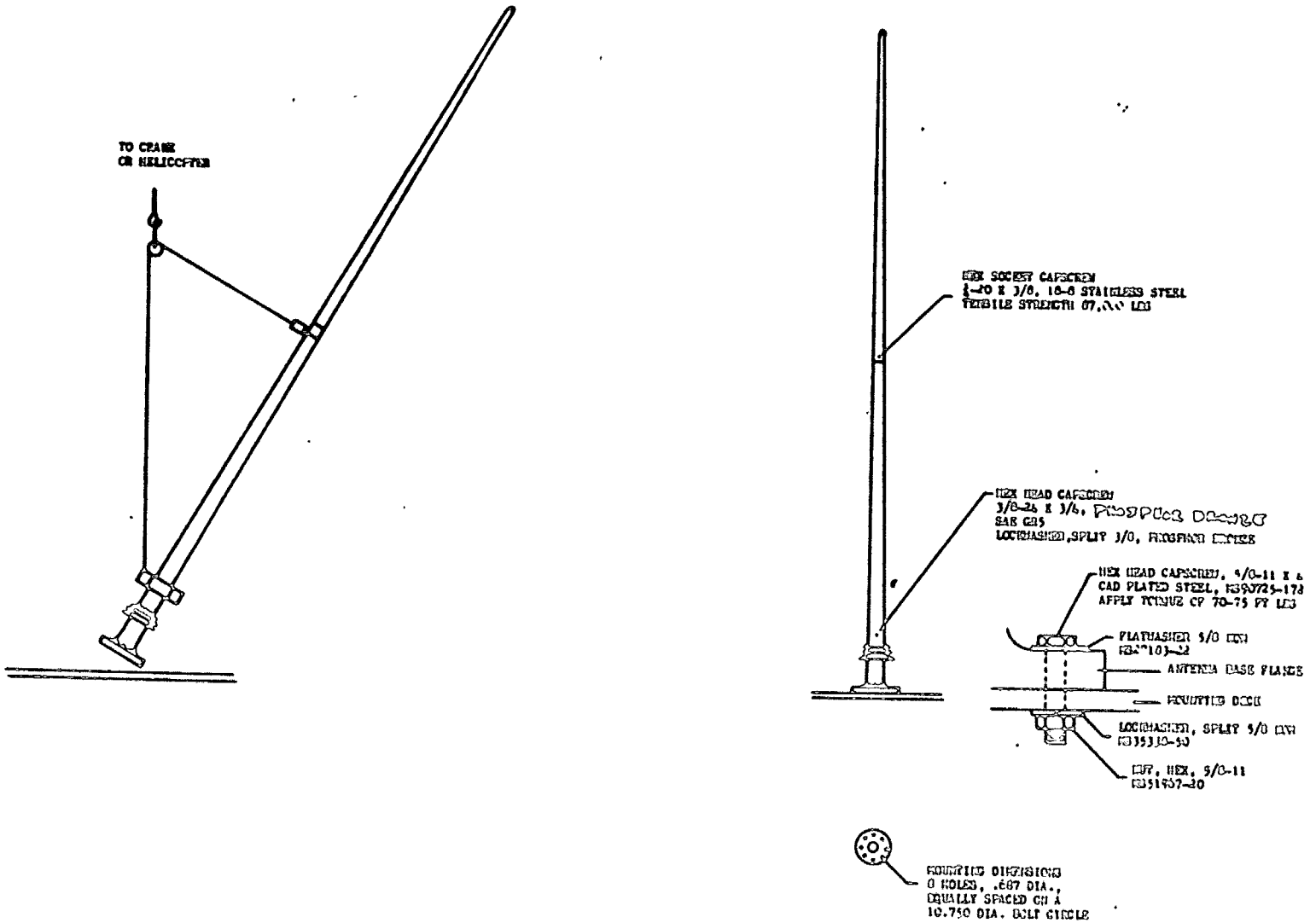

FIGURE 1. Antenna hardware and outline drawing.

3.4.2.1.1 Reinforcing materials. The reinforcing material for the insulator shall be type E (electrical grade) alumina borosilicate glass with a silane finish (sizing). Reinforcing material shall be continuous glass roving gathered without mechanical twist. Yarn, fabric, or other woven material shall not be utilized.

3.4.2.1.1.1 Glass roving. The glass roving shall not contain grease, oil, or dirt inside its form. The glass roving shall not contain knots, loose strands, or fuzz accumulation which will cause a detectable change in the smoothness of the glass roving.

3.4.2.1.2 Epoxy resin system. The antenna shall employ an epoxy resin system in accordance with MIL-R-9300.

3.4.2.2 Grading rings. The grading rings shall be of fiberglass reinforced plastic (FRP) composite material.

3.4.2.3 Antenna mounting base. The antenna mounting base shall be of FRP composite material made of the same glass and resin system as the antenna structure proper.

3.4.2.4 Antenna current carrying material.

3.4.2.4.1 Longitudinal current carrying strips. The antenna current carrying material shall be beryllium copper alloy strip, copper alloy number 172, half hard (1/2 hard) per QQ-C-533.

3.4.2.4.2 Corona shield. The corona shield used in the upper section of the antenna to terminate the top section longitudinal current carrying strips shall be of brass per QQ-B-626, composition 22, 1/2 hard.

3.4.2.4.3 Midsection coupling joint. The upper and lower halves of the midsection coupling joint shall be of brass per QQ-B-626, composition 22, 1/2 hard.

3.4.2.4.4 Lower section collector ring. The lower section collector ring terminating the lower section longitudinal conductors shall be of brass per QQ-B-626, composition 22, 1/2 hard.

3.4.2.5 Static seals. The midsection coupling joint shall employ a deformable O-ring static seal in accordance with MIL-E-16400 to preclude entry of moisture and salt spray.

3.4.3 Processes.

3.4.3.1 Castings. All castings used shall be in accordance with MIL-E-16400.

3.4.3.2 Corrosion protection and corrosion resisting treatments. All metal structures and assemblies used in the antenna shall be protected from corrosion by a chemical conversion treatment per MIL-C-5541, type III.

3.4.3.3 Painting. The paint system used for the antenna shall meet the adhesion and blister resistance requirements of MIL-E-16400.

3.4.3.3.1 Antenna exterior. The external structure of the antenna shall be painted in accordance with MIL-E-16400 with a cyclo-aliphatic epoxy paint which includes an ultra-violet screen and exhibits anti-electrical erosion and self-extinguishing properties.

3.4.3.3.2 Antenna metal components. The antenna metal components shall have the necessary interface (primer) coatings between the MIL-C-5541 metal surface treatment and the cyclo-aliphatic top coating on all surfaces exposed to the environment and where electrical contact is not required for proper electrical operation.

3.4.3.4 Brazing. Brazing shall be in accordance with the brazing requirements of MIL-E-16400.

3.5 Electrical design and construction.

3.5.1 Physical length of conductors. The total length of longitudinal current carrying conductors in the fully assembled antenna, measured from the base of the feed point collector ring assembly of the lower section through the top of the corona shield of the upper section shall be 35 ft.

3.5.2 Geometry of conductors.

3.5.2.1 Bottom section. The bottom section of the antenna shall employ six equally spaced longitudinal conductors brazed to the cylindrical feed point collector ring at the deck mounting end and brazed to the bottom of the lower half of the coupling section brass ferrule.

3.5.2.2 Top section. The top section of the antenna shall employ an even number of equally spaced longitudinal conductors brazed to the upper half of the coupling section brass ferrule and brazed to the brass corona shield at the end of the top section.

3.5.2.3 Conductor cross section. The conductors employed in the antenna shall be of sufficient cross section and detailed interconnection geometry to accommodate 5 kW of average RF power and 10 kW PEP under conditions of failure of up to and including 20 percent of the total midsection longitudinal conductor cross section with no degradation of the structural integrity due to thermal stress or high voltage breakdown phenomena such as corona or arcing.

3.5.2.4 Location of feed point. The antenna feed point center shall be nominally 12 in from the datum (mounting plane of antenna) and shall be attached to the center of the collector ring assembly.

3.5.3 Integral base insulator. The antenna shall contain an integral base insulator of FRP composite with resin and glass systems identical to the structural portions of the antenna.

3.5.3.1 RF voltage rating.

3.5.3.1.1 Dry withstand. The antenna shall have a minimum dry withstand voltage rating of 30 kilovolts(kV) root mean square(rms) at 2 MHz, when tested in accordance with ANSI C29.1.

3.5.3.1.2 Wet withstand. The antenna shall have a minimum wet withstand voltage rating of 25 kV rms at 2 MHz, when tested in accordance with ANSI C29.1.

3.5.3.1.3 Dry flashover. The antenna shall have a minimum dry flashover voltage rating of 35 kV rms at 2 MHz, when tested in accordance with ANSI C29.1.

3.5.3.1.4 Wet flashover. The antenna shall have a minimum wet flashover voltage rating of 30 kV rms at 2 MHz, when tested in accordance with ANSI C29.1.

3.5.3.2 Voltage grading. A minimum of three circumferential dielectric voltage grading petticoats shall be placed between the feed point and the mounting base structure.

3.6 Mechanical design and construction.

3.6.1 General. The antenna shall be a two-piece, hollow, linearly tapered filament-wound FRP composite structure as depicted in FIGURE 1 with integral upper and lower section conductor cages, integral standoff insulator, mounting base and upper and lower section electrical and mechanical coupling joints.

3.6.1.1 Lower section.

3.6.1.1.1 Construction. The lower section shall be constructed of filament-wound fiberglass and a thermosetting epoxy resin.

3.6.1.1.2 Dimensions. The lower section shall have a length of 18 ft from the mounting plane datum to the top of the coupling ferrule O-ring seal groove. The lower section shall have a minimum outer diameter of 4.13 in at the top of the section and a minimum outer diameter of 6.30 in at the feed point, 12 in from the mounting datum. The lower section shall have a minimum wall thickness of 0.39 in. The integral mounting base shall be capable of being mounted by eight equally spaced 0.625-in diameter bolts on a 10.75-in diameter bolt circle. The integral mounting base shall have the equivalent of a 0.51 in diameter condensation drain groove in the bottom face.

3.6.1.1.3 Antenna feed point. The lower section shall contain an electrical, RF feedpoint in the form of an eye-shaped brass boss attached to the collector ring and suitably sealed against water entry. The eye-shaped boss shall be drilled and tapped to accept a 3/8-24 X 3/4 phosphor bronze hex head cap screw.

3.6.1.2 Upper section.

3.6.1.2.1 Construction. The upper section shall be constructed of filament-wound fiberglass and a thermosetting epoxy resin.

3.6.1.2.2 Dimensions. The upper section shall have a length of 18 ft from the top of the corona shield to the bottom of the coupling ferrule O-ring sealing surface. The upper section shall have a minimum outer diameter of 4.13 in at the bottom of the section and a minimum outer diameter of 1.84 in at the top of the section. The upper section shall have a minimum wall thickness of 0.24 in.

3.6.2 Antenna section coupling unit. The two sections of the antenna (upper and lower) shall be coupled by means of a threaded brass ferrule.

3.6.2.1 Locking pins. Three threaded stainless steel locking pins shall be used to prevent relative rotation of the upper and lower antenna sections after assembly. The upper and lower section ferrule halves shall be clearance and tap drilled, respectively, to accept three equally spaced, threaded stainless steel Allen head locking screws. The upper and lower sections shall contain indelible locking pin registration marks for use in assembly to insure complete engagement of pins.

3.6.2.2 Static seal. The antenna section coupling unit shall employ an O-ring gasket, lubricated with silicone grease per MIL-S-8660, for a gas-tight seal between the upper and lower antenna section ferrules. The assembled sections shall be sealed against water entry under the structural loading of paragraphs 3.3.3.6.1 and 3.3.3.6.2.

3.6.2.3 Exposure to environment. All surfaces of the fully assembled coupling joint that would otherwise be exposed to the environment shall be fully embedded in and mechanically integrated with the FRP composite antenna structure.

3.6.2.4 Disassembly. The coupling joint shall be designed for potentially destructive disassembly (one time use only) through proper selection of assembly torque, mechanical or chemical staking of locking pins, assembly torque of locking pin and degree of ferrule thread interference.

3.6.3 Structural characteristics.

3.6.3.1 Structural damping. The fully assembled antenna structure shall have a normalized in-air damping coefficient of not less than 0.03 for all natural vibration modes.

3.5.3.2 Static sag. When the antenna is mounted or oriented horizontally the top tip-end shall not droop more than 17.72 in from the centerline of the antenna tip.

3.7 Assembly and installation kits.

3.7.1 Assembly kits. Each antenna shall be supplied unassembled with assembly kits to include, but not to be limited to the following:

a. Two strap wrenches.

b. Six locking pins in accordance with FIGURE 1; small application container of permanent Loctite; small application tube of room temperature vulcanizing(RTV) silicone rubber; and, two Allen wrenches to fit Allen head locking pins.
c. Three individually packed O-ring seals and one applicator tube of silicone grease.

3.7.2 Installation kits. Each antenna shall be supplied with installation kits to include, but not be limited to, the following:

a. Sixteen deck on table mounting bolts, flat washers and lockwashers in accordance with FIGURE 1.
b. Three feed point attachment bolts and lockwashers in accordance with FIGURE 1.

3.8 Workmanship. Workmanship for all antennas shall conform to the requirements of MIL-E-16400. This shall include freedom from defects in machining, filament winding, welding, casting and assembly.

3.9 Identification and markings. Identification and markings of the antenna and all parts, including assembly and installation kits, shall be in accordance with MIL-E-16400.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, 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 Government verification. All quality operations performed by the contractor will be subject to Government verification at any time. Verification will consist of, but is not limited to, a) Surveillance of the operations to determine that practices, methods, and procedures of the written quality program are being properly applied, b) Government product inspection to measure quality of the product to be offered for acceptance, c) Government inspection of delivered products to assure compliance with all inspection requirements of this specification. Failure of the contractor to promptly correct deficiencies discovered by him or of which he is notified shall be cause for suspension of acceptance until corrective action has been taken or until conformance of the product to prescribed criteria has been demonstrated.

4.1.2 Quality assurance terms and definitions. Quality assurance terms used in this specification shall be as defined in MIL-STD-109.

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

a. First article inspection (see 4.3)
b. Quality conformance inspection
    1. Production inspection (Group A) (see 4.4.1)
    2. Production control inspection (Group B) (see 4.4.2)
    3. Environmental inspection (Group C) (see 4.4.3).

4.3 First article inspection. Unless otherwise specified (see 6.2), five antennas shall be required for first article inspection. First article inspection shall consist of all examinations and testing necessary to determine compliance with all applicable requirements of this specification, including the tests specified in TABLE II.

4.4 Quality conformance inspection.

4.4.1 Production inspection (Group A). Production inspection shall be made on every antenna offered for delivery. This inspection shall comprise such examinations and test which will prove the workmanship and reveal omissions and errors of the production process. Such tests shall, for example, consist of: functional and performance tests at a limited number of points in the required range, tests which detect deviations from design and tests which detect hidden defects of materials. Production inspection shall include the examinations and tests shown in Group A of TABLE II.

4.4.2 Production control inspection (Group B). Production control inspection shall be conducted on a sampling basis as specified herein. These tests shall be performed on the complete antenna as offered for delivery. Production control inspection shall include the examinations and tests shown in Group B of TABLE II. Production control inspection shall be conducted on inspections lots that have passed the production inspection of 4.4.1. Sampling shall be in accordance with MIL-STD-105, using inspection level S-3 with an acceptable quality level (AQL) of 6.5 percent for each attribute.

4.4.2.1 Rejected lots. If an inspection lot is rejected, the contractor may withdraw the lot from further inspection. The contractor may also rework a rejected lot to correct the defects or screen out the defective units and reinspect the lot using tightened inspection. Rejected lots shall be kept separate from the new lots and shall not lose their identity.

4.4.3 Environmental inspection (Group C). Environmental inspection shall consist of the tests specified as Group C in TABLE II.

4.4.3.1 Sampling for inspection of equipment. For the first environmental inspection, one antenna from the first month's production shall be selected. For subsequent environmental inspections, one antenna per month shall be selected. Tests shall be conducted on lots that have passed the production inspection of 4.4.1.

TABLE II. Examination and tests.

Subject	Requirement	Test method	First Article	Quality conformance inspection		
				Group (A)	Group (B)	Group (C)
Assembly kits	3.7.1		X	X		
Installation kits	3.7.2		X	X		
Weight	3.3.2.1	4.5.1	X		X	
Size	3.3.2.2	4.5.1	X		X	
Parts & materials	3.4.1, 3.4.2	4.5.3	X	X		
Processes	3.4.3, 3.4.3.4	4.5.4	X	X		
Dimensions	3.5.1, 3.5.2.4, 3.6.1.1.2 3.6.1.2.2	4.5.2	X	X		
Marking	3.9	4.5.1	X	X		
Workmanship	3.8	4.5.5	X	X		
Feed point impedance	3.3.1.2	4.5.6	X		X	
Quarter wave frequency	3.3.1.3	4.5.7	X	X		
RF power rating	3.3.1.4	4.5.8	X			
RF voltage rating						
Dry withstand	3.5.3.1.1	4.5.9	X			
Wet withstand	3.5.3.1.2	4.5.10	X			X
Dry flashover	3.5.3.1.3	4.5.11	X			
Wet flashover	3.5.3.1.4	4.5.12	X			X
Structural Damping	3.6.3.1	4.5.13	X		X	
Static Sag	3.6.3.2	4.5.14	X	X		
Wind Induced Vibration	3.3.3.7	4.5.15	X			X
Repeated Wind Loads		4.5.16				
Spectrum I	3.3.3.6.1	4.5.16.1	X			
Spectrum II	3.3.3.6.2	4.5.16.2	X			
Structural Examination (Spectrums I and II)	3.3.3.6.3	4.5.16.3	X			
Structural Examination (Quality Assurance)	3.3.3.6.4	4.5.16.4	X		X	
Temperature		4.5.17				
Low Temp.	3.3.3.1	4.5.17.1	X			
High Temp.	3.3.3.2	4.5.17.2	X			
Salt Fog	3.3.3.3	4.5.18	X			X
Sunshine	3.3.3.4	4.5.19	X			
Fungus	3.3.3.5	4.5.20	X			
Nuclear Air Blast	3.3.3.8	4.5.21	X			
Shock	3.3.3.9	4.5.22	X			X
Vibrations	3.3.3.10	4.5.23	X			X
Adhesion and blister resistance	3.4.3	4.5.24	X			X

4.4.3.2 Noncompliance. If a sample antenna fails environmental inspection, the contractor shall immediately investigate the cause of failure and shall report to the Government inspector the results thereof and details of the corrective action taken on the process and all units of products which were manufactured with the same conditions, materials, processes, and so forth. If the Government inspector considers that the corrective action will not enable the antenna to conform to specified requirements, or if the contractor cannot determine the cause of failure, the matter shall be referred to the contracting officer. Antennas shall not be released for shipment prior to successful resolution of the failure.

4.5 Test methods.

4.5.1 Examinations and tests. The method of examination or test shall be in accordance with the test methods specified in MIL-E-16400.

4.5.2 Dimensions. The dimensions specified in paragraphs 3.5.1, 3.5.2.4, 3.6.1.1.2 and 3.6.1.2.2 shall be verified with suitably calibrated measuring instruments.

4.5.3 Parts and materials. Antennas shall be examined to determine conformance with 3.4.1 and 3.4.2.

4.5.4 Processes. Antennas shall be examined to determine conformance with 3.4.3.

4.5.5 Workmanship. The antenna shall be examined for workmanship in accordance with MIL-E-16400 and the additional requirements of 3.8.

4.5.6 Feed point impedance test. The antenna feed point impedance shall be measured at integral 1-MHz points in frequency from 2.0 to 30 MHz with a General Radio Model 1606B impedance bridge, or equal, and with a maximum of 18 in of low inductance feed strap connecting the bridge and antenna feed point. Each measurement shall be accomplished a minimum of ten times and the arithmetic average at each frequency used for conformance verification. Data shall be presented in tabular, Smith chart and R±jx plane format. The tabular data shall include the estimated standard deviation of the population from which the data were drawn, s(x). The antenna shall be installed in a suitable test site per 3.3.1.2 for purposes of this test.

4.5.7 One quarter wave frequency test. The one quarter wave frequency of the antenna shall be measured by finding that frequency for which the antenna feed point impedance, as measured with a General Radio Model 1606B impedance bridge, or equal, first goes through series resonance, R±jo, when the antenna feed point impedance is measured through an 18-inch low inductance feed strap connecting the antenna feed point and the impedance bridge. The antenna shall be installed in a suitable test site per 3.3.1.2 for this test.

4.5.8 RF power rating test. RF power of 5 kW average continuous wave(CW) shall be applied through a suitable, low-loss matching network to the antenna at 2 MHz and the one quarter wave frequency for a continuous period of one hour per frequency. This test shall be repeated for a 10 kW PEP two-tone RF power source; the tone separation shall be nominally 1 kHz. Any evidence of degradation of dielectric material due to heating and voltage breakdown (arcing) shall be cause for rejection. The antenna shall be installed in a suitable test site per 3.3.1.2 for purposes of this test.

4.5.9 Dry withstand test. The antenna shall be tested for dry withstand voltage per ANSI C29.1, with the voltage source applied to the antenna feed point and the antenna mounted on a metallic ground plane.

4.5.10 Wet withstand test. The antenna shall be tested for wet withstand voltage per ANSI C29.1, with the voltage source applied to the antenna feed point, the antenna mounted on a metallic ground plane and continuous water spray applied. The specimen shall have been thoroughly wetted down by water spray for at least thirty minutes prior to application of test voltages.

4.5.11 Dry flashover test. The antenna shall be tested for dry flashover voltage per ANSI C29.1, with the voltage source applied to the antenna feed point and the antenna mounted on a metallic ground plane.

4.5.12 Wet flashover test. The antenna shall be tested for wet flashover voltage per ANSI C29.1, with the voltage source applied to the antenna feed point, the antenna mounted on a metallic ground plane and continuous water spray applied. The specimen shall have been thoroughly wetted down by water spray for at least thirty minutes prior to application of test voltages.

4.5.13 Structural damping test. The antenna shall be tested for in-air damping coefficients normalized as a fraction of critical damping for the structure by exciting the antenna at its base at each of its first five resonant modes (frequencies) with vibration table, hydraulic actuator or other suitable device for a minimum of 10 cycles of stable peak-peak amplitude deflection. After stable double amplitude deflection is obtained, the actuator shall be mechanically locked and the number of cycles for the antenna structure to ring down to one half the initial amplitude shall be counted. A normalized damping coefficient of 0.03 corresponds to approximately 3.5 cycles to half amplitude. The antenna so tested shall have properly placed and bonded strain gauges or accelerometers or both to give adequate output in the first five modes, as well as adequate and suitable signal conditioning, recording, analyzing and displaying equipment to perform this test.

4.5.14 Static sag test. The center line of top end of the fully assembled antenna shall not deflect more than 17.71 in below the centerline of the antenna mounting base, when the antenna is rigidly mounted by its base with its longitudinal axis horizontal.

4.5.15 Wind induced vibration test. The antenna shall be vertically mounted on a truck bed using a specially fabricated antenna mount, GFE. The antenna's fore and aft, and lateral bending responses to relative wind velocities of 5 to 60 knots shall be determined with the antenna instrumented with strain gauges near the base and immediately below the coupling unit. The ambient wind shall be 3 knots or less during the tests. Data from the lateral bending strain gauges shall be used to determine compliance with 3.3.3.7 up to a relative wind velocity of 60 knots. Data from the strain gauges installed to measure fore and aft bending moments shall be used to determine the validity of the drag induced bending moments used in design for winds below 60 knots. Bending moments to be applied in accordance with the test requirements of 4.5.16 shall be revised as required to conform to the measured bending moments. The wind induced vibration test shall be conducted within a temperature range of $0^{o}C(32^{o}F)$ to $38^{o}C(100^{o}F)$.

4.5.16 Repeated wind load test. Repeated wind load tests shall be conducted within a temperature range of $15^{o}C(59^{o}F)$ to $32^{o}C(90^{o}F)$. The tests of 4.16.1 and 4.16.2 shall be performed using separate antennas.

4.5.16.1 Loading Spectrum I. The antenna shall be subjected to the cyclic bending moments of 3.3.3.6.1. During the test the antenna shall be placed in a horizontal position to simulate the average bending load due to the specified range of wind velocities and then cycled in a vertical plane at its first bending mode frequency such that the required design bending moment range is attained at a point immediately below the antenna feed point as well as at a point immediately below the coupling which joins the upper and lower sections of the antenna. The antenna shall be equipped with strain gauges at these locations for the purposes of monitoring applied bending moments during the test. The maximum applied bending moment shall equal or exceed the specified test bending moment. The minimin applied bending moment shall be equal to or less than the specified test bending moment (see 4.5.14). While being cycled under load, the coupling interface and the area of the feed point shall be continuously wetted by RILA Maring Mix (Synthetic sea water compound mixed at 1 lb to 3 gallons of tap water) or equivalent. The antenna shall be examined at least every 100,000 cycles for external evidence of structural degradation or when external structural degradation is apparent. Following completion of the test, or following premature failure, the antenna shall be examined in accordance with 4.5.16.3. The following shall be considered as evidence of failure to have satisfactorily completed the test:

a. Cracks longer than 1/2 inch in structural metallic components.

b. Cracking or delamination in more than 25 precent of the laminate thickness at any one location following sectioning in accordance with 4.5.16.3.
c. Loss of more than 25 percent of the total electrical conducting path at any cross section of the antenna, or the entry of simulated sea water into the antenna at the coupling between the upper and lower sections. Cracking of the external finish observed during test shall be reported as to location and number of test cycles at which it occurred.

4.5.16.2 Loading Spectrum II. The antenna shall be subjected to the cyclic bending moments of 3.3.3.6.2. The test loads shall be applied in such a manner as to closely represent the longitudinal distribution of bending moment calculated using approved aerodynamic drag coefficient data. The antenna shall be equipped with strain gauges at locations correspondng to those specified in 4.5.16.1 for purposes of monitoring applied bending moments during test. The applied bending moments shall be within +10, -0 percent of the specified test bending moments (see 4.5.15). The antenna shall be examined at least every 200 cycles of loading for external evidence of structure degradation. Following completion of the test, or following premature failure, the antenna shall be examined in accordance with 4.5.16.3. The following shall be considered as evidence of failure to have satisfactorily completed the test:

a. Permanent deflections which upon removal of applied loads exceed 6 inches at the tip of the antenna.
b. Local rupturing or crushing of glass filaments anywhere on the outer surface of the antenna.
c. Cracks longer than 2 inches in structural metallic components.
d. Loss of more than 50 percent of the total electrical conducting path at any cross section of the antenna.

Note: Small localized fatigue damage at the points of test load application shall not be considered evidence of failure to comply with these requirements.

4.5.16.3 Structural examination following test. Following the test of 4.5.16.1 and 4.5.16.2, the test antennas shall be examined as follows:

a. The antenna shall be sectioned longitudinally along its entire length in the plane of loading during test. Transverse sections shall be cut approximately 12 in from each internal collector ring for purposes evaluating electrical conductivity at the juncture of each collector ring and the associated internal conductor strips. Additional transverse and longitudinal sections shall be cut as required to evaluate all areas of evident or suspected internal structural failure anywhere in the antenna. Local sections shall be smoothed and polished as required to permit an evaluation of evidence or suspected structural degradation.
b. Evaluations of the test antenna with respect to the failure criteria of 4.5.16.1 and 4.5.16.2 shall be made and reported without delay to the procuring activity.
c. Areas found to have experienced reportable structural damage or loss of electrical conductivity following all tests performed in accordance with 4.5.16 shall be identified for sectioning in subsequent structural quality assurance examination and production control inspection (group B). (See 4.5.16.4 and 4.4.2).

4.5.16.4 Structural examination-quality assurance. Those antennas selected for structural examination on a sample basis in conformance with the requirements of 4.4.2, Production control inspection-group B, shall be examined as follows:

a. The antenna shall be cut longitudinally along its entire length in a plane passing through one of the antenna feed points. Transverse and longitudinal sections shall also be cut at local areas identified in 4.5.16.3(c). Smoothing or polishing of the latter sections shall be performed as required so as to permit evaluation of the structural characteristics of the fiberglass laminate.
b. Those sectioned portions of the antenna not conforming to the structural proportions shown on applicable manufacturing drawings, or which reveal fabrication anomalies such as voids, lack of bonding, machining errors, or deficiencies previously noted in antennas employed in the first article inspections of 4.3, shall be reported immediately to the appropriate Government quality control representative together with recommended corrective action.

4.5.17 Temperature tests. The sequence of the temperature tests shall be in accordance with the requirements of MIL-E-16400. All temperature test methods shall be in accordance with MIL-E-16400.

4.5.17.1 Low temperature tests. Cut section specimens consisting of, but not limited to, the following shall be used for the low temperature test:

a. 24 in section extending from antenna mounting base, integral insulator and petty-coats and feed point and up through 12 in above the collector ring assembly
b. 24 in section cut 12 in either side of mating surfaces of antenna section coupling unit
c. 24 in section cut 24 in below top point of antenna and extending through the corona shield.

Note: All cut ends of sections shall be hermetically sealed and finished as if they were a complete antenna.

4.5.17.2 High temperature tests. The same cut sections as in 4.5.17.1 shall be used to verify conformance to the high temperature test.

4.5.18 Salt fog tests. Salt fog test methods shall be in accordance with the requirements of MIL-E-16400, exposed equipment, Procedure II. The cut sections of 4.5.17.1 shall be used for these tests.

4.5.19 Sunshine tests. Sunshine test methods shall be in accordance with the requirement of MIL-E-16400. The cut sections of 4.5.17.1 shall be used in this test.

4.5.20 Fungus tests. Fungus test methods shall be in accordance with the requirements of MIL-E-16400. The cut sections of 4.5.17.1 shall be used for this test.

4.5.21 Nuclear air blast calculations. Calculations using the methods of MIL-E-16400 for nuclear air blast and the parameter values of paragraph 3.3.3.8 shall be used to verify conformance to the requirements for nuclear air blast.

4.5.22 Shock tests. Shock test methods shall be in accordance with the requirements of MIL-E-16400. A fully assembled, torqued, lockpinned and staked antenna shall be used in these tests. The structural investigation methods of 4.5.16.3, in addition to complete conductor continuity testing, shall be used to identify any hidden damage to the antenna resulting from the shock test regardless of the results of visual examination and attendant failure criteria of MIL-E-16400. In the application of structural examinations per 4.5.16.3 and the conductor continuity testing, criteria for failure shall be any electrically open (greater than 1 ohm of electrical resistance) conductor path or degradation of structural materials greater than 10 percent of the criteria of 4.5.16.1(a) and (b) and the criterion of 4.5.16.2(b).

4.5.23 Vibration tests. Vibration test methods shall be in accordance with the requirements of MIL-E-16400 and the special provisions of 3.3.3.10. The post test examination methods and failure criteria shall be the same as for 4.5.22.

4.5.24 Adhesion and blister resistance tests. The paint system test method shall conform to the requirements of MIL-E-16400, Procedure II. To verify the requirements of adhesion and blister resistance requirements of MIL-E-16400, the same type of cut sections as used in 4.5.17.1 shall be used. These sections may be completely stripped and re-treated and painted or newly fabricated, treated and painted sections may be used.

5. Preparation for delivery. (Preparation for delivery requirements specified herein apply only to direct Government procurement. Preparation for delivery requirements between contractors and sub-contractors shall be as specified in the individual order).

5.1 Preparation for delivery shall be in accordance with MIL-E-17555 as specified in the contract or order (see 6.1).

6. NOTES

6.1 Ordering data. Procurement documents should specify the following:
a. Title, number and date of this specification
b. Applicable levels of packaging and packing (See 5.1)
c. Number of first article samples to be submitted if other than specified in 3.2.

6.2 First article.

6.2.1 Invitations for bids should provide that the Government reserves the right to waive the requirement for first article samples as to those bidders offering a product which has been previously procured or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending procurement.

6.3 Data generated by this document are not deliverable unless specified on the Contract Data Requirements List (DD Form 1423). The data required by this specification is as follows:

a.	Paragraph 4.3	First article inspection procedure	DI-T-4901
b.	Paragraph 4.3	First article inspection report	DI-T-4902

Preparing activity:
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OMB Approval
No. 22-R255

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DOCUMENT IDENTIFIER AND TITLE
DOD-A-24319B(EC)

NAME OF ORGANIZATION AND ADDRESS

CONTRACT NUMBER

MATERIAL PROCURED UNDER A
☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT

1. HAS ANY PART OF THE DOCUMENT CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?
   A. GIVE PARAGRAPH NUMBER AND WORDING.

   B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES

2. COMMENTS ON ANY DOCUMENT REQUIREMENT CONSIDERED TOO RIGID

3. IS THE DOCUMENT RESTRICTIVE?
   ☐ YES ☐ NO *(If "Yes", in what way?)*

4. REMARKS

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DATE

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