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DETAIL SPECIFICATION

# ANTENNA SYSTEM, AIMS SHIPBOARD, ELECTRONICALLY STEERED OE-120/UPX

Inactive for new design
after 7 May 2009

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

## 1. SCOPE

1.1 Scope. This specification covers the requirements for performance and technical design for a Central Identification, Friend or Foe (IFF) electronically steered OE-120/UPX AIMS Shipboard Antenna System.

## 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

FEDERAL STANDARDS

| | | |
|---|---|---|
| FED-STD-313 | - | Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities. |

DEPARTMENT OF DEFENSE SPECIFICATIONS

| | | |
|---|---|---|
| MIL-S-901 | - | Shock Tests, H.I. (High Impact); Shipboard Machinery, Equipment, and Systems, Requirements for. |
| MIL-DTL-5541 | - | Chemical Conversion Coatings on Aluminum and Aluminum Alloys. |
| MIL-A-8625 | - | Anodic Coatings for Aluminum and Aluminum Alloys. |
| MIL-DTL-13777 | - | Cable, Special Purpose, Electrical, General Specification for. |
| MIL-DTL-15090 | - | Enamel, Equipment Light Gray (Navy Formula No. 111). |
| MIL-E-24762 | - | Enclosures for Electronic Equipment, Survivable, Naval Shipboard Use. |
| MIL-PRF-38535 | - | Integrated Circuits (Microcircuits) Manufacturing, General Specification for. |

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

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-167-1 - Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II – Internally Excited).
MIL-STD-461 - Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment.
MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests.
MIL-STD-1472 - Human Engineering.

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

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

DLA Land and Maritime DRAWINGS

87060 - Circuit Breakers, Magnetic, Panel Seal, Shock Enhanced, Trip-free, Series Trip, Single Pole (0.2 to 30 Amperes).
87061 - Circuit Breakers, Magnetic, Panel Seal, Shock Enhanced, Trip-free, Series Trip, Two Pole (0.2 to 30 Amperes).
87062 - Circuit Breakers, Magnetic, Panel Seal, Shock Enhanced, Trip-free, Series Trip, Three Pole (0.2 to 30 Amperes).

(Application for copies should be addressed to Defense Supply Center, Columbus, P. O. Box 3990, Columbus, Ohio 43216-5000, documents are also available at the DLA Land and Maritime-VA Web site: http://www.landandmaritime.dla.mil/Programs/MilSpec/DocSearch.aspx

NAVSEA PUBLICATION

ST000-AA-IDX-010-PEETE - Portable Electric/Electronic Test Equipment Index.

(Copies of these documents are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

NAWCAD

ATP-8201658 - Acceptance Test Procedure, Antenna Horn.

(Application for copies should be addressed to NAWCAD, (Code 4.5.9.1), Villa Road, Saint Inigoes, MD. 200684-0010).

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AMERICAN NATIONAL STANDARD INSTITUTE/AMERICAN SOCIETY FOR QUALITY

ASQC A8402 - Quality Management and Quality Assurance – Vocabulary.

(Copies of these documents are available online at http://webstore.ansi.org/ansidocstore/default.asp , or from the American Society for Quality, PO Box 3005, 611 E. Wisconsin Ave., Milwaukee, WI 53201-4606.)

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

IEEE12207 - Software Life Cycle Processes.

(Copies of this document are available ISO Case postale 56 • CH-1211 Geneva 20 Tel. + 41 22 749 01 11 Fax + 41 22 749 09 47 E-mail copyright@iso.org Web www.iso.org )

THE INSTITUTE FOR INTERCONNECTION AND PACKAGING ELECTRONIC CIRCUITS (IPC, INC.)

IPC 2221 - Generic Standard on Printed Design.

J-STD-001 - Requirements for Soldered Electrical and Electronic Assemblies.

(Copies of this document are available online at www.ipc.org or can be obtained through the IPC-Association Connecting Electronics Industry, 2215 Sanders Road, suite 200 South, Northbrook, IL 60062-6135.)

INTERNATIONAL ORGANIZATION FOR STANDARDS (ISO)

ISO 9000 - Quality Management Systems – Fundamentals and Vocabulary.

(Copies are available online at http://iso.org or http://www.iso.org/iso/home.htm or from American National Standards Institute, 13th Floor, 11 West 42nd Street, New York, NY 10036-0350.)

SOCIETY OF AUTOMOTIVE ENGINEERS, INC (SAE)

SAE-AS-20708 - Synchros, General Specification for.

(Copies are available online at http://www.sae.org or from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001.)

TECHAMERICA

EIA-TIA-232 - Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.

(Copies of these documents are available online at http://www.techamerica.org/standards or from TechAmerica, 601 Pennsylvania Ave. NW, North Building, Suite 600, Washington DC 20004.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.5 Ozone Depleting Substances (ODS). Any Class I Ozone Depleting Substance required in any of the specifications, standards, or handbooks referenced in this document is hereby deleted as a requirement and substituted with a "suitable substance."

3. REQUIREMENTS

3.1 Design objectives. The IFF shipboard antenna system defined by this specification is an electronically steered beam radiating antenna that also provides the required Interrogation Side Lobe Suppression (ISLS). The ISLS radiation can be omni-directional or can be the antiphase (difference pattern) of the beam pattern. The position or direction of the radiated beam shall be controlled by a 10-bit digital command signal. Also, it shall be possible to slave the position of the beam to radar 1X synchro data signals. When using digital input signals, the total operating cycle for positioning the beam from any bearing directly to any other bearing shall be less than 50 microseconds and the beam shall not be required to pass through intervening synchro data inputs at rotational speeds from 1 to 90 revolutions per minute. The vertical coverage of the directive beam and the omni-directional (or difference) patterns shall be as nearly identical as practical.

3.1.1 Allowable design changes. The performance requirements and the technical design approaches required by this specification are achievable through known engineering techniques. Design approaches other than specified herein shall also provide equal or better performance. Prior approval to use these other approaches is required.

3.1.2 Shipboard configurations. Because this antenna will be installed on several types of ships having various radar configurations, versatility in the methods of installation of this antenna shall be provided. A capability for performing periodic repair and maintenance by ship's personnel shall be included for all equipment of this antenna system. These installation and maintenance capabilities shall consider the normal environmental conditions of exposure to impulses of stack gases, wind loading, ice loading, nuclear air blast, salt laden air and spray, and the temperature variations encountered throughout the world.

3.2 General requirements. The general requirements (see 6.11) shall apply for the design and construction of the OE-120/UPX except as hereinafter specified.

3.2.1 Prohibited materials. Equipment shall not contain toxic or hazardous substances in accordance with FED-STD-313, and http://www.epa.gov/osw/hazard/wastemin/priority.htm. The use of ozone depleting chemicals in accordance with http://www.epa.gov/osw/hazard/wastemin/priority.htm shall require approval of the contracting activity. Unless otherwise specified, the materials specified in table I should not be used. Special care shall be taken when selecting materials to be installed in a controlled atmosphere.

TABLE I. Prohibited materials.

| |
|---|
| Carcinogens |
| Glass fibers (exposed) |
| Lithium and lithium compounds, except batteries approved for the intended service conditions |
| Magnesium or magnesium alloys |
| Polyvinyl chloride (PVC) except when used for parts leads |
| Radioactive commodities |
| Zinc or zinc alloys |

3.2.2 Selection of parts. The selection of parts in accordance with (see 6.11) shall not preclude the use of parts of smaller physical characteristics, provided that the use of such parts shall be restricted to applications whereby a saving in weight or one linear dimension of at least 25 percent can be affected.

3.2.3 Recycled, recovered, environmentally preferable, or biobased materials. Recycled, recovered, environmentally preferable, or biobased materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.2.4 Parts management. Electrical and mechanical parts management (see 6.4).

3.2.5 Modular assemblies and subassemblies. Whenever modular assemblies and subassemblies are used in more than one location, all like assemblies and subassemblies shall be interchangeable without requiring adjustments or modifications. Adjustment of normal functional controls will be permitted.

3.2.6 Solid state components. Maximum feasible use shall be made of solid state components. Use of thermionic and ionizing tubes, such as in the transmitter output stages, shall require prior approval. Solid state components capable of working over a broad range of temperatures shall be used wherever technically feasible and cost effective. Microelectronic devices employed in the design of the antenna system requiring MIL-PRF-38535, appendix A, shall conform to (see 6.8).

3.2.7 Maintenance design. The equipment shall be designed to provide ease of maintenance. Extension cords, extender boards, and adapter cables shall be supplied with the equipment.

3.2.8 Self testing. Self testing techniques shall be employed to the greatest extent practicable. Means shall be provided for the localization of faults to reasonably small circuit entities, which are easily replaceable.

3.2.9 Connections for standard test equipment. Connections shall be readily available for such external standard test equipment as may be required for operational check-out tests.

3.2.10 Test points and test features. Test points and test features shall be provided. Self-test features and ease of fault isolations shall be emphasized.

3.2.11 Captive screws and nuts. Captive screws and nuts shall be utilized, wherever feasible, to preclude loss of hardware when equipment is disassembled for maintenance.

3.2.12 Thermal design. Forced ventilation or equivalent technique to prevent hot spots and reduce internal temperature shall be provided where required.

3.2.13 Power. Nominal operating configuration shall be 115 volts, 60 Hz and 400 Hz. The input power connector contacts or pin assignments and conductor color code internal to the equipment shall be as specified in table ll.

TABLE ll. Conductor designations. 1/

| Conductor assignment | Conductor designator | Conductor color |
|---|---|---|
| 115 V rms | A | White |
| 115 V rms | C | Black |
| Safety ground | B | Green |

1/ Ship electrical distribution systems are delta-connected; this precludes the use of the safety ground as a power-carrying conductor. Safety ground connections for bonding and grounding are provided for EMI and personnel safety considerations.

3.2.14 Overload protection. Protective devices shall be provided within the equipment for protection from damage due to overload and excessive heating. The circuit breaker protection for the equipment, and the interface to the electrical power system, shall be coordinated to ensure that the circuit breaker closest to the cause of an overcurrent or fault current condition will trip first. Multi-phase circuit breakers shall disconnect all phases when an overload occurs in any one phase. Protective devices shall not be installed in the neutral unless neutral power sensing is essential to protect operation of the equipment and the overcurrent protective device simultaneously opens all conductors of the circuit, and operates such that no pole can operate independently. When electrical overcurrent protection devices are used internally, the status (that is open or closed) shall be displayed on the operating panel and restoration of the device shall be controllable from the front panel. Circuit breakers used shall be in accordance with DLA Land and Maritime drawings 87060, 87061, or 87062, and shall be mounted in the horizontal position. The intent of this requirement is to prevent inadvertent shut down of adjacent equipment connected to a common source. Equipment shall be suitable for operation at 115 volts, 60 Hz and 400 Hz including emergency conditions. Equipment shall remain operational for momentary power interruptions of 150 milliseconds, and shall restart within 1 second following a power interruption of 5 minutes or less. Prior approval for the use of low voltage blown fuse indicators is required.

3.2.15 Printed circuit boards. Where plug-in printed wiring boards are employed, they shall be in accordance with IPC 2221 and shall be readily removable from the chassis. Test points shall be easily accessible without withdrawing boards from installed positions. Board extenders, stored within the equipment and allowing access to both sides of the board, shall be provided to connect the printed circuit board into its normally connected circuitry for servicing purposes. Sufficient spacing shall be provided for adequate air circulation and to prevent accidental contact with adjacent boards during operation, testing, and board extraction.

3.2.16 DC voltage test points. Test points for all direct current (DC) supply voltages (including modulator high voltage) shall be provided and shall be plainly labeled and conveniently located for ease of servicing.

3.2.17 Fail-safe provisions. The equipment shall be fail-safe by design. In the event of a failure or failures, there shall not be additional or avalanche failures due to these failures. In addition, the design shall preclude damage to the equipment due to incorrect or accidental turn-on or turn-off.

3.2.18 Cables and connectors. Power and control cables shall be consistent with general parts requirements of (see 6.11), except MIL-DTL-13777 shall be used for portable use, if required. All accessible surfaces of equipment shall be at ground potential. Equipment power cable assemblies shall be provided with a safety ground conductor. A safety ground conductor shall be included with the power cable assembly and connector of equipment drawers, and shall be such that the disconnecting of the safety ground from the drawer will result in disconnecting of the power assembly. Drawers, panels, and doors shall be grounded at all times and in all positions. The DC resistance from the equipment to ground potential shall not exceed 100 milliohms. Safety ground conductors shall be the same size or larger than the power conductors. Equipment shall be provided with means to disconnect all sources of power from the equipment. The disconnect means shall be such that accidental contact by personnel will not place the equipment in operation. Connectors shall be configured so that they cannot be plugged into the wrong receptacle. In all cases, port connectors shall be clearly marked as to their appropriate use. Connectors shall be designated so that exposed pin contacts are 30 V or less. Mating connectors shall be furnished with all connectors, receptacles, or plugs. Protective connector covers shall be provided for each cable connector.

3.2.19 Controls, indicators, and panel layouts. The design of operator and maintainer panel layouts, controls and color-coding shall conform to the criteria of MIL-STD-1472. Tactile identification of controls is not required.

3.2.19.1 Elapsed time meters. Elapsed time meters, which shall not be capable of being reset to zero, are required to record the time the antenna system/subsystem is operating.

3.2.19.2 Alarm lamps. Lamps used on front panels for alarms and other purposes shall conform to the requirements of the Transilluminated Displays paragraph of MIL-STD-1472. A capability for remote indication of alarm lamp status shall be provided.

3.2.19.3 Power on-off indicator. Illuminated indicator(s) shall be provided that will indicate when input power is applied to the OE-120/UPX system.

3.2.20 Shock, vibration, and inclination. The equipment shall be capable of withstanding rough shocks during transportation and accidental shocks during actual operation. All parts of the equipment, as well as relays and other protective electrical devices shall be adequately mounted to prevent loosening, damaging, and disturbing of settings and adjustments by shock, vibration and inclination normally encountered by equipment of this type in the Military service, as specified in 3.2.20.1, 3.2.20.2 and 3.2.20.3.

3.2.20.1 Shock. The equipment shall be capable of meeting the shock requirements of MIL-S-901 for grade A, class I, lightweight, type A equipment.

3.2.20.2 Vibration. The equipment shall be capable of meeting the type I, environmental vibration requirements of MIL-STD-167-1.

3.2.20.3 Inclination. The equipment shall be capable of being rested on any side and shall be capable of supporting the weight of the encased equipment plus an additional 250 pounds, distributed over an area of at least 1 square foot, without damage.

3.2.21 Enclosure. The enclosure shall be watertight for equipment exposed to the weather and shall be drip proof to 15 degrees for equipment installed below decks.

3.2.22 Service environmental requirements. The equipment shall be capable of continuous operation under any combination of the following service environmental conditions:

a. Outside air temperature, class 2 (-28°C to +65°C), inside (below deck) temperature, class 4 (0°C to +50°C).

b. Relative humidity, 0 to 95 percent.

c. Elevation: Up to +12,000 feet.

d. Salt laden air as encountered in a shipboard environment.

e. Sand and dust particles 10 to 50 microns in size.

f. Icing: 4.5 pounds per square foot (lbs/sq ft) operational and 7 lbs/sq ft non-operational.

g. Nuclear air blast: The antenna shall be designed for incidental free field over pressure equal to 3 pounds per square inch with a positive phase duration of 3.5 seconds and a peak dynamic pressure of 0.2 pounds per square inch with a time duration of 3.5 seconds. The free field over pressure ($P_s$) and dynamic pressure (q) at any time after the arrival of the shock front are then given by the following relationships:

$$P_s = 3.0\left(\frac{1-t}{3.5}\right)e^{\frac{-t}{3.5}};\ q = 0.2\left(\frac{1-t}{3.5}\right)^2 e^{\frac{-2t}{3.5}}$$

h. Stack gas: Continued exposure to stack gas at 65 degrees Centigrade (°C) in the presence of moisture, with the resultant residual sulfuric and sulfurous acids.

3.2.23 Finishes.

3.2.23.1 Aluminum finishes. Where practical, aluminum and aluminum alloy parts shall be anodized in accordance with MIL-A-8625. Where anodizing is not used, chemical treatment conforming to MIL-DTL-5541 shall be used. When required, hard anodizing shall be used.

3.2.23.2 Housed units. The finish coats for external surfaces of housed units shall be gray enamel conforming to type III, class 2 of MIL-DTL-15090.

3.2.23.3 Exposed units. All exterior surfaces except the antenna radome shall be spray painted prior to assembly with the following:

First coat Devoe 1/ 201K0505 - light green
2-3 mils (Dry thickness)

Second coat Devoe 1/ 201K0842 - buff
2-3 mils (Dry thickness)

Third coat Devoe 1/ 229K2616 - Navy gray
1.5-2 mils (Dry thickness)

The antenna radome shall be spray painted with the following:
Devoe 1/ 219K2904 - Gray
2-5 mils (Dry thickness)

1/ Devoe Raynolds Devran or equivalent

3.2.23.4 Color coded markings. The requirement of 3.2.23 shall not prevent the use of color coded markings used to facilitate matching parts during installations, painted lettering for identification and instruction plates or interconnecting cables subject to handling during assembly and disassembly of the equipment.

3.2.24 Electromagnetic interference. The electromagnetic interference emission susceptibility of the equipment shall meet the applicable requirements of class IA, IB and IC in accordance with MIL-STD-461.

3.2.25 Standby to operate condition. The equipment shall be instantly operable (capable of transmitting if RF is present) from standby condition at all ambient temperatures specified herein when the Challenge Switch is switched to ON position.

3.2.26 Warm-up time. The equipment shall be fully operable within 10 minutes from the nonoperating condition while subjected to an ambient temperature of -28°C.

3.2.27 Storage. The equipment shall be capable of satisfactory operation after being stored for a period not exceeding one year at storage room ambient temperature ranges from -62°C to +75°C.

3.2.28 Transport requirement. The equipment shall be capable of air transport at altitudes up to 50,000 feet without damage, in nonpressurized nontemperature controlled cargo aircraft.

3.2.29 Standard modules. Wherever possible, the design of this antenna system shall utilize standard modules (see 6.6). This requirement shall not restrict equipment or system design to a lesser performance than that which could be achieved utilizing non-standard modules. Specific approval to use non-standard modules is required.

3.2.30 Soldering. Soldering shall be in accordance with J-STD-001, class 3. Tin plating is prohibited on leads as a final finish (see 6.5). Use of tin-lead (Sn-Pb) finishes are acceptable provided the minimum lead content is 3 percent.

3.3 Design requirements.

3.3.1 Basic system. The antenna system shall have three basic elements or sections: (1) the radiating section; (2) the RF phasing and distribution section; and (3) the control and interface section. These sections shall combine to provide:

a. A steerable radiating beam for transmitting on 1,030 MHz and receiving on 1,090 MHz.

b. An omni-directional (or difference) radiating pattern for transmitting on 1,030 MHz.

c. Means for directing the beam pattern to any of 1,024 separate and equidistant bearing positions from externally supplied input command signals of 10-bit digital control words.

d. Means for converting radar 1X synchro data into 10-bit digital control words to slave the beam position to either an associated radar or display system or both.

e. An indicator showing which 0 degrees to 359 degrees which, when adjusted for ships heading (true), will indicate to which of the 1,024 positions the beam is pointing.

f. On-line self-test functions to assure agreement of beam position with input command signals.

g. Capability to compensate for ship's pitch and roll 2X (60 or 400 Hz) inputs from externally supplied (other subsystem) signals. When no pitch and roll compensating signals are interconnected, the antenna system shall meet all requirements based upon the assumption of a horizontally established platform with zero roll and pitch.

h. Capability to automatically compensate the beam position for ship's heading (TRUE) from externally supplied 1X (60 to 400 Hz) synchro signals. This function shall be front panel switch selective.

i. Capability to detect the presence or absence of the Interrogator Side Lobe Suppression (ISLS) trigger. Provide correct switching of the ISLS RF to the omni directional pattern and the remaining RF to the beam pattern. Generate an operator alarm and ISLS inhibit signal for output to external equipment when the ISLS trigger is absent. The inhibit signal shall be disabled within 1,340 microseconds upon receipt of an ISLS trigger. The operator alarm shall be removed within 20 milliseconds upon receipt of an ISLS trigger.

j. Capability to compensate for the beam position up to +/- 3.1635 in azimuth for assembly mounting inaccuracies.

3.3.2 Physical restrictions. The shape and structure of the antenna system shall be any that will be suitable to meet the aggregate requirements for installation versatility, maintenance accessibility, and technical performance. A circular array for the radiating section appears to have several benefits over phased linear arrays, but the use of phased linear arrays is not excluded. Whichever is used, a repairable structure is mandatory. It must be relatively simple to install and must require the minimum use of topside area. It must be so constructed to permit shipment by normal means over the road by trucking, across the sea by normal cargo vessels, and through the air by normal air cargo (military or commercial) planes. Replacement of any portion of the antenna system shall not require the ship to be returned to a special repair base. Modular design shall be utilized, as much as is practical and sectionalizing the radiating section is considered highly desirable to permit mounting around masts and towers as well as upon deckhouses and platforms.

3.3.3 Weight and size. The size of the radiating section shall be as small as is practical. For the circular array, the diameter shall not exceed 13 feet. For phased linear array, the length of each section shall not exceed 14 feet. The structural cross section of either type shall not exceed 2 feet, to permit a useful central opening for mounting around towers or masts. The weight of the section(s) mounted on the mast or platform shall be kept to a practical minimum. If cables are to run from a deck mounted unit, the array (less cables) shall be less than 400 pounds for the circular and 800 pounds for the total of the phased linear arrays. If the RF distribution section (or a part thereof) is combined with the radiating section, the combined weight shall be less than 800 pounds for the circular array, or 1,200 pounds for the phased linear array. If these weight limitations cannot be met, request for waivers will be considered when technical justifications accompany the request.

3.3.3.1 Distribution section. The size and weight of the distribution section shall be kept to the practical minimum for the design method chosen. Because the various methods are not physically similar, no limitations will be set. Prime importance is the performance of the chosen design. However, maintainability and size shall be important factors as well.

3.3.3.2 Control and interface section. Design of rack mounted and console equipment shall maintain the center of gravity as low as practical. The size and weight of the control and interface section shall not exceed the values given below:

Size (inches): 23H-23W-23D.

Weight (pounds): 85.

3.3.4 Radiating section characteristics. As a minimum capability, the radiation section shall provide the following:

3.3.4.1 Antenna horn characteristics. Each antenna horn shall meet the following characteristics:

VSWR: 1.03 gigahertz (GHz) 1.4:1 SWR.

Antenna beamwidth:

Horn Azimuth at 1.03 GHz min. 77/max. 85 degrees for 3dB beamwidths.
Horn Azimuth at 1.09 GHz min. 73/max. 81 degrees for 3dB beamwidths.
Horn Elevation at 1.03 GHz min. 41/max. 49 degrees for 3dB beamwidths.
Horn Elevation at 1.09 GHz min. 37/max. 45 degrees for 3dB beamwidths.

Antenna gain:

At 1.03 GHz, min. 8.5/max. 9.3 dBi.
At 1.09 GHz, min. 9.1/max. 9.9 dBi.

Phase center:
At 1.03 GHz, min. –5.0/ max. 5.0 degrees at AZ = 0, EL = 0.
At 1.09 GHz, min. –5.0/ max. 5.0 degrees at AZ = 0, EL = 0.

Water tightness: min. 1.5/max. 2.0 PSIG.

3.3.4.2 System characteristics. Each system shall meet the following characteristics:

a. Directive beam:

Beam width:
5.8 degrees to 7.8 degrees azimuthal.
40 degrees to 60 degrees vertical.
Voltage standing wave ratio (VSWR):
1.5 to 1, or less.
Gain of main lobe:
Overall gain of at least 13.5 decibels isotropic (dBi). Losses in the RF section may exceed 4.5 decibels (dB) but shall not exceed 7.5 dB. Overall gain, including the RF section of the main lobe shall be at least 13.5 dBi for at least 90 percent of the possible beam positions and at least 13.0 dBi for the remaining beam positions. The gain at any particular beam position shall not deviate by more than 0.5 dB from the overall mean for all the possible positions.
Polarization:
Vertical.
Transmit frequency:
1,030 megahertz (MHz).
Receive frequency:
1,090 MHz.
Transmit peak power:
5 kilowatts (kW) at the input to unit 2;
0.5 to 10 microsecond (μs) pulses at 0.02 duty cycle.
Switching time:
Less than 50 μs from one position to any other position.
Bearing positions:
1,024 equidistant steps through 360 degrees.
Synchronization:
A - 10-bit digital word.
B - Radar 1X synchro data, 60 hertz (Hz).
Secondary lobes:
The side lobe levels shall be at least 20.5 dB (1,030 MHz) and at least 18.7 dB (1,090 MHz) below the main lobe for at least 90 percent of the possible beam positions and at least 18.0 below the main lobe for all of the remaining positions.

b. Omni-directional pattern:
Polarization:
Vertical.
Vertical beamwidth:
40 degrees to 60 degrees, to match vertical coverage of beam pattern.
Magnitude variations:
The omni-pattern variations in horizontal magnitude (scalloping) shall be within 4.5 dB peak-to-peak.
Transmit frequency:
1,030 MHz.
Receive frequency:
(None).
Transmit peak power:
5 kW, at input to unit 2, 0.5 μs to 1.0 μs pulses at 0.004 duty cycle.
VSWR:
1.5 to 1, or less.

Gain:

The omni-pattern shall be at least 1.5 dB above the side lobe structure for at least 95 percent of the possible beam angular position and at least 0 dB above side lobe structure for the remaining beam positions.

c. Indication of beam position. It is required that the direction of the radiated beam be indicated at a remote position, preferably at the control and interface unit(s). The indication shall be in units of one degree (0 degrees to 359 degrees) unless there is a technical benefit to indicate the bearing in one-third degree units. However, this latter method is not desired from a human engineering point of view. In addition to the indication of bearing, there must be an indication that the position is relative or true bearing. Both types will be utilized but not simultaneously.

d. On-line test functions. Automatic on-line testing functions shall be provided to assure that the direction of the radiated beam is in fact corresponding (within appropriate system tolerances) to the direction of the input command signals. Automatic alarming at a remote position, preferably at the control and interface unit(s), shall occur when the radiated beam is at a bearing not correct for the input command signals. This alarming shall also occur whenever excessive lead or lag errors, or slow switching times indicate steering performances beyond the acceptable system tolerances.

3.3.5 RF distribution section characteristics. This section shall provide three basic functions: (1) provide the phasing and selection of the RF energy paths to the radiating section for transmitting the beam pattern; (2) provide the same beam pattern for receiving target replies; and (3) provide the phasing and selection of RF energy paths for transmitting the omni-directional pattern for ISLS. The design of the RF distribution section may utilize any of the following methods:

a. Switched taper feed.

b. Butler matrix.

c. R2R lens.

d. Optical systems (other than R2R).

e. RF cavity.

f. Other (when specifically approved).

3.3.5.1 RF distribution section design. The design of the RF distribution section must achieve minimum attenuation, good main beam to secondary beam ratio, a high degree of reliability, accessibility for repair and maintenance servicing, and versatility in the methods of installation. The optimum design for any one feature may not combine favorably with the optimum design of other features. Therefore, the following priority is established to assist in determining technical tradeoffs for the final design (listed in descending order of importance).

Minimum attenuation
High degree of reliability
Accessibility for maintenance and repair
Ratio of main beam to secondary beams (side lobes)
Versatility of installation methods

3.3.5.2 Design limits guidance. The following information is provided as guidance to understanding the design limits considered acceptable as a compromise in accomplishing the priorities of 3.3.5.1.

a. The RF attenuation (losses) from one input of the distribution section to the input of the radiating elements shall be less than 4.5 dB but a need exists to achieve something less than 3.0 dB.

b. Mean time between failures (MTBF) shall be not less than 1,000 hours for above deck components and 500 hours for below deck components.

c. Easy access to all component parts shall be possible. This requirement includes the radiating sections if portions or all of the distribution section are combined with the structure of the radiating section. The mean time to repair (MTTR) shall be not more than four hours (worst case).

d. To achieve the best combined design of a, b, and c, the following reduction in main beam characteristics may be considered. However, prior approval for any reduction must be obtained before using these values:

| | |
|---|---|
| Main beam gain: | 13.5 dB |
| Secondary beams: | 18 dB below main beam |
| Omni-pattern: | no change |

e. The requirement for versatility of installation methods may be reduced to a non-versatile method with prior approval.

3.3.6 Control and interface section characteristics. The control and interface unit(s) shall provide the control of performance of the antenna system for both the radiate and the receive functions. The following features are minimum requirements:

a. Beam direction from a 10-bit input signal (digital).

b. Beam direction from radar synchro input signals 1X.

c. Beam direction from self generated input signals.

d. ISLS inhibit output from missing ISLS trigger detection.

e. Indication of the bearing of the beam position.

f. On-line self test features to assure proper direction of the radiated beam.

g. Self-test and fault isolation maintenance capability.

h. Automatic compensation for beam error due to ship's pitch and roll (utilizing pitch and roll signals from ship's system).

i. Compensation of the beam position up to $\pm$ 3.1635° in azimuth for antenna assembly mounting inaccuracies.

j. An interface in compliance with EIA-TIA-232 shall be included to provide the capability to monitor system operation, perform program debugging, and load operating program code.

k. Beam positioning referenced to TRUE north or referenced RELATIVE to the ship's bow. The TRUE compensation signal shall be 1X 60 Hz or 400 Hz synchro signals.

3.3.6.1 Beam direction from 10-bit input signals. It shall be possible to control the position of the beam using a 10-bit digital word supplied from an external source. The bearing, or direction shall change in a consecutive and clockwise manner through 1,024 equal change increments. Ship's heading (relative bearing) shall be 0000000000. The following characteristics define the type of input signals with which the antenna system must interface.

a. Zero near ground potential; ones minus 15 volts.

b. Zero near ground potential; ones minus 3 volts.

c. Zero near ground potential; ones plus 3.5 volts.

3.3.6.2 Beam direction from synchro data. It shall be possible to control the position of the beam using synchro data 1X input signals.

3.3.6.3 Self-generated beam position. It shall be possible to control the position of the beam from self-generated signals. The type of signals may be synchro data or digital (electronic counter). The rate of beam rotation shall be adjustable from a front panel control from 0 to 90 (approximate) revolutions per minute (rpm). In addition, a synchro output shall be provided capable of driving at least a type 23CT6 synchro unit in accordance with SAE-AS-20708.

3.3.6.4 Beam positioning modes. From a front panel control(s) it shall be possible to select any one of the following modes of beam positioning:

a. Directed position (from 10-bit input word).

b. Sectoring across a directed position (from a 10-bit input word).

c. Directed sequential rotation (from 10-bit words, or synchro data).

d. Free from sequential rotation (from internal signals).

3.3.6.5 ISLS operation. The ISLS switching function shall be provided in this antenna system. An external trigger (from the interrogator) will be supplied to initiate this switching function. Whenever this trigger is not present, the antenna shall be in the beam position and if absent for a period exceeding 20 milliseconds cause an ISLS inhibit signal to be output. A visual indication that the ISLS is being inhibited shall be provided. When the ISLS inhibit is being outputted and an ISLS trigger is detected, the ISLS inhibit signal shall be disabled within 1,340 microseconds, and the ISLS inhibit indicator shall be disabled within 20 milliseconds. Upon receipt of this trigger, the antenna shall provide the omni-pattern (or difference pattern) for the duration of the ISLS pulse and immediately return to the beam pattern. For Modes 1, 2, 3/A and C, this ISLS pulse (P2) occurs 2.0 microseconds after the first pulse (P-1) of the interrogation pair (P1-P3). For Mode 4, this ISLS pulse follows the four synchronizing pulses forming a symmetrical five pulse group. Switching action must be rapid to provide a suitable P3 pulse in the Mode 1 challenge wherein the P1-P3 spacing is three microseconds. This requires the switching of the ISLS (P2) pulse to be complete in less than one microsecond. The external trigger pulse supplied to initiate the ISLS operation shall have the characteristics specified in a through d:

a. Pulse amplitude: 10 volts peak minimum (min) to 80 volts peak maximum (max), positive.

b. Pulse width: 0.2 μs to 1.0 μs.

c. Drive capability: Shall be capable of driving a 75-ohm load.

d. Direct current (DC) level in pulse OFF state: In the absence of a pulse, the DC output level shall not exceed +0.6 volts.

3.3.6.6 Bearing indication of the main beam. A direct reading indicator shall be provided that continuously identifies the bearing of the main beam. When true correction is selected, the readout shall indicate the true bearing of the beam; when relative is selected, the readout shall indicate the relative bearing of the beam. A visual indication of the beam reference (true or relative) shall be provided adjacent to the bearing indicator.

3.3.7 Input power connector. Input power shall be supplied through a separate connector on all units unless specifically approved to include this interconnection via a multipurpose cable. Connectors shall be configured so that they cannot be plugged into the wrong receptacle. In all cases, port connections shall be clearly marked as to their appropriate use. Connectors shall be designated so that exposed pin contacts are 30 V or less. Connectors shall be such that the connectors cannot be plugged into the wrong receptacle. If input power is required to the mast-mounted equipment, provisions shall be made to prevent personnel from being exposed to or harmed by dangerous voltage. Equipment shall be in accordance with all applicable Federal Regulations. Equipment shall be such that systems (including personnel, other equipment, interfaces and ordnance) will not be exposed to safety hazards during the installation, operation, maintenance, repair, or replacement of equipment or parts thereof. Equipment shall be such that systems will not be exposed to safety hazards shall the equipment fail during installation, operation, maintenance, repair, or replacement of the equipment or parts thereof. Equipment shall be tested in accordance with IEC 950, UL 1950, or equivalent test procedure, as specified in the Safety (Personnel Hazard) paragraph (see 6.11).

3.4 Test, measurement, and diagnostic equipment (TMDE). Test provisions for the equipment shall conform to (see 6.10), except as specified herein.

3.4.1 Test point criteria. Except for shop testing, test points shall be accessible (1) with the removal of no more than one cover panel, (2) while the equipment is operational, and (3) without removal of any cables or connectors. The use of extender boards is permitted to allow access to test points on printed circuit cards. Test points shall be provided for the following requirements. Multiple use of test points is permitted.

a. Signal quality and circuit performance. Test points, test jacks, or both, shall be provided to permit the injection of signals and the monitoring of signals at the input and output terminals of the system, each unit and each assembly.

b. Alignment. Test points, test jacks, or both, shall be provided to energize, inject a standard dynamic signal, or monitor the intermediate circuit affected by the alignment. Where TMDE is used to align or adjust a system, unit, assembly and subassembly, circuitry shall be designed such that a technician can see and operate the TMDE while making adjustments and probing the circuit under test.

c. Fault isolation. Test points, test jacks, or both, shall be provided to permit the injection and measurement of signals at input and output terminals of the unit, assembly, and subassembly to determine satisfactory operation or malfunction of the unit, assembly, or subassembly.

d. Shop testing. Shop testing of assemblies and subassemblies will be performed with the assemblies and subassemblies removed from the prime equipment. Test points shall be provided so that the assembly can be:

(1) Activated (such as DC and dynamic signals applied),

(2) Checked for quality of operation and,

(3) Fault isolated to the shop replaceable item (such as, flat pack, VCO, mixer, detector multiplier, and T0-5 can). Assembly and subassembly test points, when approved, may be placed at various nodes or locations on the assembly and subassembly.

3.4.2 General purpose electronic test equipment (GPETE). GPETE for use at all levels of maintenance shall be selected using NAVSEA Publication ST000-AA-IDX-010-PEETE.

3.4.3 Special tools. Special tools shall be supplied in accordance with (see 6.3). Special tools shall meet the storage and operating environmental conditions specified for the prime equipment.

3.4.4 Built-in test equipment (BITE).

a. BITE shall be provided for the following levels:

(1) Level A BITE shall provide a GO, NO-GO indication of the system performance. Level A BITE as a minimum shall indicate a failure when:

(a) The beam position is in error by greater than one degree from the position required by the input position command signal less any corrections for deck tilt (pitch and roll) and heading.

(b) The ISLS switching function fails or is lacking.

(c) VSWR of the antenna system is greater than 1.5:1.

(d) Any critical voltage exceeds its normal value by more than five percent.

(2) Level B BITE shall provide a GO, NO-GO indication of quality and performance of the antenna and each below deck assembly, such as: antenna drive, antenna control, and power supply.

(3) Level C BITE shall indicate and isolate failure or malfunction to the subassembly, (such as: Antenna section, printed circuit cards) without disassembly or trial-and-error replacement. The AN/UPM-137 or AN/UPM-155 AIMS test set may be used with Level C BITE to fault locate to the subassembly level.

b. BITE activation.

(1) Level A and level B BITE activation shall be automatic and shall not require operator initiation.

(2) Level C BITE activation may be automatic or manual.

c. GO, NO-GO indicators. Level A and Level B indicators for below deck equipment shall be uncovered and plainly visible at all times. Level C indicators may be covered or uncovered. If covered, they shall be made visible by the removal of no more than one cover plate.

(1) Indicators for level A BITE shall be lights, meters, or other indicators installed on the system control panel. Alarms shall also be provided in the form of flashing lights installed on the control panel. Provision shall be made for repeating all indicators for level A BITE and their alarms at a remote location.

(2) Indicators for level B BITE shall be provided on the front panel of each below deck unit or assembly. For above deck assemblies, indicators shall be installed on the below deck control panel.

(3) Indicators for level C BITE shall be provided. The indicators can be mounted on a surface of each subassembly so that they are visible from the maintenance positions, or they may be mounted on the control and interface unit front panel.

d. Dependability.

(1) Level A BITE shall detect system failure not less than 99 percent of the time.

(2) Level B BITE (a) shall isolate not less than 96 percent of the detected system failures to a single subassembly, and (b) may isolate 4 percent of the detected failures to a group of two subassemblies. The number of subassemblies in a group for a single failure shall not exceed three unless specific approval is granted.

e. Calibration and maintenance.

(1) Tests points, test jacks, or both, shall be provided for injecting signals into the BITE and monitoring the responses of the BITE for a given check. The calibration features shall be located as follows:

(a) Level A BITE: On the control panel of the system.

(b) Level B BITE: On the assembly front panel.

(c) Level C BITE: On the subassembly or on the control and interface unit front panel.

(2) The calibration and malfunction of BITE shall not affect the operation of the prime equipment.

(3) An RS-232 interface shall provide the capability to monitor system operation, to perform program debugging, and to load operating program code.

3.5 Reliability requirements.

3.5.1 Quantitative reliability requirements. The 0E-120/UPX shall have a lower test mean-time-between failures (MTBF) of 1,000 hours for unsheltered (above deck) equipment, and 500 hours for sheltered (below deck) equipment.

3.6 Maintainability requirements.

3.6.1 Quantitative maintainability requirements. The equipment repair time (ERT) shall be as follows:

Above deck equipment:

Specified equipment repair time (ERT) 1.5 hours.
Maximum equipment repair time ($ERT_{max}$) 4.0 hours.

Below deck equipment:

Specified equipment repair time (ERT) 10 minutes.
Maximum equipment repair time ($ERT_{max}$) 30 minutes.

3.6.2 Qualitative maintainability requirements. The equipment shall be constructed to provide ease of maintenance, accessibility, and replacement of all modules and parts. Ease of maintenance, troubleshooting, and repair shall be a primary design consideration.

3.7 Workmanship screen. All equipment shall withstand a defect detection vibration screen of random type vibration at $0.04g^2/Hz \pm 3$ dB from 80 Hz to 350 Hz and temperature cycling as specified in 4.4.7.

3.8 Leakage current. Leakage current of each equipment that stands alone, each rack or cabinet of equipment, and each equipment, which can be removed and carried to a maintenance area for servicing, shall not exceed 5 milliamperes (mA).

3.9 Resource allocation and reserves. Resource allocation and reserve requirements specified in IEEE 12207 shall be applied to computer software and firmware development. The 20 percent reserves specified are exclusive of growth requirements.

4. VERIFICATION

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

a. Conformance inspection (see 4.3).

4.2 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in 4.4.

4.2.1 Quality assurance terms and definitions. Reference shall be made to ASQC A8402 to define the quality assurance terms used.

4.3 Conformance inspection. Conformance inspections shall be as specified in table lll.

4.3.1 Government verification. All verification operations performed by the contractor will be subject to Government verification at any time. Verification will include (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 product to be offered for acceptance, and (c) Government product 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 made or until conformance of product to prescribed criteria has been demonstrated.

4.3.2 Failures. The contractor shall, at no additional cost to the Government, correct all failures or deficiencies, which occur during all inspections or tests (including workmanship screening and equipment conditioning), analyze the failures and deficiencies, determine the corrective action required, and implement and demonstrate the effectiveness of the corrective action to the satisfaction of the Government.

TABLE lll. Conformance inspection.

| Inspection | Requirement paragraph | Test paragraph |
|---|---|---|
| Surface examination | 3.2 and 3.3 | 4.4.1 |
| Weight and size | 3.3.2 and 3.3.3 | 4.4.2 |
| Operating test | 3.3.4 | 4.4.3 |
| Controls indicators and panel layouts | 3.2.19 | 4.4.6 |
| Temperature test | 3.2.22 | 4.4.5 |
| Enclosure | 3.2.21 | 4.4.10 |
| Inspection of preparation for delivery | 5.1 | 4.9 |
| Power (supply line voltage and frequency) | 3.2.13 | 4.4.4 |
| Shock test | 3.2.20 | 4.4.11 |
| Inclination | 3.2.20 | 4.4.13 |
| Vibration test | 3.2.20 | 4.4.12 |
| Salt spray | 3.2.22 | 4.4.14 |
| Humidity | 3.2.22 | 4.4.15 |
| Reliability demonstration test | 3.5 | 4.5 |
| Maintainability requirements demonstration test | 3.6 | 4.6 |
| Support maintenance test procedure verification | 3.4 | 4.7 |
| Electromagnetic interference emission and susceptibility and self compatibility | 3.2.24 | 4.4.16 |
| Workmanship screen | 3.7 | 4.4.7 |
| Leakage current | 3.8 | 4.4.8 |

4.4 Tests and examinations. The tests and examinations described hereinafter are either modified or additional requirements to procedures specified in detailed requirements of (see 6.11) for shipboard equipment. All other examinations and tests shall be in accordance with detailed requirements of (see 6.11) for shipboard equipment.

4.4.1 Surface examinations. (see 3.2 and 3.3) The Service Test Model (STM) shall be examined for conformance with workmanship, assembly, fit, safety, toxic hazards, flammability, identification, marking, materials, parts, surface treatments, and surface finish (painting, anodizing, plating) requirements of (see 6.11) for shipboard equipment.

4.4.2 Weight and size. (see 3.3.2 and 3.3.3) Measure and weigh units to verify compliance.

4.4.3 Operating test. (see 3.3.4) The antenna system shall be energized and subjected to an operating test to insure the proper functioning and performance at an adequate number of points in the required range to demonstrate conformance to specification requirements, including safety. The operating test shall verify the proper operations of all manual and automatic functions, and on-line self-test functions. ATP-8201658 will be used when testing the antenna horns.

4.4.3.1 Operating test duration and conditions. The contractor shall subject the 0E-120/UPX to a continuous operating test of 48 hours at approximately 25ºC (room ambient) with the total functions operating. If a failure occurs during the first 24 hours, the equipment (after correction) shall be retested for the full 48 hours duration. If a failure occurs after 24 hours, the equipment (after correction) shall be tested for the remaining time with a minimum of 8 hours of successful operation without further failures. During this operating test, the monitoring of the equipment performance shall include, as a minimum requirement, the functional checks to assure proper operation under the most stringent operating mode. No adjustments of the equipment other than normal operating adjustments shall be allowed during the operating test.

4.4.4 Supply line voltage and frequency. (see 3.2.13) During operational test, verify supply line voltage and frequencies meet the requirements.

4.4.5 Temperature. (see 3.2.22) Verify equipment operation at temperatures specified in section 3.2.22 a.

4.4.6 Controls, indicators and panel layout. (see 3.2.19) Controls, indicators and panel layout shall be visually inspected to verify compliance.

4.4.7 Workmanship screen. (see 3.7) Vibration (see 4.4.7.1) and temperature cycling (see 4.4.7.2) shall be performed on each piece of equipment. Vibration shall be performed prior to temperature cycling. The screen shall be performed after surface examination (see 4.4.1) and prior to the operating test (see 4.4.3). The vibration may be performed at the module, drawer, or unit level. All the hardware, including cables and connectors, shall be exposed to vibration.

4.4.7.1 Vibration. The vibration shall be random, or subject to acquiring activity approval, pseudo-random or complex waveform vibration, for an accumulated time of 10 minutes, with the last 5 minutes failure-free, using single axis random vibration at 6g's rms, $0.04g^2$/Hz from 80 to 350 Hz with a 3 dB drop off from 80 to 20 Hz and from 350 to 2,000 Hz. Axis of vibration shall be perpendicular to the plane of the boards. All items shall be hard-mounted (without shock isolators) and subjected to the vibration conditions of figure 1. Input vibration levels shall be measured at the mounting points of the item under vibration. If variations are found at these points, the level used for control purposes shall be the average of the levels at the mounting points. Control equipment having a bandwidth no greater than 10 Hz for vibration frequencies up to 500 Hz and 100 Hz for vibration frequencies above 500 Hz shall be used for the control and analysis of the acceleration spectral density (ASD). The instantaneous acceleration peaks shall be limited to three times the root-mean-square (rms) acceleration level. The item shall be energized during vibration and appropriate input signals applied to observe any abnormal conditions of the output functional characteristics. All failures occurring during screening shall be corrected and the vibration resumed.

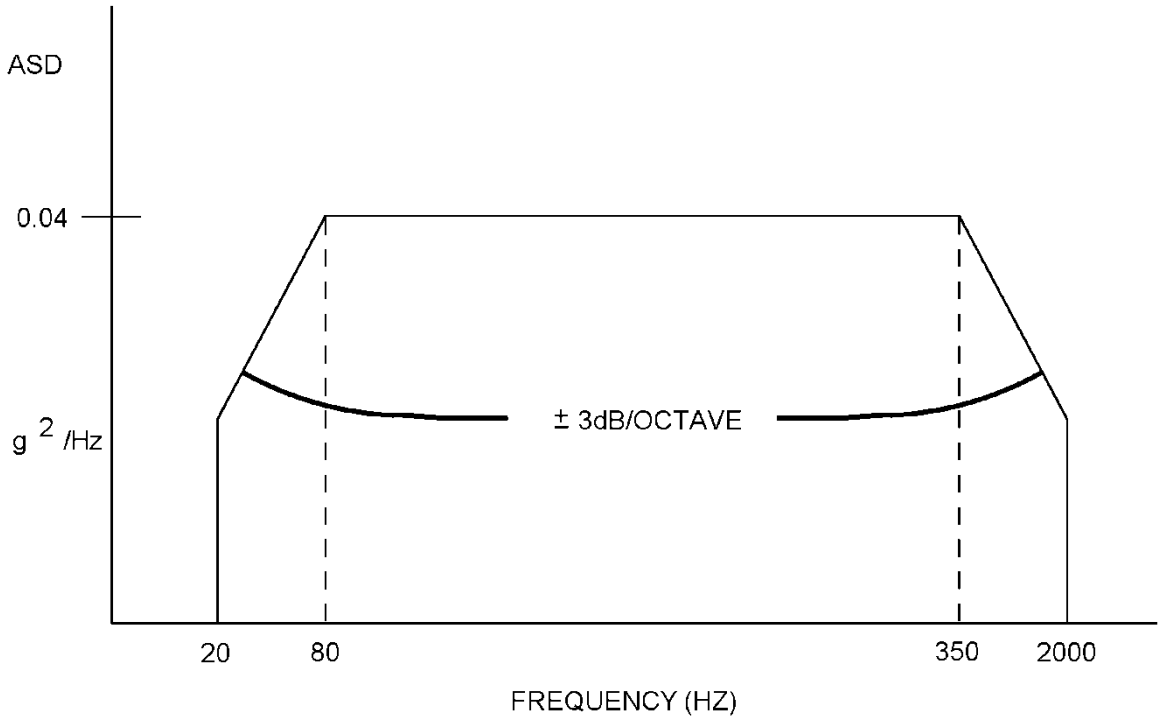



FIGURE 1. Random vibration curve (see 4.5.7.1).

4.4.7.2 Temperature cycling. Each module, drawer, or unit shall be subjected to 10 failure-free cycles, with the last 5 consecutive cycles failure-free, of the temperature curve shown on figure 2. Temperature cycling will be between -54ºC and +71ºC for a cycle in which the temperature shall reach stabilization at -54ºC with cold turn-on after temperature rise to -28ºC (class 2 equipment) or 0ºC (class 4 equipment). Hot dwell shall occur at +71ºC and performance at +46ºC (class 2 equipment) or +40ºC (class 4 equipment). Hot turn-off shall be after the performance measurement. Where performance measurements are called for, a minimal functional operating test shall be performed. The dwell times shall be maintained until the largest electrical or electronic part in the module, drawer, or unit shall be stabilized. Total on time shall be not less than 80 minutes in a 120-minute period.

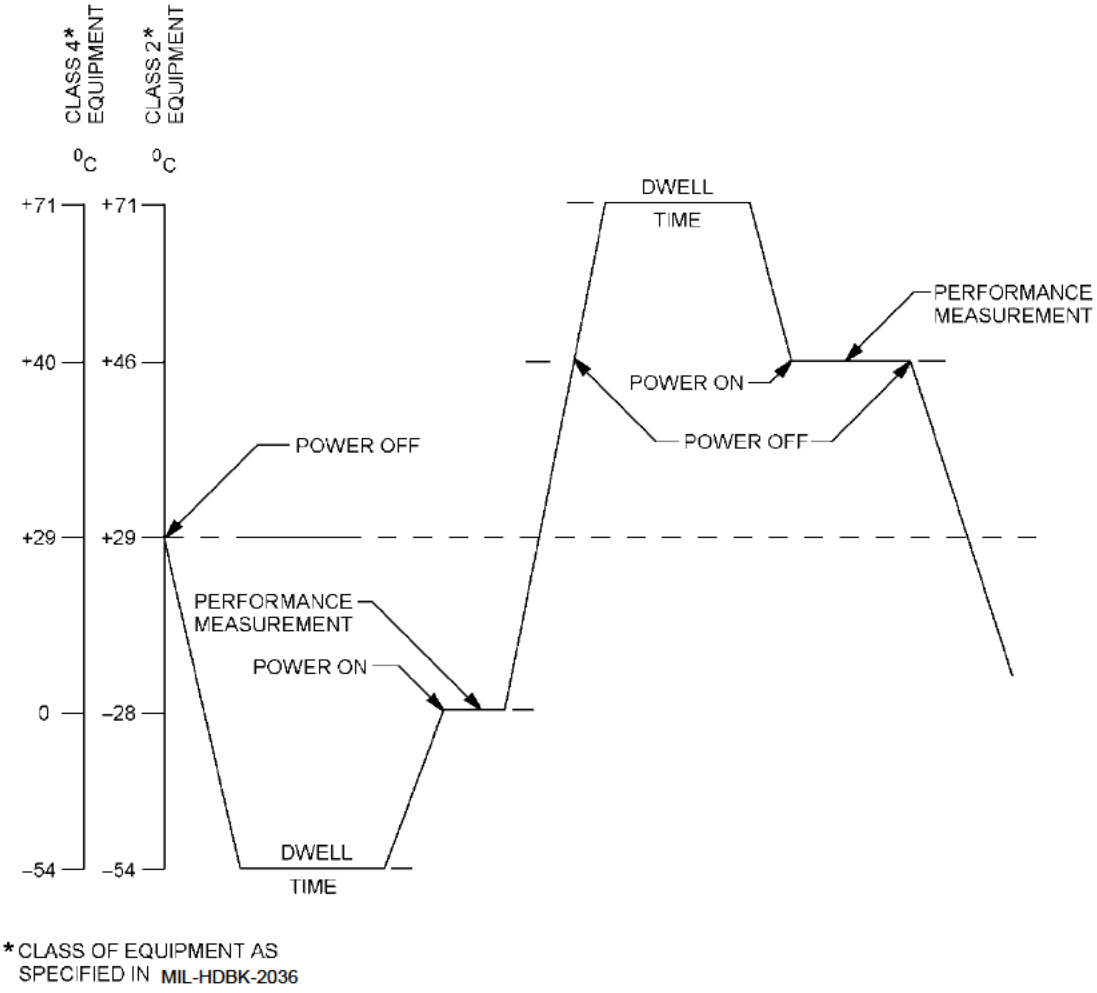



FIGURE 2. One cycle of temperature curve (not to scale) (see 4.4.7.2).

4.4.8 Leakage current test. (see 3.8) The equipment requirements for leakage current shall be verified once on each different item of equipment in the system. Equipment leakage current shall not exceed 5 milliamperes.

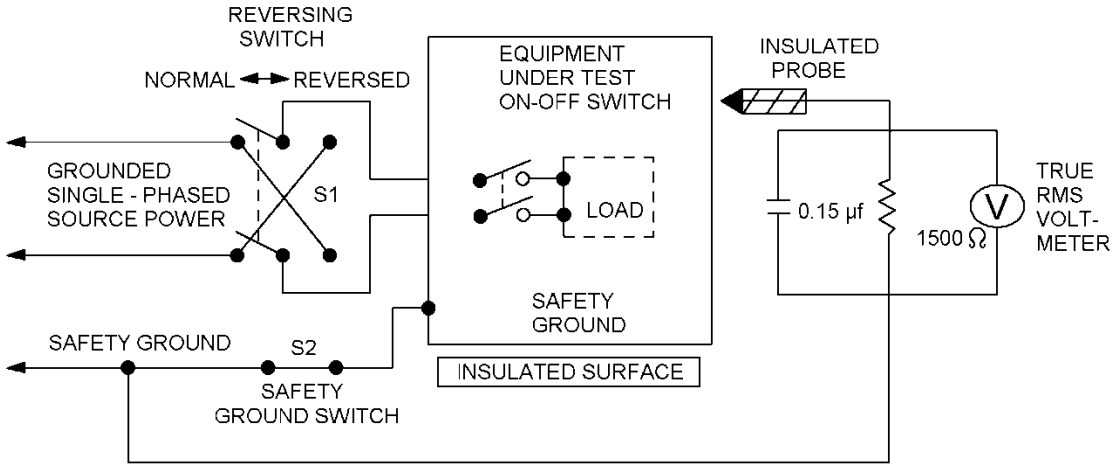
**WARNING**

**THIS TEST MAY BE HAZARDOUS TO THE UNGROUNDED CONDITION OF THE EQUIPMENT DURING THE TEST. DO NOT TOUCH EXPOSED METAL SURFACES WITHOUT ADEQUATE ELECTRICAL SHOCK PROTECTION.**

**THE UNITED STATES GOVERNMENT NEITHER ASSUMES NOR ACCEPTS RESPONSIBILITY FOR ANY INJURY OR DAMAGE THAT MAY OCCUR DURING OR AS A RESULT OF THIS TEST.**

4.4.8.1 Equipment test connections. After power removal, each equipment directly connected to an external power source and units deriving power from the equipment shall be placed on an insulated surface. All safety ground conductors between the equipment and units deriving power from the equipment shall be intact. The safety ground conductor between the equipment and the source power shall be opened during the test. The equipment shall be connected as shown in figure 3.

4.4.8.2 Measurement. Leakage current shall be measured on equipment in its normal operating configuration at 115 volts, 60 Hz and 400 Hz. Equipment controls in each operating mode shall be such that maximum power will be utilized during leakage current measurements. The leakage current shall be determined by the voltage-drop method. A true rms voltmeter shall be used. The voltage measured across the 1,500-ohm resistor, when equal to 7.5 volts, represents 5 mA of leakage current. The overall measurement error shall not exceed five percent. The probe shall be used on all external conducting parts such as case, connector housings, recessed calibration or adjustment controls, and control shafts with knobs removed. The voltage shall be measured from each part to ground for every combination of switch positions available on figure 3. The open safety ground conductor shall be reconnected immediately after the test is completed.




GENERAL ORDER OF TEST:

1. Source power OFF. Connect equipment in accordance with diagram.
2. ON-OFF SW OFF. S1 SW normal. S2 SW closed. Connect source power.

OBSERVE WARNING

3. S2 SW OPEN. ON-OFF SW ON.
4. For each probe point, record voltmeter reading (CASE, CONNECTORS, CONTROLS, SHAFTS).
5. ON-OFF SW OFF. Repeat Step 4.
6. S1 SW REVERSED. ON-OFF SW ON: Repeat Step 4.
7. ON-OFF SW OFF. Repeat Step 4.
8. S2 SW CLOSED. S1 SW normal.
9. Repeat Step 3 through Step 8 for each mode of operation.
10. Remove source power. Disconnect equipment. Sign record sheet.

**WARNING**

**DO NOT TOUCH EXPOSED METAL SURFACES**

THIS TEST MAY BE HAZARDOUS DUE TO THE UNGROUNDED CONDITION OF THE EQUIPMENT DURING TEST. THE UNITED STATES GOVERNMENT NEITHER ASSUMES NOR ACCEPTS RESPONSIBILITY FOR ANY INJURY OR DAMAGE THAT MAY OCCUR FROM THE USE OF THIS DIAGRAM FOR LEAKAGE CURRENT MEASUREMENT.

FIGURE 3. Single-phase test diagram for leakage current measurement (see 4.4.8.2).

4.4.9 Leakage test. Each antenna radiating element of the circular array shall be totally submerged in water and pressurized to 3.0 pounds per square inch through the RF connector to test for pressure leakage. Any antenna radiating element with evidence of air leakage shall be resealed and the pressure leakage test repeated. Test duration for each antenna radiating element shall be 10 minutes, minimum.

4.4.10 Enclosure evaluation. (see 3.2.21) Enclosures shall be evaluated for compliance in accordance with MIL-E-24762.

4.4.11 Shock testing. (see 3.2.20) Verify compliance by testing in accordance with method 516.7 of MIL-STD-810.

4.4.12 Vibration testing. (see 3.2.20) Test in accordance with method 514.7 of MIL-STD-810.

4.4.13 Inclination testing. (see 3.2.20) Rest equipment on a side while a load of 250 pounds distributed over at least 1 square foot is placed on the topside. After subjecting each side to this condition, examine the equipment and there shall be no damage.

4.4.14 Salt spray. (see 3.2.22) Test in accordance with method 509.6 of MIL-STD-810.

4.4.15 Humidity. (see 3.2.22) Test in accordance with method 507.6 of MIL-STD-810.

4.4.16 Electromagnetic interference emission and susceptibility and self compatibility. (see 3.2.24) Test in accordance with MIL-STD-461.

4.5 Reliability demonstration tests. (see 3.5.1)

4.5.1 Reliability demonstration. A reliability demonstration shall be performed in accordance with (see 6.7) for sheltered and unsheltered equipment, as appropriate, using the test conditions of the test condition matrix (see table III). Continuous functional operational testing in each operational mode shall be accomplished during extremes and normal environmental conditions, whenever possible.

4.5.2 Failure. (see 6.2.2) The failure definitions and categories shall be defined with acquiring activity approval. Any operating discrepancy or degradation that requires an unscheduled adjustment or calibration to be made, after initial satisfactory operation of the equipment under test, shall be defined as a relevant failure.

4.5.3 Pattern failures. In the event pattern failures (the occurrence of two or more failures of the same part in identical or equivalent applications when the failures are caused by the same basic failure mechanism and the failures occur at a rate which is inconsistent with the parts predicted failure rate) during any testing, the contractor shall immediately notify the acquiring activity. The acquiring activity shall have the authority to continue the test; start another test; require the contractor to conduct a test, analyze, and fix (TAAF) program (A test procedure used during a development program to achieve reliability growth by testing the equipment under simulated use environments to induce failures due to weak design or inadequate parts. The failures are analyzed and fixed, that is, corrective action is taken for each failure to prevent reoccurrence.); or continue acceptance. The TAAF test environment shall be equivalent to the test environment in which the pattern failure occurred. The Government has the authority to determine patterns of failure.

4.6 Maintainability demonstration. (see 3.6) The maintainability requirements shall be demonstrated in accordance with (see 6.9). A separate demonstration shall be performed for the above deck and below deck equipment. The equipment shall be configured as a system for the maintainability demonstration. The maintainability requirements shall be successfully completed prior to the delivery of any equipment. The maintainability demonstration shall be performed after completion of first article testing.

4.7 Support maintenance test procedure (SMTP) verification. (see 3.4) The SMTP verification test will demonstrate compliance with the TMDE requirements.

a. Sample: The SMTP verification shall be performed on the service test model (STM).

b. Test procedures: The test procedures used in the SMTP verification shall be procedures of the technical manual or the developed procedures.

c. Test personnel: The SMTP verification shall be performed by a technician selected by the government from contractor or Government personnel.

d. Test equipment, jigs, and tools.

(1) General purpose electronic test equipment used in the support maintenance test procedure verification shall be selected from the approved list of GPETE specified in 3.4.2.

(2) The contractor shall furnish all jigs, fixtures, interface devices, tools, and test equipment required to perform the tests of the support maintenance test procedure verification.

e. Assemblies and subassemblies: The contractor shall furnish a complete set of unaligned assemblies and subassemblies.

f. Depot and intermediate tests: The technician shall:

(1) Align each assembly and subassembly (if required).

(2) Verify that each assembly and subassembly is operating properly.

(3) Verify that each assembly and subassembly can be fault isolated to a circuit (such as VCC, Mixer, Flat pack, and Filter).

(4) Verify the threshold and accuracy of built-in test equipment.

g. Organizational level tests: The technician shall:

(1) Install the assemblies and subassemblies in the prime equipment and verify.

(2) Verify the operation of built-in TMDE.

(3) Operate the equipment in all modes. If the equipment does not meet all specification operating requirements except environmental, the technician shall troubleshoot the equipment, repair the equipment, and repeat the organizational level tests.

4.8 Quality assurance terms and definitions. Quality assurance terms used in this specification and classification of defects shall be as defined in ISO 9000.

4.9 Inspection of preparation for delivery. (see 5.1) Inspection of the preservation, packing, and container marking shall be conducted to insure conformance.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.1). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Ordering data. Procurement documents should specify the following:

a. Title, number and date of this specification.

b. Unless otherwise specified (see 2.1), the versions of the individual documents referenced will be those in effect on the date of release of the solicitation.

c. Packaging requirements (see 5.1).

d. STM subjected to STM test and inspection (see 4.7).

6.2 Definitions.

6.2.1 On-line test functions. Automatic on-line testing functions provided to assure that the direction of the radiated beam is in fact corresponding (within appropriate system tolerances) to the direction of the input command signals).

6.2.2 Failure. The term failure refers, in reliability demonstrations, to any malfunction or parameter deviation that prevents the equipment from performing to full capability in all modes, in the specified operational environment, to the operating parameter levels set forth herein.

6.2.3 Subassembly. Two or more parts that form a portion of an assembly while having parts, which are individually replaceable (i.e., modules and printed circuit boards with components).

6.2.4 Assembly. A number of parts or subassemblies or any combination thereof, joined together to perform a specific function while being capable of disassembly. (Such as, audio amplifier, synthesizer, and crystal oscillator.)

6.2.5 Unit. An assembly or any combination of parts, subassemblies and assemblies mounted together, normally capable of independent operation in a variety of situations (such as transmitter or receiver).

6.2.6 Test, measurement, and diagnostic equipment (TMDE). TMDE is all instruments, devices (electrical, electronic, mechanical, magnetic, or chemical), tools and interface equipment used to: test, observe, measure, monitor, modify, generate, calibrate and control physical properties, movements, and other characteristics. This includes power sources, modifiers, scalars, jigs, templates, monitoring devices, waveguides, standards, and programming software required to test, measure, and diagnose.

6.3 Special tools. (see 3.4.3) Special tools are defined as those tools not listed in the National Supply Catalog (copies of this catalog may be consulted in the office of the Defense Contract Management Agency (DCMA)).

6.4 Parts management. Electrical and mechanical parts management guidance can be obtained using MIL-HDBK-965, Acquisition Practices for Parts Management.

6.5 Tin whisker growth. The use of alloys with tin content greater than 97 percent, by mass, may exhibit tin whisker growth problems after manufacture. Tin whiskers may occur anytime from a day to years after manufacture and can develop under typical operating conditions, on products that use such materials. Conformal coatings applied over top of a whisker-prone surface will not prevent the formation of tin whiskers. Alloys of 3 percent lead, by mass, have shown to inhibit the growth of tin whiskers. For additional information on this matter, refer to ASTM-B545 (Standard Specification for Electrodeposited Coatings of Tin).

6.6 Standard modules. Refer to MIL-STD-1378, Requirements for Employing Standard Electronic Modules (SEM) which when utilized in the design and construction is shown to reduce system life cycle costs, among other benefits.

6.7 Reliability test methods. In previous acquisitions, it has been found that reliability demonstrations performed in accordance with MIL-HDBK-781, test plan XXC provided satisfactory results.

6.8 Solid state components. It was found that applying Guideline 64 of MIL-HDBK-454 yielded satisfactory components.

6.9 Design and development of maintainable products. MIL-HDBK-470 has been utilized successfully in the past.

6.10 Test, measurement and diagnostic equipment. Guideline 32 of MIL-HDBK-454 has provided satisfactory results for previous acquisitions.

6.11 Preparation of electronic equipment specifications. Satisfactory results were obtained using MIL-STD-2036 in the past.

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

6.13 Subject term (key word) listing:

Antenna, Radiating, Steered Beam
BITE, Built-In Test Equipment
Components, Solid State
IFF, Identification Friend or Foe
ISLS, Interrogation Side Lobe Suppression
Phasing, RF
Radiation, Beam Pattern, Antiphase
Radiation, Omni-directional
Signal, Digital Command, 10-bit
Signal, Synchro Data, 1X
Ventilation, Forced

6.14 Changes from previous revision. This specification is marked with vertical lines to indicate where changes 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.

Custodians:
Navy – AS
DLA - CC

Review activities:
Navy - EC

Preparing activity:
DLA - CC

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NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.dla.mil/.