INCH-POUND

MIL-A-29521(EC)
25 April 1988

MILITARY SPECIFICATION

ANTENNA GROUP, AN/BRA-34(V), AN/BRA-34A(V), AN/BRA-34B(V)

This specification is approved for use by the Space and Naval Warfare Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the performance, design, manufacture, test, and acceptance requirements for the Antenna Group, AN/BRA-34(V), AN/BRA-34A(V), and AN/BRA-34B(V), hereinafter referred to as the antenna group.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbook form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

MILITARY

MIL-C-17	Cables, Radio Frequency, Flexible And Semirigid, General Specification For
MIL-S-901	Shock Tests, H.I. (High-Impact); Shipboard Machinery, Equipment And Systems, Requirements For
MIL-P-15024	Plates, Tags And Bands For Identification Of Equipment
MIL-E-16400G	Electronic, Interior Communication And Navigation Equipment, Naval Ship And Shore: General Specification For

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Space and Naval Warfare Systems Command, SPAWAR 003-121, Washington, DC 20363-5100, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

AMSC N/A

FSC 5985

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

MIL-E-17555	Electronic And Electrical Equipment, Accessories, And Provisioned Items (Repair Parts): Packaging Of
MIL-F-19207	Fuseholders, Extractor Post Type, Blown Fuse Indicating And Nonindicating, General Specification For
MIL-E-22200	Electrodes, Welding, Covered; General Specification For
MIL-C-23020	Cable, Coaxial (For Submarine Use)
MIL-C-24217	Connectors, Electrical, Deep Submergence, Submarine
MIL-C-24231	Connector, Plugs, Receptacles, Adapters, Hull Inserts, And Hull Insert Plugs, Pressure-Proof, General Specification For
MIL-P-55110	Printed Wiring Boards, General Specification For

STANDARDS

MILITARY

MIL-STD-12	Abbreviations For Use On Drawings, And In Specifications, Standards, And Technical Documents
MIL-STD-22	Welded Joint Design
MIL-STD-108	Definitions Of And Basic Requirements For Enclosures For Electric And Electronic Equipment
MIL-STD-109	Quality Assurance Terms And Definitions
MIL-STD-129	Marking For Shipment And Storage
MIL-STD-167-1	Mechanical Vibrations Of Shipboard Equipment (Type I - Environmental And Type II - Internally Excited)
MIL-STD-248	Welding And Brazing Procedure And Performance Qualification, Requirements For
MIL-STD-271	Nondestructive Testing Methods
MIL-STD-275	Printed Wiring For Electronic Equipment
MIL-STD-278	Welding And Casting Standard
MIL-STD-454	Standard General Requirements For Electronic Equipment
MIL-STD-461	Electromagnetic Emission And Susceptibility Requirements For The Control Of Electromagnetic Interference
MIL-STD-462 and Interim Notice 5	Electromagnetic Interference Characteristics, Measurement Of
MIL-STD-471	Maintainability Verification/Demonstration/ Evaluation

MIL-STD-781	Reliability Testing For Engineering Development, Qualification, And Production
MIL-STD-810	Environmental Test Methods And Engineering Guidelines
MIL-STD-965	Parts Control Program
DoD-STD-1399, Section 300	Interface Standard For Shipboard Systems, Electric Power, Alternating Current (Metric)
MIL-STD-1472	Human Engineering Design Criteria For Military Systems, Equipment And Facilities
DoD-STD-1686	Electrostatic Discharge Control Program For Protection Of Electrical And Electronic Parts, Assemblies And Equipment (Excluding Electrically Initiated Explosive Devices) (Metric)
DoD-STD-2000-4	General Purpose Soldering Requirements For Electrical And Electronic Equipment
MIL-STD-2164	Environmental Stress Screening Process For Electronic Equipment

HANDBOOK

MILITARY

MIL-HDBK-781	Reliability Test Methods, Plans, And Environments For Engineering Development, Qualification, And Production

2.1.2 Other Government drawings and publications. The following other Government drawings and publications form a part of this specification to the extent specified herein. Unless otherwise specified, the issues shall be those in effect on the date of the solicitation.

DRAWINGS

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

28617 A,B	Antenna Group AN/BRA-34A And AN/BRA-34B
5489441	Antenna Group AN/BRA-34(V)2, AN/BRA-34A(V)2, And AN/BRA-34B(V)2 Drawing List
SS-128-2477254	Fiberglass Mast Specifications, Submarine Antenna
SS-171-4398596	AN/BRA-34 Radome Manufacturing Details

NAVAL UNDERWATER SYSTEMS CENTER, NEW LONDON LABORATORY (NUSC/NLL)

03428001	Global Positioning System (GPS) VLF/LF Antenna Modification Assembly

PUBLICATIONS

ASSISTANT SECRETARY OF THE NAVY (SHIPBUILDING AND LOGISTICS)

NAVMAT P 4855-1	Naval Power Supply Reliability, Design And Manufacturing Guidelines

NAVSEA

0900-LP-023-8071	Procedures For Painting Fiberglass Radomes And Camouflage Painting Of Submarine Fiberglass Faired Masts
0900-LP-074-4010	TRIDENT CCS Specification
TE-000-AB-GTP-010	Parts Applications And Reliability Information For Navy Electronic Equipment

NAVAL SHIP SYSTEMS ENGINEERING STATION (NAVSSES)

062-029 Code Ident 25685	Critical Item Product Fabrication For Cable, Special Purpose, Electrical Submarine Antenna Systems

SPACE AND NAVAL WARFARE SYSTEMS COMMAND (SPAWAR)

EE110-KV-OMI-010/ W110-BRA-34	FOMM Technical Manual Support Volume For Antenna Group AN/BRA-34(V), AN/BRA-34A(V), AN/BRA-34B(V)

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

2.2 Other publications. The following document forms a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS shall be the issue of the nongovernment documents which is current on the date of the solicitation.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70-1988 National Electrical Code

(Application for copies should be addressed to the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210.)

(Nongovernment standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets, or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 General. The antenna group shall conform to the requirements of MIL-E-16400G to the extent specified herein. The AN/BRA-34(V), AN/BRA-34A(V), and AN/BRA-34B(V) are multifunction antenna groups that provide signals to communication and navigation systems and support very low frequency (VLF), low frequency (LF), medium frequency (MF), high frequency (HF), ultra high frequency (UHF) line-of-sight (LOS), Navy navigation satellite (NAVSAT), UHF satellite communications (SATCOM), identification, friend or foe (IFF), and global positioning system (GPS) (AN/BRA-34(V)2, AN/BRA-34A(V)2, and AN/BRA-34B(V)2 configurations only) submarine communications and navigation requirements. The antenna group shall consist of an antenna control unit in the radio room and an interconnecting junction box, a hull-penetration (see 6.4.5) connector for electrical connections, a special purpose electrical cable, and a mast antenna. There are six configurations of the antenna group: AN/BRA-34(V)1, AN/BRA-34A(V)1, AN/BRA-34B(V)1, AN/BRA-34(V)2, AN/BRA-34A(V)2, and AN/BRA-34B(V)2. Incorporation of software; firmware, or microprocessors in the antenna group shall not be permitted.

3.1.1 First article. When specified in the contract or purchase order, a sample shall be subjected to first article inspection (see 4.3 and 6.3).

3.1.2 Antenna group description. The antenna group shall consist of the equipment shown in FIGURE 1. The antenna group relationship of units shown in FIGURE 2 is typical and is provided for reference only. Antenna group drawings, NAVSEA microfilm reel 28617A and reel 28617B, and NUSC drawing (DWG) 03428001 shall be used for general guidance, unless specifically referenced.

3.2 Details of units or parts. Detailed requirements shall be as specified in 3.2.1 through 3.2.8.

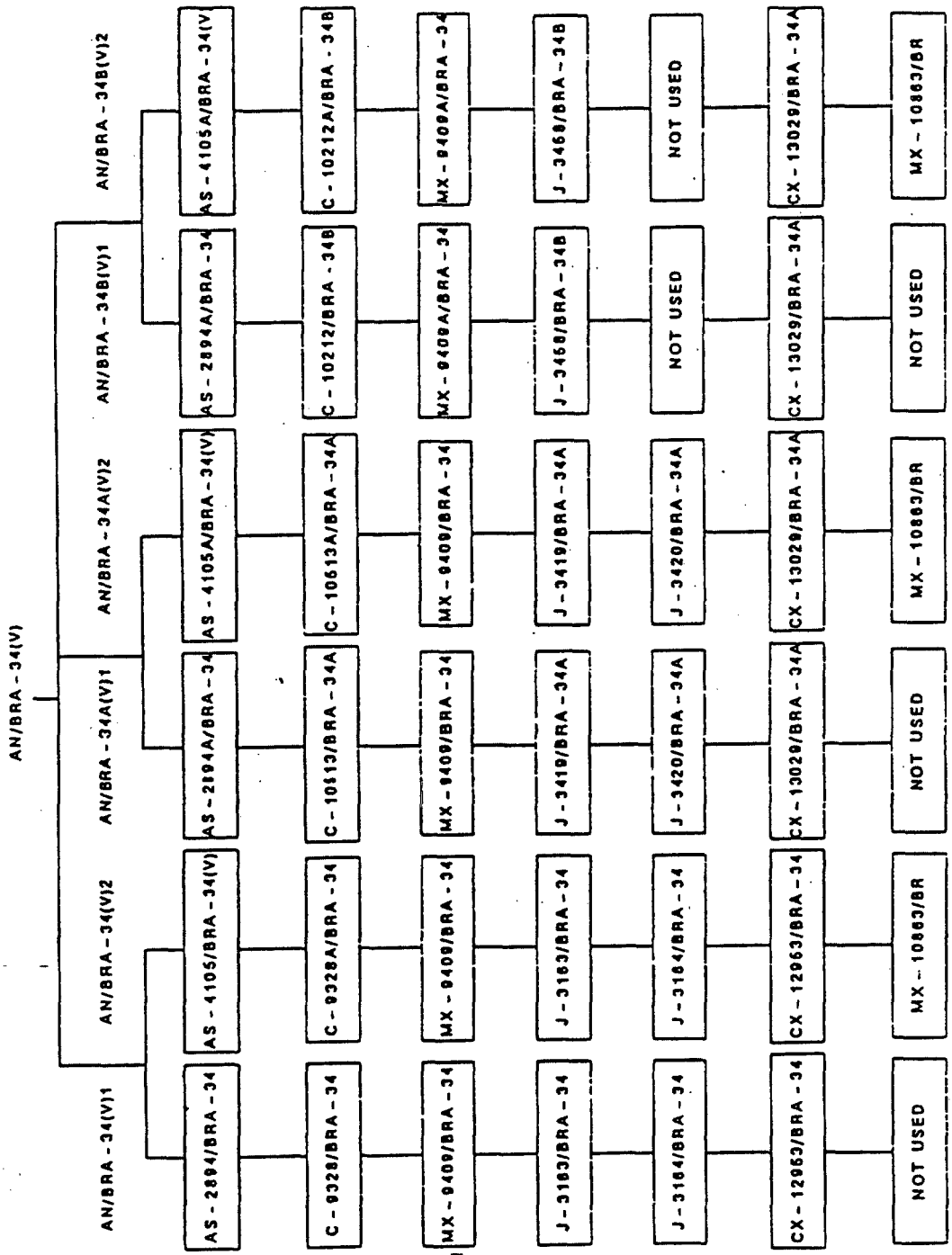
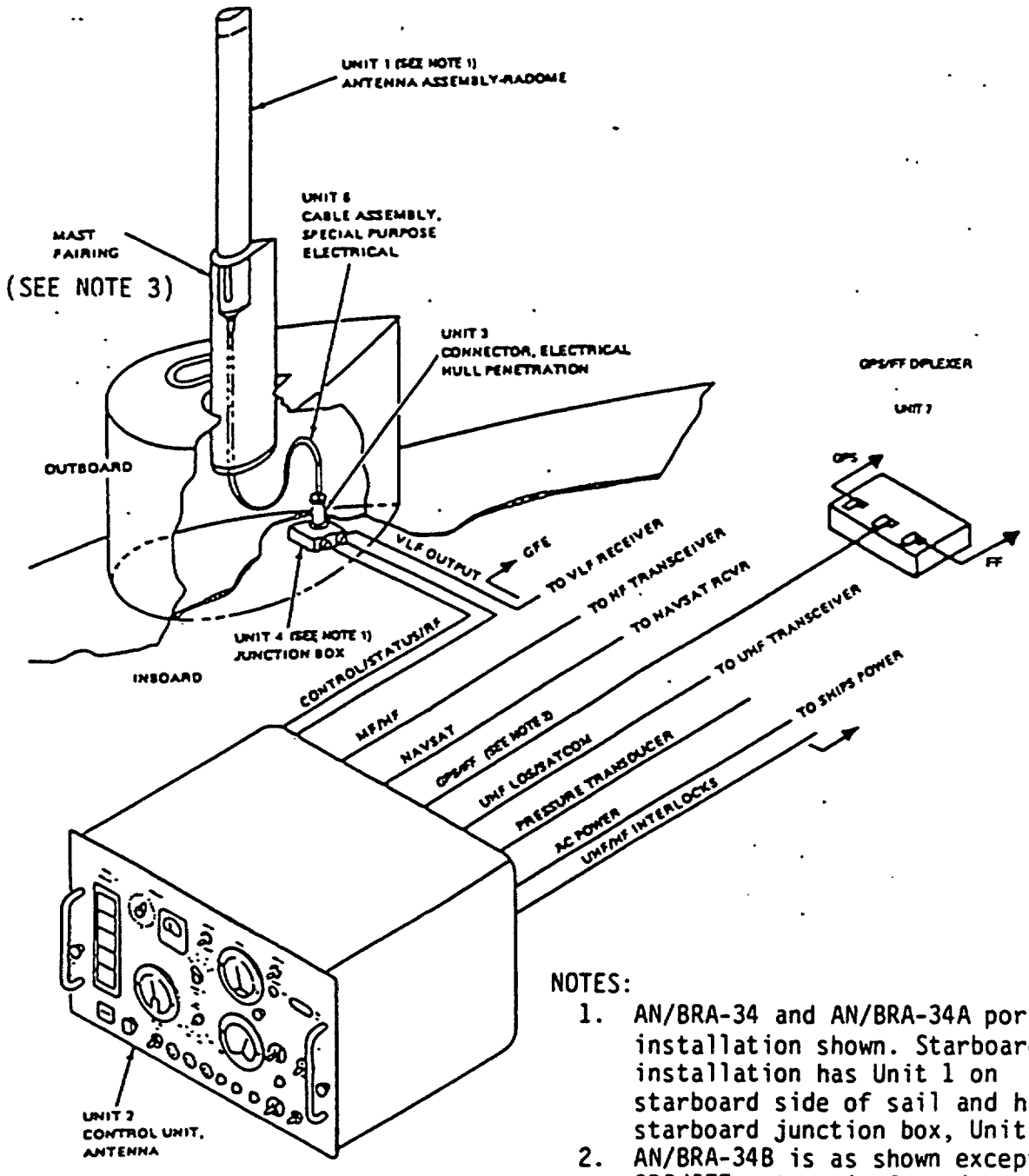


FIGURE 1. Definition of equipment nomenclature.



NOTES:

1. AN/BRA-34 and AN/BRA-34A port installation shown. Starboard installation has Unit 1 on starboard side of sail and has starboard junction box, Unit 5.
2. AN/BRA-34B is as shown except GPS/IFF output is from junction box - not control unit.
3. Not part of Antenna Group, AN/BRA-34(V).

FIGURE 2. Antenna group, relationship of units.

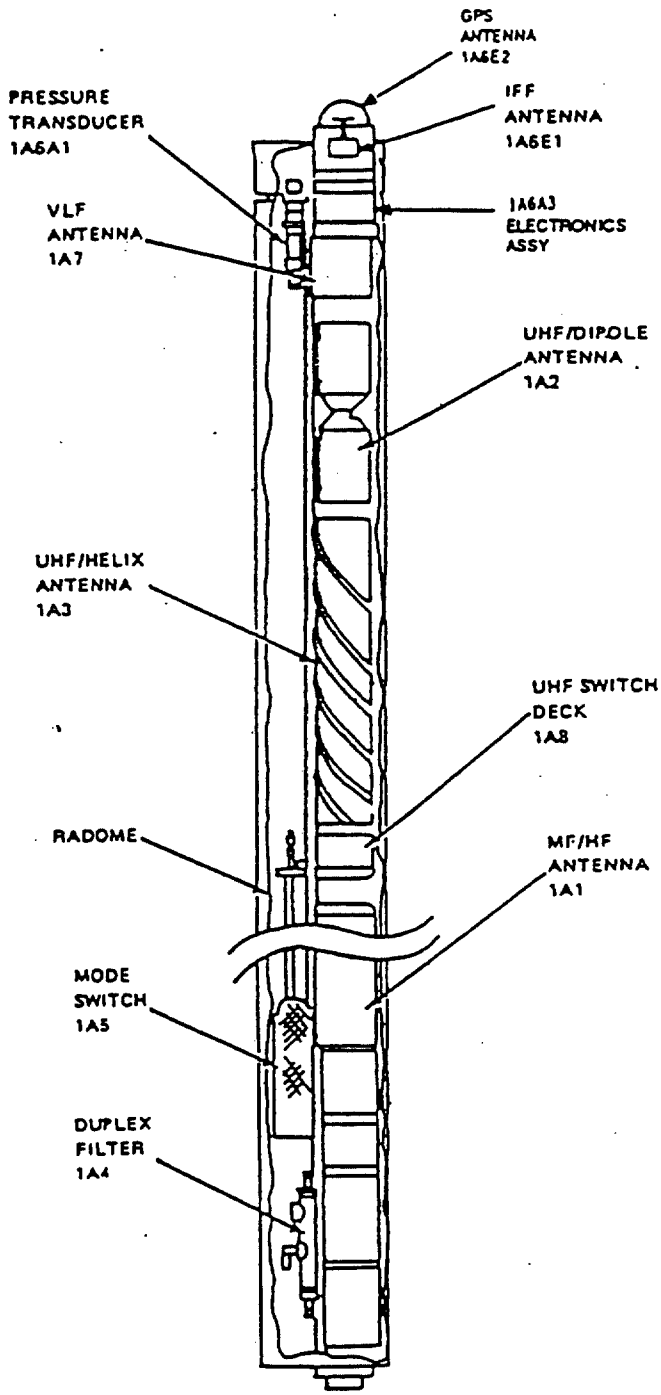


FIGURE 3. Unit 1, antenna assembly-radome.

3.2.1 Antenna assembly-radome (Unit 1). The antenna assembly-radome shall be as specified in 3.2.1.1 through 3.2.1.10 and as shown in FIGURE 3.

3.2.1.1 Functional capability. The basic design concept of the antenna assembly-radome is that of an epoxy-bonded fiberglass shell which houses and seals within it the antenna sections that perform the functions specified in a through g:

a. MF and HF transceive (2 megahertz (MHz) to 30 MHz)
b. UHF LOS transceive (225 MHz to 400 MHz)
c. VLF and LF receive (10 kilohertz (kHz) to 170 kHz)
d. NAVSAT receive (149.988 MHz and 399.963 MHz)
e. UHF SATCOM transceive (240 MHz to 320 MHz)
f. IFF transceive (950 MHz to 1150 MHz)
g. GPS receive (1227 MHz ±10 MHz and 1575 MHz ±10 MHz)

3.2.1.2 Simultaneous operation. All antenna sections contained within a radome shall conform to all specification performance requirements when operated individually and in any combination with any or all other sections contained within the radome. Sections shall operate without time limit and at maximum specification limits without impairing the performance of any other section. No section shall incur damage when operated in a receive or transmit mode due to the operation of another section operated in a transmit or receive mode, except that VLF reception during MF and HF transmission shall not be required.

3.2.1.3 MF and HF antenna (Unit 1A1). The MF and HF antenna shall consist of a helical conductor wound within a pregrooved plastic form, on which a metallic capacitive top load is mounted. Inside the helix and top load shall be a shorting device comprising a metallic shorting tube with shorting brushes at each end to complete the circuit between the helix and top load.

3.2.1.4 UHF dipole antenna (Unit 1A2). The UHF dipole antenna shall be a vertical dipole to be used for UHF LOS transmission and reception, NAVSAT reception, and UHF SATCOM low-angle transmission and reception.

3.2.1.5 UHF helix antenna (Unit 1A3). The UHF helix antenna shall be a quadrafilar helix for reception and transmission of SATCOM signals in an overhead (high-angle) mode. The UHF helix antenna shall be compatible with a UHF SATCOM transceiver operating in a simplex mode.

3.2.1.6 Duplex filter (Unit 1A4). The duplex filter shall combine or separate the MF and HF frequency band and the UHF and IFF-GPS frequency bands.

3.2.1.7 Mode switch (Unit 1A5). The mode switch shall provide the capability to disconnect all antennas except the MF and HF antenna for improved MF and HF transmission performance.

3.2.1.8 GPS antenna, IFF antenna, and depth transducer assembly (Unit 1A6). The GPS antenna, IFF antenna, and depth transducer assembly shall perform the functions specified in a through c:

a. GPS antenna. The GPS antenna shall be used for reception of the GPS satellite signal.

b. IFF antenna. The IFF antenna shall be a modified conical antenna to be used for IFF transmission and reception.

c. Depth transducer. The depth transducer shall provide a voltage output representing depth of the antenna below the water surface.

3.2.1.9 VLF antenna (Unit 1A7). The VLF loop antenna system shall provide radio reception service aboard submarines in the frequency range from 10 kHz to 170 kHz. The antenna shall operate with Coupler, CU-1441( )/BRR or CU-2364/BRR.

3.2.1.10 UHF switch deck (Unit 1A8). The UHF switch deck shall separate or combine UHF and IFF signals, amplify and filter VHF and UHF received signals, and provide relay selection of UHF dipole antenna or UHF helix antenna.

3.2.2 Antenna control unit (Unit 2). The antenna control unit is located in the radio room and shall house the power supply, reflectometer, and various control and indicating circuits necessary for remote operation of the various sections of the antenna.

3.2.3 Hull-penetration connector (Unit 3). The hull-penetration connector shall consist of an insert assembly with a receptacle on the outboard (see 6.4.4) side and a cable assembly on the inboard (see 6.4.3) side. The inboard cable assembly shall be provided with connectors required to complete the circuit between the hull receptacle and the inboard junction box. The hull-penetration liner is not a part of this assembly.

3.2.4 Junction box, port (Unit 4). The port junction box shall be the junction point for interconnecting wiring between the hull-fitting (see 6.4.2) connector of the cable assembly (Unit 3) and the antenna control unit (Unit 2). The port junction box shall provide a connector for VLF and LF output. The J-3458/BRA-34B port junction box shall also provide an IFF output connector.

3.2.5 Junction box, starboard (Unit 5). The starboard junction box shall be identical to the port junction box (Unit 4) except for the placement of mechanical parts and attaching hardware, which shall be located to facilitate starboard installation.

3.2.6 Cable assembly (Unit 6). The cable assembly shall comprise an outboard cable with associated end fittings. The outboard cable assembly shall be in accordance with NAVSSES 062-029 Code Ident 25685, MIL-C-24217, and MIL-C-24231 and shall conform to the cold bend requirements of MIL-C-17. The cable assembly shall complete the control and radio frequency (RF) circuitry between the antenna and the hull-fitting receptacle.

3.2.7 GPS-IFF diplexer (Unit 7). The GPS-IFF diplexer shall separate or combine the GPS signal and the IFF signal.

3.2.8 Antenna group interfaces. AN/BRA-34(V)1, AN/BRA-34A(V)1, and AN/BRA-34B(V)1 antenna group interfaces, including connector type and pin designation, shall be as specified in the Interconnecting Cabling Diagram figure of EE110-KV-OMI-010/W110-BRA-34 without Change A incorporated. AN/BRA-34(V)2, AN/BRA-34A(V)2, and AN/BRA-34B(V)2 antenna group interfaces, including connector type and pin designation, shall be as specified in the drawings specified in NAVSEA DWG 5489441.

3.3 Performance characteristics. Performance characteristics shall be as specified in 3.3.1 through 3.3.12.

3.3.1 MF and HF antenna (Unit 1A1) performance characteristics. The MF and HF antenna shall have the performance characteristics specified in a through e:

a. Frequency range. The range of operating frequencies shall extend from 2.0 MHz to 30.0 MHz, measured at the antenna assembly-radome base connector.

b. Impedance. The input impedance shall be 50 ohms nominal, measured at the antenna assembly-radome base connector.

c. Voltage standing wave ratio (VSWR). The tuned VSWR shall be 2:1 or less over the frequency range of 2.0 MHz to 30.0 MHz, measured at the antenna assembly-radome base connector.

d. Pattern. The azimuthal radiation pattern shall be omnidirectional within ±1 decibel (dB), measured at the antenna assembly-radome base connector.

e. Bandwidth. The 3-dB bandwidth of the antenna, measured at the antenna assembly-radome base connector, shall be 15 kHz or greater between 2.0 MHz and 2.5 MHz; the bandwidth shall be 25 kHz or greater between 2.5 MHz and 30 MHz.

3.3.1.1 MF and HF antenna efficiency. The antenna efficiency shall be measured with the top and base of the radome 198 inches (in.) and 22.6 in., respectively, above the snorkel waterline. The antenna efficiency (in HF-only mode) shall be measured at the antenna assembly-radome base connector, allowing compensation for antenna assembly-radome internal cabling, and shall be as specified in a through c:

a. 2.0 MHz to 2.49 MHz: 5 percent or greater
b. 2.5 MHz to 4.0 MHz: 15 percent or greater
c. 4.01 MHz to 30.0 MHz: 50 percent or greater

3.3.2 UHF dipole antenna (Unit 1A2) performance characteristics. The UHF dipole antenna shall have the performance characteristics specified in a through f:

a. Frequency range. The UHF dipole antenna shall operate over a frequency range of 225 MHz to 400 MHz and at 150 MHz, measured at the antenna assembly-radome base connector.

b. Impedance. The input impedance shall be 50 ohms nominal, measured at the antenna assembly-radome base connector.

c. VSWR. The VSWR shall be 2:1 or less with respect to 50 ohms over the frequency range of 225 MHz to 400 MHz and at 150 MHz, measured at the antenna assembly-radome base connector.

d. Pattern. The azimuthal radiation pattern shall be omnidirectional within ±2 dB, measured at the antenna assembly-radome base connector. The radiation pattern in the vertical plane shall have a figure-eight shape representative of a vertical dipole. This pattern shall be maintained over the frequency range of 225 MHz to 400 MHz.

e. Gain. The UHF dipole antenna gain shall be as specified in APPENDIX A.

f. Polarization. The antenna shall have linear vertical polarization.

3.3.2.1 UHF LOS performance requirements. The UHF dipole antenna shall provide for transmission and reception of UHF LOS continuous wave (CW) signals over the frequency range of 225 MHz to 400 MHz.

3.3.2.2 NAVSAT performance requirements. The UHF dipole antenna shall be compatible with the performance capabilities of NAVSAT. The UHF dipole antenna performance requirements shall be as specified in a and b:

a. Phase-shift variation. The maximum phase-shift variation for NAVSAT signals at the antenna control unit output, during a 20-minute interval shall not exceed 1 degree.

b. Frequency. The antenna shall be capable of simultaneous reception of 149.988 MHz and 399.963 MHz.

3.3.2.3 UHF SATCOM (low-angle) performance requirements. The UHF dipole antenna shall be compatible with a UHF SATCOM transceiver operating in a simplex mode over the frequency range of 240 MHz to 320 MHz.

3.3.3 UHF helix antenna (Unit 1A3) performance characteristics. The UHF helix antenna shall have the performance characteristics specified in a through h:

a. Frequency range. The UHF helix antenna shall operate over the frequency range of 240 MHz to 320 MHz, measured at the antenna assembly-radome base connector.

b. Impedance. The input impedance shall be 50 ohms nominal, measured at the antenna assembly-radome base connector.

c. VSWR.. The VSWR shall not exceed 2:1 with respect to 50 ohms, measured at the antenna assembly-radome base, over the frequency range of 240 MHz to 320 MHz.

d. Pattern. The antenna shall have an omnidirectional pattern within ±1 dB in the horizontal plane at an elevation angle of 30 degrees, measured at the antenna assembly-radome base connector. The pattern shall be unidirectional in the vertical plane with the maximum at zenith.

e. Gain. The UHF helix antenna gain shall be as specified in APPENDIX A.

f. Polarization. The antenna shall have right-hand circular polarization.

g. Transmit or receive function. The antenna shall have a transmit or receive function selection capability controlled by the UHF transmitter keyline (+12 volts direct current (VDC), 200 milliamperes (mA) maximum).

h. Switching time. Switching time between receive and transmit shall not exceed 30 milliseconds.

3.3.4 GPS antenna (Unit 1A6) performance characteristics. The GPS antenna shall have the performance characteristics specified in a through f:

a. Frequency ranges. The GPS antenna shall operate over the frequency ranges of 1227.6 MHz ±10 MHz and 1575.42 MHz ±10 MHz, measured at the antenna assembly-radome base connector.

b. Pattern. The pattern shall be nominal hemispherical, measured at the antenna assembly-radome base connector.

c. Gain. The antenna gain, measured at the antenna assembly-radome base connector, shall be equal to or greater than 0 decibels isotropic circular source (dBic) for +25 degrees to +90 degrees elevation and greater than -5 dBic for +10 degrees to +25 degrees elevation. Maximum gain shall be +6 dBic at zenith. Azimuthal gain variation shall be within ±1.5 dB at an elevation angle of +20 degrees.

d. Polarization. The antenna shall have right-hand circular polarization. The gain of the antenna element when receiving a left-hand circularly-polarized signal shall be no greater than -10 dBic including any back-lobe radiation.

e. VSWR. The VSWR shall not exceed 1.8:1 with respect to 50 ohms over the frequency ranges of 1227.6 MHz ±10 MHz and 1575.42 MHz ±10 MHz, measured at the antenna assembly-radome base connector.

f. Impedance. The input impedance shall be 50 ohms nominal, measured at the antenna assembly-radome base connector.

3.3.4.1 GPS amplifier-filter. The GPS amplifier-filter shall have the performance characteristics specified in a through f:

a. Amplifier gain. 25 dB minimum over the frequency ranges of 1227.6 MHz ±10 MHz and 1575.42 MHz ±10 MHz

b. Gain flatness. See 3.3.4.2a

c. Noise figure. The noise figure of the amplifier-filter combination shall not exceed 3.0 dB, including cables and connectors between the antenna feed and the filter input, over the frequency ranges of 1227.6 MHz ±10 MHz and 1575.42 MHz ±10 MHz.

d. Compression point. The amplifier gain at the 1-dB compression point shall be 10 decibels referred to one milliwatt (dBm) minimum.

e. Filter rejection. The filter rejection of all frequencies 1200 MHz and below shall be at least 50 dB.

f. Input or output VSWR. The VSWR shall not exceed 1.8:1 with respect to 50 ohms at either the input or output of the amplifier-filter combination.

3.3.4.2 GPS antenna-filter-preamplifier combined characteristics. GPS antenna-filter-preamplifier combined characteristics shall be as specified in a through c:

a. Amplitude ripple. At any specified location, that is, azimuth angle and elevation angle on the antenna radiation pattern between the elevation angles of +10 degrees to +90 degrees and azimuth angles from 0 degree to 360 degrees, the maximum received signal amplitude ripple, measured at the output of the preamplifier shall not exceed +0.75 dB over the frequency ranges of 1227.6 MHz ±10 MHz and 1575.42 MHz ±10 MHz.

b. Phase linearity deviation. Phase deviations from a linear slope shall not exceed limits of ±5 degrees. The rate of change of the phase deviation with frequency (group delay) shall not exceed 8 nanoseconds (ns). The phase shall not ripple more than 5 times within a band ±5 MHz about the center frequencies of 1227.6 MHz and 1575.42 MHz.

c. Protection. Protection from burnout by stray RF fields, including UHF, MF, and HF radiation, shall be included. The preamplifier shall incur no damage when subjected to a 1-watt (W) CW input signal for unlimited time at any frequency between 2 MHz and 400 MHz.

3.3.5 IFF antenna (Unit 1A6) performance characteristics. The IFF antenna shall have the performance characteristics specified in a through f:

a. Frequency range. The IFF antenna shall operate over the frequency range of 950 MHz to 1150 MHz, measured at the antenna assembly-radome base connector.

b. Impedance. The input impedance shall be 50 ohms nominal, measured at the antenna assembly-radome base connector.

c. VSWR. The VSWR of the antenna shall be equal to or less than 2:1, measured at the antenna assembly-radome base connector, over the frequency range of 950 MHz to 1150 MHz.

d. Pattern. The antenna shall be omnidirectional within ±2 dB in the horizontal plane, measured at the antenna assembly-radome base connector. The pattern in the vertical plane shall approximate a figure-eight shape with the peak located near the horizon.

e. Gain. The IFF antenna gain shall be as specified in APPENDIX A.

f. Polarization. The antenna shall have linear vertical polarization.

3.3.6 Depth transducer (Unit 1A6) performance characteristics. The depth transducer shall provide a voltage output representing depth of the antenna below the surface, and shall have the characteristics specified in 3.3.6.1 through 3.3.6.3.

3.3.6.1 Output voltage. The maximum output voltage from the depth transducer shall be 5 volts (V) ±0.25 V. The voltage shall vary from 0 V ±0.1 V to maximum, representing 0 meter (m) to 30.48 m (100 feet (ft)), respectively. Scale factor for these values shall be 0.164 V per meter depth (0.05 V per foot depth).

3.3.6.2 Impedance. The output impedance of the depth transducer and associated circuitry shall be low enough to drive a 50,000-ohm load at the output voltage specified in 3.3.6.1.

3.3.6.3 Pressure. The depth transducer shall be capable of withstanding pressure up to 70.3 kilograms per square centimeter (kg/cm^2) (1000 pounds per square inch (psi)).

3.3.7 VLF antenna (Unit 1A7) performance characteristics. The VLF antenna shall have the performance characteristics specified in a through f and in 3.3.7.1 through 3.3.7.1.7.

a. Frequency range. The range of operating frequencies shall extend from 10 kHz to 170 kHz.

b. Effective height. The effective height of each loop shall be at least 0.59 millimeter (mm) (0.023 in.) at 20 kHz and 3.6 mm (0.142 in.) at 120 kHz.

c. Pattern. The antenna shall have two bidirectional (figure-eight) patterns displaced 90 degrees ±0.5 degree in the horizontal plane across the frequency range of 10 kHz to 170 kHz. Throughout this frequency range, the four maximum values of these orthogonal response patterns shall be approximately equal, with differences not to exceed 2 dB.

d. Loop decoupling. When measured at 20 kHz, decoupling between the loops shall be at least 34 dB.

e. Loop Q. The in-air Q of each loop inductor shall have a value greater than 135 at a frequency of 20 kHz measured in free space. The in-air Q of each loop inductor measured at the antenna assembly-radome base shall have a value greater than 65 at a frequency of 20 kHz.

f. Loop inductance. Each single-plane loop inductor shall have a nominal inductance of 500 ±15 microhenries at a frequency of 20 kHz measured at the antenna assembly-radome base. The inductance of the two windings shall be within ±1 percent.

3.3.7.1 VLF output requirements. The requirements specified in 3.3.7.1.1 through 3.3.7.1.7 include the loop antenna, preamplifier, cabling, and connectors, and are measured at the output of the junction box (Unit 4 or Unit 5).

3.3.7.1.1 Preamplifiers. Preamplifiers shall be provided within the loop antenna assembly for each VLF loop such that the effective height of each loop at the junction box output when terminated in 50 ohms is 60 mm (0.23 in.) ±20 percent at 20 kHz. The preamplifiers shall be capable of being bypassed by removal of power supply voltage.

3.3.7.1.2 Frequency response. The output of each loop preamplifier at the junction box output shall have a frequency response, when referenced to 100 kHz, as specified in TABLE I.

TABLE I. Frequency response.

Frequency range	Amplitude relative to level at 100 kHz
10 kHz to 20 kHz	±2 dB
20 kHz to 50 kHz	±2 dB
50 kHz to 70 kHz	±0.75 dB
70 kHz to 130 kHz	±0.25 dB
130 kHz to 150 kHz	±0.75 dB
150 kHz to 170 kHz	±2 dB

3.3.7.1.3 Phase difference. The maximum phase difference between loops shall be less than 20 ns at 100 kHz and less than 300 ns between 10 kHz and 14 kHz.

3.3.7.1.4 Phase-shift variation. The maximum phase-shift variation over a 100-hour interval shall be less than 45 ns. The root-mean-square (rms) phase-shift variation over the same period shall be less than 15 ns. The variation shall be measured using the antenna, preamplifier, and associated cables and connectors within the radome, and the outboard cable and hull-penetration from the antenna to the junction box.

3.3.7.1.5 Harmonic distortion. Harmonic distortion at a maximum output voltage of 0.1 V shall not exceed 1 percent (with the output terminated in 50 ohms).

3.3.7.1.6 Phase response. A least mean square fit line, drawn through a plot of phase-shift versus frequency in linear coordinates over the frequency range of 70 kHz to 130 kHz shall intercept the phase-shift axis at zero frequency within the range of ±25 degrees. The phase-shift shall be measured from the electromagnetic field in air incident on the antenna to the output of the junction box. The maximum deviation of phase response from the least mean square fit line shall be +1 degree from 70 kHz to 130 kHz, ±2 degrees from 50 kHz to 70 kHz, and ±2 degrees from 130 kHz to 150 kHz.

3.3.7.1.7 Sensitivity. A field intensity of 30 microvolts per meter at the loop center (single plane) shall provide a minimum signal-to-noise ratio (SNR) of 20 dB in a 50-hertz (Hz) bandwidth for the loop and preamplifier combination. Sensitivity measurements shall be made using a 500-ohm transmission line fed by a standard signal generator at a frequency of 20 kHz as the excitation source within a shielded enclosure. The 500-ohm transmission line shall be a single wire as one conductor, and the shielded room the other conductor. The transmission line shall be terminated in its characteristic impedance with a noninductive resistance. A simulator may be used if approved by SPAWAR. The sensitivity of the loop antenna at 100 kHz shall be such that a field intensity of 60 microvolts per meter shall produce a SNR greater than or equal to 0 dB in a bandwidth of 70 kHz.

3.3.8 UHF switch deck (Unit 1A8) performance characteristics. Performance characteristics of the VHF and UHF preamplifier portion of the UHF switch deck shall be as specified in 3.3.8.1.

3.3.8.1 VHF and UHF preamplifier. A low noise preamplifier shall be provided for reception of VHF and UHF signals from both the UHF dipole antenna and the UHF helix antenna. The preamplifier shall be mounted within the antenna assembly-radome as near as possible to the feed points of the two antennas. The maximum noise figure shall be 4 dB from 150 MHz to 400 MHz. The preamplifier gain shall be 29 dB +3 dB over the 150-MHz to 400-MHz range. The 1 dB compression point of the preamplifier shall occur with a minimum of -10 dBm input. A fail-safe means for bypassing the preamplifier during the transmit mode shall be included. The preamplifier shall incur no damage when subjected to a 1-W CW input signal for unlimited time at any frequency between 2 MHz and 400 MHz.

3.3.9 Antenna control unit (Unit 2) performance characteristics. The antenna control unit shall provide all controls and indicators for antenna selection and for tuning the MF and HF antenna. Functional capabilities and relative positions of front panel controls and indicators shall be as shown in FIGURE 4, except that the VLF/LF PREAMP selector switch capability shall be required only for AN/BRA-34(V)2, AN/BRA-34A(V)2, and AN/BRA-34B(V)2 antenna groups.

3.3.10 Cable assembly (Unit 6) performance characteristics. The cable assembly shall be in accordance with MIL-C-23020, MIL-C-24217, and MIL-C-24231 and shall conform to the cold bend requirements of MIL-C-17. The cable assembly shall complete the control RF circuitry between the antenna and the hull-fitting receptacle. The cable assembly shall operate under adverse conditions of temperature and in the severe environment of the sea.

3.3.10.1 Attenuation. The attenuation of the coaxial cable used in the outboard cable assembly (including connectors) shall be as specified in a through c:

a. 150 MHz to 400 MHz: 2.2 dB maximum
b. 950 MHz to 1200 MHz: 4.25 dB maximum
c. 1200 MHz to 1600 MHz: 5.0 dB maximum

3.3.10.2 VSWR. The VSWR of the coaxial cable used in the outboard cable assembly (including connectors) shall be as specified in a through c:

a. 100 MHz to 400 MHz: 1.25:1 maximum
b. 900 MHz to 1200 MHz: 1.80:1 maximum
c. 1200 MHz to 1600 MHz: 2.0:1 maximum

3.3.11 Insertion loss. Insertion loss from the antenna assembly-radome base connector to the connector nearest each antenna including the relay package, associated cable, diplexer, switch, and connector shall be as specified in a through c:

a. 150 MHz to 400 MHz: 1.2 dB maximum
b. 950 MHz to 1150 MHz: 3.25 dB maximum
c. 1200 MHz to 1600 MHz: 2.5 dB maximum

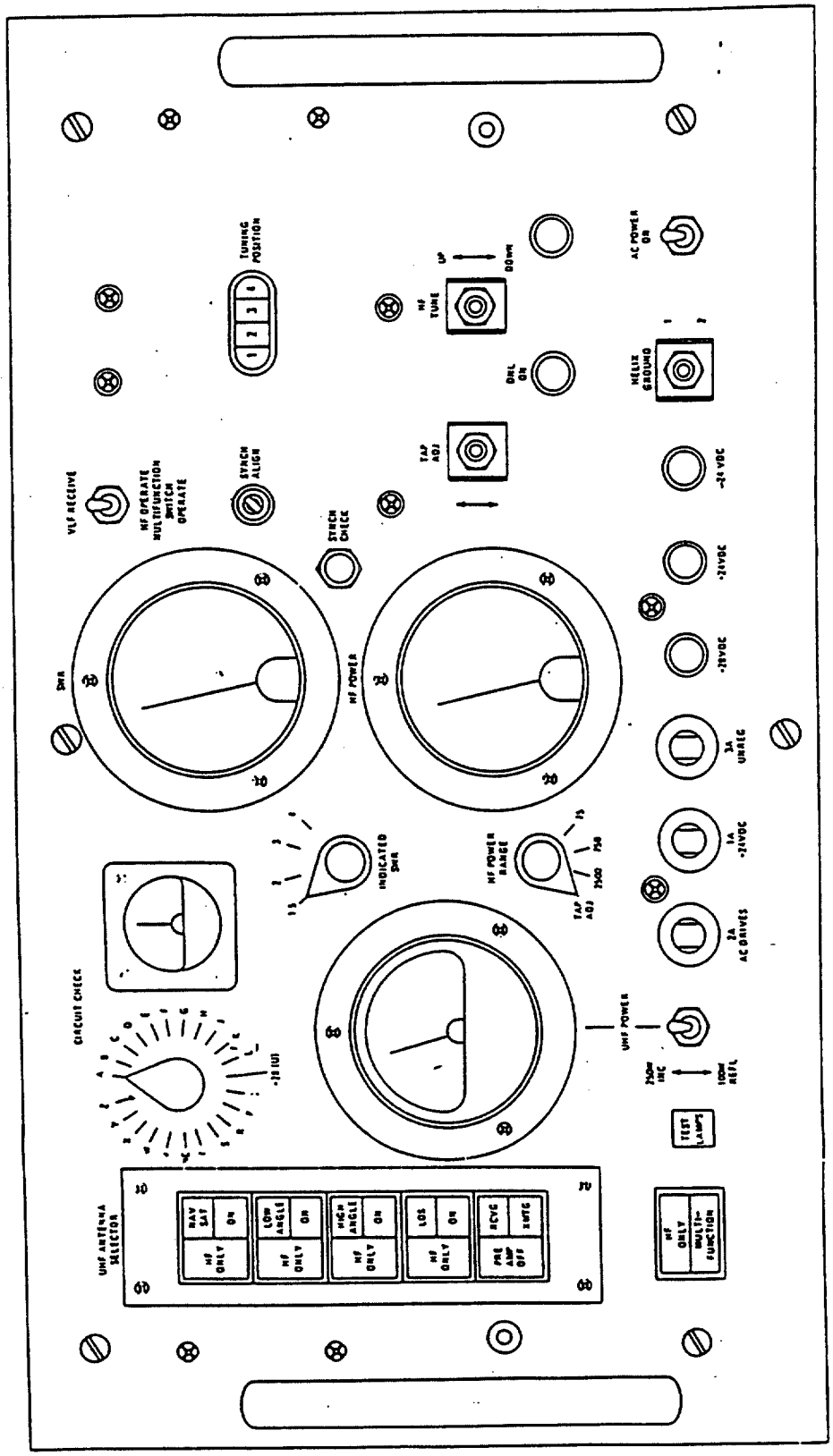


FIGURE 4. Antenna control unit front panel.

3.3.12 RF power input. Maximum RF power input capability of each unit separately, and the antenna group connected as a system, shall be as specified in a through d:

a. MF and HF operating mode (2.0 MHz to 30.0 MHz): 1-kW CW
b. UHF LOS operating mode (225 MHz to 400 MHz): 100-W CW
c. UHF SATCOM operating mode (225 MHz to 400 MHz): 100-W CW
d. IFF operating mode (950 MHz to 1150 MHz): 1-kW peak power with a 10 percent duty cycle

3.4 Design and construction. Design and construction shall be as specified in 3.4.1 through 3.4.3.6.

3.4.1 Parts, materials, and processes. The parts, materials, and processes shall be in accordance with the Parts, materials and processes paragraph of MIL-E-16400G, except as otherwise specified in 3.4.1.1 through 3.4.1.3.3.

3.4.1.1 Parts. Parts shall be as specified in 3.4.1.1.1 through 3.4.1.1.5.2.

3.4.1.1.1 Parts control. Parts control shall be in accordance with MIL-STD-965, Procedure I.

3.4.1.1.2 Derating. The derating criteria of NAVSEA TE-000-AB-GTP-010 shall be utilized in the design of the antenna group equipment.

3.4.1.1.3 Electrostatic discharge (ESD). ESD protection shall be provided in accordance with the Design protection paragraph of DoD-STD-1686.

3.4.1.1.4 Indicator lamps. Indicator lamps shall conform to the Indicators and associated items paragraph of MIL-E-16400G, except for dimmer controls.

3.4.1.1.5 Printed wiring board (PWB) fabrication and PWB protection. PWB fabrication and protection shall be as specified in 3.4.1.1.5.1 and 3.4.1.1.5.2.

3.4.1.1.5.1 PWBs. PWBs shall be fabricated in accordance with the requirements of MIL-STD-275 and MIL-P-55110. PWBs and chassis shall be marked to key and facilitate insertion of the PWB into the correct position. No damage shall occur if a PWB is inserted into an incorrect position.

3.4.1.1.5.2 PWB protection. With power applied to the equipment, removal or insertion of each PWB shall not damage the PWB or any other part of the equipment. Each PWB shall be keyed to prevent incorrect insertion.

3.4.1.2 Materials. Materials shall be as specified in 3.4.1.2.1 through 3.4.1.2.5.

3.4.1.2.1 Mercury and radioactive material. Parts used in the antenna group shall not contain, nor have come in direct contact with mercury, mercuric compounds, or mercury-bearing instruments on devices employing only a single-boundary containment during manufacture or inspection. No radioactive paints or coatings shall be used.

3.4.1.2.2 SUBSAFE requirements. All materials used in construction of the hull-fitting insert and connector shall conform to SUBSAFE requirements and are subject to approval by SPAWAR (see 4.5.17).

3.4.1.2.2.1 SUBSAFE requirements (hull-penetration). Portions of the antenna system (hull-penetration) to be supplied under this specification are in a SUBSAFE application aboard Navy submarines. SUBSAFE is a term used to identify certain materials in which maximum confidence is required. The materials utilized shall be manufactured under strict quality control procedures to assure maximum compliance with all invoked specifications.

3.4.1.2.3 Magnetic permeability. The antenna group (except for the junction box) shall employ no material which has a magnetic permeability greater than 2.0 after fabrication, except for material required to be magnetic for the electrical functioning of the equipment.

3.4.1.2.4 Material flammability. Material used as part of the antenna group shall conform to MIL-STD-454, Requirement 3.

3.4.1.2.5 Selection of alternative materials. Aluminum or other lightweight material may be used in those units of the antenna group where the weight of the units can be significantly reduced without loss of strength, machine accuracy, or resistance to wear and corrosion. Use of magnesium is not permitted.

3.4.1.3 Processes. processes shall be as specified in 3.4.1.3.1 through 3.4.1.3.3

3.4.1.3.1 Painting. Painting shall be in accordance with the Painting paragraph of MIL-E-16400G, except that radome finishing shall be in accordance with NAVSEA 0900-LP-023-8071.

3.4.1.3.2 Structural welding. Structural welding shall conform to MIL-STD-454, Requirement 13.

3.4.1.3.3 Soldering. Soldering shall conform to the requirements of DoD-STD-2000-4.

3.4.2 Electrical design. Electrical design shall be as specified in 3.4.2.1 through 3.4.2.3.

3.4.2.1 Prime power. The antenna control unit shall operate from single-phase, 115 volts alternating current (VAC) +10 percent, 60 Hz +5 percent power having characteristics as specified in DoD-STD-1399, Section 300, Type I. Maximum power consumption shall be 525 W.

3.4.2.2 Power supply design. Guidance for the design and construction of power supplies is provided in NAVMAT P 4855-1. Power density in excess of 2 W per cubic in. shall require the approval of the Government. The junction temperature of semiconductor devices shall not exceed +110° Celsius (C) under worst-case conditions. The power supply shall have a reserve capacity of at least 40 percent. Hot spot temperatures shall not exceed 40°C rise above ambient temperature with a maximum temperature of +110°C for parts less than or equal to 3 W of dissipation; 55°C rise above ambient temperature with a maximum temperature of +125°C for parts greater than 3 W of dissipation; 30°C rise above ambient temperature with a maximum temperature of +100°C for transformers; and 10°C rise above ambient temperature, due to self-heating, with a maximum temperature of +85°C for capacitors. Power supplies shall be designed to be maintainable at either intermediate or depot level; they shall not be limited by design to repair by the manufacturer. Power supplies shall not be encapsulated or embedded (potted) unless it can be shown by analysis and test to be necessary for heat removal or dissipation. This requirement shall not exclude conformal coating. The mean-time-between-failures (MTBF) requirement shall be not less than 40,000 hours at 55°C. Power supplies shall be designed to withstand and shall not be damaged by any load between an open-circuit and a short-circuit.

3.4.2.3 Blown fuse indicators. Blown fuse indicators shall be provided for all fuses and shall be of the neon type using clear lenses, except where neon-type indicators cannot be utilized due to the voltage involved. Where neon-type indicators cannot be used, MIL-F-19207 shall apply.

3.4.3 Mechanical characteristics. Mechanical characteristics shall be as specified in 3.4.3.1 through 3.4.3.6.

3.4.3.1 Enclosures. Except for interior surfaces with openings for cooling, the antenna control unit and junction box enclosures shall be designed in accordance with the Enclosures paragraph of MIL-E-16400G and conforming to the dripproof (45 degrees) requirements of MIL-STD-108.

3.4.3.2 Airborne and structureborne noise. The antenna group shall conform to the airborne noise acceptance levels as specified in TABLE II. The antenna group shall conform to the structureborne noise acceptance levels specified in TABLE I-10 of NAVSEA 0900-LP-074-4010. Noise requirements shall be in accordance with APPENDIX 60.2 of NAVSEA 0900-LP-074-4010.

TABLE II. Airborne noise acceptance levels (dB).

Unit	Frequency Range (Hz)							
	37.5-75	75-150	150-300	300-600	600-1.2k	1.2k-2.4k	2.4k-4.8k	4.8k-9.6k
1	90	85	80	80	75	75	75	75
2	72	68	64	Numerical average between 300 Hz and 4800 Hz shall not exceed 45 dB.				44
3	72	68	64					44

3.4.3.3 Locking devices. Locking devices shall be in accordance with the Shaft locking devices paragraph of MIL-E-16400G.

3.4.3.4 Controls, indicators, and panel layouts. The design of operator and maintenance panel layouts, controls, and consoles shall be in accordance with MIL-STD-1472. The abbreviations of MIL-STD-12 shall be used for labeling where applicable.

3.4.3.4.1 Controls. Controls with critical settings or which require setting only occasionally shall be provided with a locking device.

3.4.3.5 Lifting-sling attachment. The antenna assembly-radome (Unit 1) design shall include provisions for lifting-sling attachment points.

3.4.3.6 Mechanical requirements. The antenna assembly-radome (Unit 1) shall be capable of mounting and operating within a retractable faired mast in the sail of a submarine in accordance with NAVSEA DWGs SS-128-2477254 and SS-171-4398596.

3.5 Physical characteristics. Physical characteristics shall be as specified in 3.5.1 and 3.5.2.

3.5.1 Dimensions. Dimensions of the antenna group equipment shall not exceed those dimensions specified in TABLE III. Dimensions of the antenna assembly-radome (Unit 1), hull-penetration connector (Unit 3), and cable assembly (Unit 6) shall be as specified in NAVSEA microfilm reel 28617A and reel 28617B.

3.5.2 Weight. Maximum weight of the antenna group equipment shall be as specified in TABLE III.

TABLE III. Antenna group physical characteristics.

Nomenclature	Unit	Height cm[1/] (in.)	Width cm (in.)	Depth cm (in.)	Weight kg (lb)
Antenna assembly-radome	1	2/	2/	2/	281.2 (620)
Antenna control unit	2	26.7 (10.5)	48.3 (19.0)	48.0 (18.88)	36.7 (81)
Hull-penetration connector	3	2/	2/	2/	22.7 (50)
Junction box, port	4	18.1 (7.12)	30.5 (12.00)	24.8 (9.75)	10.0 (22)
Junction box, starboard	5	18.1 (7.12)	30.5 (12.00)	24.8 (9.75)	10.0 (22)
Cable assembly	6	2/	2/	2/	34.0 (75)
GPS-IFF diplexer	7	7.6 (3.0)	17.2 (6.76)	4.4 (1.75)	0.7 (1.5)

1/ Centimeters
2/ Dimensions shall be as specified in NAVSEA microfilm reel 28617A and reel 28617B.

3.6 Environmental requirements. The antenna group outboard equipment (Unit 1, Unit 3, and Unit 6) and inboard equipment (Unit 2, Unit 4, Unit 5, and Unit 7) shall conform to the requirements specified in 3.6.1 through 3.6.7.

3.6.1 Temperature. The antenna group shall conform to the requirements specified in the Operating temperature ranges paragraph and the Non-operating temperature ranges paragraph of MIL-E-16400G as specified in a and b:

a. Range 2 for outboard equipment
b. Range 4 for inboard equipment

3.6.2 Humidity. The inboard equipment shall maintain the specified performance when exposed to the humidity environments specified in MIL-STD-810, Method 507.2, Procedure III, except that testing shall be performed for a total of five cycles (120 hours).

3.6.3 Shock. The antenna group equipment shall withstand the Grade A, Class I, Type A test for light and medium weight equipment in accordance with MIL-S-901, as modified by APPENDIX B.

3.6.4 Vibration. The antenna group equipment shall withstand the Type I vibration requirements of MIL-STD-167-1.

3.6.5 Inclination. The 60-degree inclination requirement of MIL-E-16400G shall apply to the antenna group inboard equipment.

3.6.6 Hydrostatic pressure. Hydrostatic pressure requirements shall be as specified in 3.6.6.1 through 3.6.6.3.

3.6.6.1 Antenna assembly-radome. The antenna assembly-radome (Unit 1) shall withstand the hydrostatic pressure cycles specified in a through d without structural failure (see 6.4.1), water absorption in radome walls, or leakage beyond the indicated seals. The primary seal is formed by the crush-ring seal and external plug. The secondary seal comprises the O-ring and the internal plug.

a. Radome shell. 1050 psi for 5 minutes (no leakage beyond primary seal)
b. Radome shell. 1050 psi for 5 minutes (no leakage beyond secondary seal with primary seal removed)
c. Radome shell. 1050 psi for 1 hour
d. Radome completely assembled:

1. 1050 psi for 5 minutes
2. 6 psi for 10 minutes
3. 1050 psi for 10 minutes
4. 6 psi for 1 hour
5. 1050 psi for 30 minutes

3.6.6.1.1 Antenna connector. The antenna assembly-radome base connector shall conform to the hydrostatic pressure requirements of MIL-C-24231.

3.6.6.2 Cable assembly. The outboard wetted portion of the cable assembly (Unit 6) shall withstand 70.3 kg/cm^2 (1000 psi) of external pressure for 1 hour without evidence of leakage or degradation of the cable or fitting. The insulation resistance between each conductor and all other conductors in the cable and to ground, after exposure to pressure, shall not be reduced below 1000 megohms, when measured immediately after exposure to pressure.

3.6.6.3 Hull-penetration connector. The hull-penetration connector (Unit 5) shall conform to the hydrostatic pressure requirements of MIL-C-24231.

3.6.7 Underwater explosion. The hull-penetration connector (Unit 5) shall pass underwater explosion tests in accordance with APPENDIX B.

3.7 Electromagnetic interference (EMI) suppression. The inboard equipment shall be designed to operate compatibly in a submarine electromagnetic environment. As a minimum, the antenna group shall conform to the requirements of MIL-STD-461 for Class A5 equipment. The required tests are CE01, CE03, CS01, CS02, CS06, CS09 (for junction box only), RE01, RE02, RS01, RS02, and RS03.

3.8 Human factors requirements. The antenna group shall conform to the human factors operational and maintenance design criteria of MIL-STD-1472 and the requirements specified in 3.4.3.4.

3.9 Safety. All construction and material installation performed by the contractor shall be designed to prevent injury to personnel or equipment during installation, operation, and maintenance. The personnel safety shall be as specified in the Safety (personnel hazard) paragraph of MIL-E-16400G and as specified in 3.9.1 through 3.9.7.

3.9.1 Equipment power connectors. Equipment power connectors for 115-VAC input power, and interconnecting alternating current power cable connectors between equipment, shall have only three pins designated A, B, and C. Pin assignment and color code shall be as specified in TABLE IV. The black-and-white color code shall be maintained from the input connector pins to all components having the same voltage and frequency as the input power.

TABLE IV. Pin assignment and color code.

Pin designation	Conductor assignment	Color code
A	115-VAC return	White
B	Safety ground	Green
C	115-VAC high (hot)	Black

3.9.2 Critical controls. Critical controls, the accidental activation of which may cause damage to equipment, injury to personnel, or degradation of system function, shall be designed and located so that they are not susceptible to being moved accidentally.

3.9.3 Drawer slides. Drawer slide design shall include provisions to prevent accidental derailing and detachment of equipment from the slider.

3.9.3.1 Support strength. Drawer slides in the closed and extended positions, detents, mounting surfaces, and other attachment mechanisms which support equipment shall have a safety factor equal to twice the maximum anticipated weight.

3.9.4 Leakage current. The leakage current of any individual unit of the antenna group shall not exceed 5 mA at 115-VAC, 60-Hz, single-phase source power.

3.9.5 Equipment electrical power ON-OFF switch. A switch for disconnecting equipment from all electrical power systems shall be mounted on the equipment front panel. The function of the switch shall be clearly labeled. The switch shall break all power conductors of the power circuit.

3.9.6 Power indicator lamp. A green power indicator lamp shall be mounted near the power ON-OFF switch to indicate when the equipment is energized. The lamp shall be connected across the input power conductors on the load side of the switch.

3.9.7 Overcurrent device location. A fuse or an overcurrent trip unit of a circuit breaker shall be connected in series with each ungrounded conductor as determined by NFPA 70-1988 for grounded source power.

3.10 Identification plate or part number marking. Each part or assembly that is separate from other units (except for transmission lines) at the time of delivery shall contain an identification plate which shall be in accordance with Type A, B, or C of MIL-P-15024, except that plastic is not acceptable.

3.10.1 Weight marking. Equipment weighing in excess of 15.8 kilograms (kg) (35 pounds (lbs)) shall have the weight clearly marked on the external surface of the equipment and readily visible during installation and removal. The marking shall be as permanent as the normal life expectancy of the equipment.

3.10.2 ESD marking. Items sensitive to ESD shall be marked as specified in 3.10.2.1 through 3.10.2.3.

3.10.2.1 Assemblies. Assemblies shall be marked in accordance with the Assemblies paragraph of DoD-STD-1686.

3.10.2.2 Equipment enclosures. Equipment enclosures shall be marked in accordance with the Equipment enclosures paragraph of DoD-STD-1686.

3.10.2.3 Nonstandard parts. ESD-sensitive nonstandard parts shall be marked with the sensitive electronic device symbol specified in MIL-STD-129.

3.11 Reliability. The lower test MTBF (θ_1 as defined in MIL-HDBK-781) of the antenna group shall be 850 hours.

3.12 Maintainability. The antenna group inboard components shall have a mean-corrective-maintenance-time (M_{ct}) not exceeding 10 minutes and a maximum-corrective-maintenance-time (95th percentile) not exceeding 1 hour when corrective maintenance is accomplished at the organizational level by replacement of lowest assemblies (modules, printed circuit boards, and chassis-mounted parts). Corrective maintenance time includes localization, isolation, disassembly, interchange, reassembly, alignment, and checkout for all corrective maintenance.

3.13 Workmanship. Workmanship shall be as specified in 3.13.1 and 3.13.2.

3.13.1 General workmanship. Workmanship shall conform to MIL-STD-454, Requirement 9.

3.13.2 Environmental stress screening. The antenna control unit and junction box shall withstand the environmental stress screening process specified in MIL-STD-2164.

4. QUALITY ASSURANCE PROVISIONS

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

4.1.1 Responsibility for compliance. All items shall conform to all requirements of Section 3 and Section 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.1.2 Government verification. All quality assurance 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, and 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.

4.1.3 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 specified in a through c:

a. First article inspection (see 4.3)
b. Quality conformance inspection (see 4.4)
    1. Production inspection (Group A) (see 4.4.1)
    2. Production control inspection (Group B) (see 4.4.2)
c. Inspection of packaging (see 4.10)

4.3 First article inspection. Unless otherwise specified (see 6.2), one antenna group shall be required for first article inspection. First article inspection shall consist of all examination and testing necessary to determine compliance with the requirements of this specification. First article inspection shall include the tests specified in TABLE V.

TABLE V. Examinations and tests.

Examination or test	Requirement paragraph	Test paragraph	First article inspection	Quality conformance inspection	
				Group A	Group B
Surface examination:					
Dimensions	3.5.1	4.5.1	X	X	
Weight	3.5.2	4.5.1	X	X	
Parts, materials, and processes	3.4.1 through 3.4.1.3.3	4.5.1	X	X	
Marking	3.10 through 3.10.2.3	4.6	X	X	
Safety	3.9 through 3.9.3.1	4.5.1	X		X
Design and construction	3.4.1.1.2 through 3.4.1.1.4, 3.4.1.1.5.1, 3.4.1.1.5.2, 3.4.2.2, 3.4.2.3, 3.4.3.3, 3.4.3.4.1, 3.4.3.5, 3.4.3.6, 3.9.5 through 3.9.7	4.5.1	X		
Environmental requirements:					
Temperature	3.6.1	4.5.18	X		X
Humidity	3.6.2	4.5.19	X		X
Shock					
Antenna assembly-radome	3.6.3	4.5.20	X		
Antenna control unit	3.6.3	4.5.20	X		X
Hull-penetration connector	3.6.3	4.5.20	X		
Junction box, port	3.6.3	4.5.20	X		
Junction box, starboard	3.6.3	4.5.20	X		
Cable assembly	3.6.3	4.5.20	X		
GPS-IFF diplexer	3.6.3	4.5.20	X		
Vibration					
Antenna assembly-radome	3.6.4	4.5.21	X		

TABLE V. Examinations and tests - Continued.

Examination or test	Requirement paragraph	Test paragraph	First article inspection	Quality conformance inspection	
				Group A	Group B
Antenna control unit	3.6.4	4.5.21	X		X
Hull-penetration connector	3.6.4	4.5.21	X		
Junction box, port	3.6.4	4.5.21	X		
Junction box, starboard	3.6.4	4.5.21	X		
Cable assembly	3.6.4	4.5.21	X		
GPS-IFF diplexer	3.6.4	4.5.21	X		
Inclination	3.6.5	4.5.22	X		X
Hydrostatic pressure	3.6.6 through 3.6.6.3	4.5.23, 4.5.23.1	X	X	
Underwater explosion	3.6.8	4.5.1	X		
Cable cold bend test	3.3.10	4.5.1	X	(For each cable lot)	
EMI interference suppression	3.7	4.5.24	X		X
Leakage current	3.9.4	4.5.25 through 4.5.25.2	X	X	
Reliability	3.11	4.7 through 4.7.7.1	X		
Maintainability	3.12	4.8 through 4.8.3	X		
Airborne and structure-borne noise	3.4.3.2	4.5.1	X		
Mercury and radioactive material	3.4.1.2.1	4.5.1, 4.5.16	X	X	
SUBSAFE requirements	3.4.1.2.2, 3.4.1.2.2.1	4.5.17.1 through 4.5.17.1.5	X	X	
Enclosures	3.4.3.1	4.5.1	X		X
Magnetic permeability	3.4.1.2.3	4.5.1	X		
Simultaneous operation	3.2.1.2	4.5.2	X		X
Insertion loss	3.3.11	4.5.14	X	X	
Structural welding	3.4.1.3.2	4.5.1	X		
Soldering	3.4.1.3.3	4.5.1	X		
Prime power	3.4.2.1	4.5.1	X		X
Human factors	3.4.3.4, 3.8	4.5.1	X		
General workmanship	3.13.1	4.5.1	X	X	

TABLE V. Examinations and tests - Continued.

Examination or test	Requirement paragraph	Test paragraph	First article inspection	Quality conformance inspection	
				Group A	Group B
Environmental stress screening:					
Antenna control unit	3.13.2	4.9	X	X	
Junction box, port	3.13.2	4.9	X		
Junction box, starboard	3.13.2	4.9	X		
GPS-IFF diplexer	3.13.2	4.9	X		
Performance test	-	4.5.2	X	X	
Pre- and post-test functional verification	-	4.5.3	X		
VSWR	3.3.1c, 3.3.2c, 3.3.3c, 3.3.4e, 3.3.5c	4.5.4	X	X	
Pattern	3.3.1d, 3.3.2d, 3.3.3d, 3.3.4b, 3.3.5d, 3.3.7c	4.5.5	X		X
RF power input	3.3.12	4.5.15	X	X	
Gain	3.3.2e, 3.3.3e, 3.3.5e	4.5.8	X		X
Polarization	3.3.2f, 3.3.3f, 3.3.4d, 3.3.5f	4.5.9	X		X
Antenna group function	3.2.1, 3.2.1.1, 3.2.1.3 through 3.2.7	4.5.2	X		
Antenna group interfaces	3.2.8	4.5.1	X		X
MF and HF antenna performance characteristics	3.3.1	4.5.2, 4.5.6	X		X
MF and HF antenna efficiency	3.3.1.1	4.5.2, 4.5.7	X		X
UHF dipole antenna performance characteristics	3.3.2	4.5.2	X		
UHF LOS performance requirements	3.3.2.1	4.5.2	X		
NAVSAT performance requirements	3.3.2.2	4.5.2	X		
UHF SATCOM (low-angle) performance requirements	3.3.2.3	4.5.2	X		

TABLE V. Examinations and tests - Continued.

Examination or test	Requirement paragraph	Test paragraph	First article inspection	Quality conformance inspection	
				Group A	Group B
UHF helix antenna performance characteristics	3.3.3	4.5.2	X		
GPS antenna performance characteristics	3.3.4	4.5.2, 4.5.10	X		
GPS amplifier-filter:					
Amplifier gain	3.3.4.1	4.5.2	X	X	
Gain flatness	3.3.4.1	4.5.2	X	X	
Noise figure	3.3.4.1	4.5.2	X	X	
Compression point	3.3.4.1	4.5.2	X	X	
Filter rejection	3.3.4.1	4.5.2	X	X	
Input or output VSWR	3.3.4.1	4.5.2	X	X	
GPS antenna-filter-preamplifier combined characteristics	3.3.4.2	4.5.2	X	X	
IFF antenna performance characteristics	3.3.5	4.5.2	X		
Depth transducer performance characteristics	3.3.6	4.5.2	X		
Output voltage	3.3.6.1	4.5.2	X		X
Impedance	3.3.6.2	4.5.2	X		
Pressure	3.3.6.3	4.5.2	X		X
VLF antenna performance characteristics:					
Frequency range	3.3.7a	4.5.2	X		
Effective height	3.3.7b	4.5.11	X		X
Loop decoupling	3.3.7d	4.5.2	X		X
Loop Q	3.3.7e	4.5.2	X		X
Loop inductance	3.3.7f	4.5.2	X		X
VLF output requirements	3.3.7.1	4.5.2	X		
Preamplifiers	3.3.7.1.1	4.5.2	X		X
Frequency response	3.3.7.1.2	4.5.12	X	X	
Phase difference	3.3.7.1.3	4.5.2	X		X
Phase-shift variation	3.3.7.1.4	4.5.13	X		X
Harmonic distortion	3.3.7.1.5	4.5.2	X	X	
Phase response	3.3.7.1.6	4.5.2	X	X	
Sensitivity	3.3.7.1.7	4.5.2	X	X	
UHF switch deck:					
VHF and UHF preamplifier	3.3.8.1	4.5.2	X		
Noise figure	3.3.8.1	4.5.2	X	X	

TABLE V. Examinations and tests - Continued.

Examination or test	Requirement paragraph	Test paragraph	First article inspection	Quality conformance inspection	
				Group A	Group B
Frequency response	3.3.8.1	4.5.2	X	X	
Gain	3.3.8.1	4.5.2	X	X	
Compression point	3.3.8.1	4.5.2	X	X	
Antenna control unit performance characteristics	3.3.9	4.5.2	X		
Cable assembly performance characteristics	3.3.10	4.5.2	X		
Attenuation	3.3.10.1	4.5.2	X	X	
VSWR	3.3.10.2	4.5.2	X	X	

4.4 Quality conformance inspection. Quality conformance inspections shall be as specified in 4.4.1 through 4.4.4.

4.4.1 Production inspection (Group A). Production inspection shall be conducted on every antenna group offered for delivery. Production inspection shall comprise such examinations and tests which will prove the workmanship and reveal omissions and errors of the production process, such as 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 consist of the examinations and tests specified in TABLE V, Group A.

4.4.2 Production control inspection (Group B). Production control inspection shall be conducted on a sampling basis as specified herein, and shall consist of examinations and tests which encompass functional and performance tests throughout the entire range of operation, tests to determine deviations in the processes and equipment required to fabricate the antenna group, and environmental tests to prove the durability of the materials, parts, units, and the antenna group as a whole. One antenna group shall be selected from each six consecutive production antenna groups for submission to Group B sampling tests. The antenna groups submitted for Group B sampling tests shall be selected by the procuring activity and shall be representative of current production. These tests shall be performed on the complete antenna group as offered for delivery. Production control inspection shall include the examinations and tests specified in TABLE V, Group B. Failure of the sample unit to conform to prescribed requirements shall constitute a failure and shall be cause for rejection of the sample unit. Group B inspection shall be performed on antenna groups that have passed Group A inspection specified in 4.4.1. The antenna groups shall conform to the requirements of production control inspection prior to release for shipment.

4.4.2.1 Rejected units. If an antenna group is rejected, the contractor may withdraw the unit from further inspection. The contractor may also rework the rejected unit to correct the defect(s) and may reinspect the unit. Production control inspection for rejected units shall be as specified in 4.4.2. Rejected units shall be kept separate from new units and shall not lose their identity.

4.4.3 Nonconformance corrective action and retest. If a sample unit fails the inspection specified in 4.4.2, the contractor shall immediately investigate the cause of the failure and shall implement the corrective action necessary to correct the units of product which were manufactured under the same conditions, materials, processes, and so forth. The antenna group shall then be retested.

4.4.4 Reinspection of conforming production control inspection sample units. Unless otherwise specified (see 6.2), sample units which have been subjected to, and have passed, production control inspection may be accepted on the contract, provided all damage has been repaired and the antenna groups are resubjected to, and pass, production inspection.

4.5 Test methods. Test methods shall be as specified in 4.5.1 through 4.5.25.2. Testing shall be performed at ambient pressure and room temperature unless otherwise specified herein.

4.5.1 Examinations and tests. Examinations and tests specified herein shall be conducted in accordance with the applicable inspection procedures of MIL-E-16400G and Government-approved test procedures. It shall be the responsibility of the contractor to provide all cables, connectors, test instrumentation, test facilities, and other devices required to set up and perform all tests at the contractor's plant, or other place of test, to verify compliance with the requirements specified herein. When the antenna group is tested as a system, the contractor shall provide interconnecting cables adequate to simulate realistic installation conditions; that is, length, attentuation, and shielding shall be as identical as possible to actual installations.

4.5.2 Performance test. The antenna group shall be subjected to a performance test to determine compliance with the performance parameters and safety requirements specified herein.

4.5.3 Pre- and post-test functional verification. Prior to proceeding with any of the Group B environmental test methods, the test item shall be operated under standard ambient conditions. When operation of the test item is required during the test exposure, the operation and performance checks shall be of sufficient duration or shall be repeated at appropriate intervals. The test item shall be visually examined. If a test chamber is used for the test, a visual examination of the test item within the chamber shall be performed at test conditions, when possible. Upon completion of the test, a visual examination of the test item shall be performed again after the

test item has been returned to standard ambient conditions. Deterioration, corrosion, or change in tolerance limits of any internal or external parts which could in any manner prevent the test item from conforming to operational service or maintenance requirements, shall provide reason to consider the test item as having failed to withstand the conditions of the test. Leakage or degradation of impregnating compounds shall be considered damage and cause for rejection. Performance tests shall be conducted on the test item to determine whether the test item suffers performance degradation resulting from exposure to the test conditions. Performance testing shall include, but not be limited to, measurements of VSWR and insertion loss for comparison with previously-obtained measurement values. Degradation of performance shall be reason for failure.

4.5.4 VSWR. Tests shall be conducted to determine conformance with the requirements of 3.3.1c, 3.3.2c, 3.3.3c, 3.3.4e, and 3.3.5c. Measurements shall be made at 100-kHz increments from 2.0 MHz to 3.0 MHz, 200-kHz increments from 3.0 MHz to 7.0 MHz, 0.5 MHz increments from 7.0 MHz to 14 MHz, and 1-MHz increments from 14.0 MHz to 30.0 MHz. Swept frequency measurements shall be made from 225 MHz to 400 MHz, 950 MHz to 1150 MHz, 1217.6 MHz to 1237.6 MHz, and 1565.42 MHz to 1585.42 MHz.

4.5.5 Pattern. Tests shall be conducted to determine conformance to the requirements of 3.3.1d, 3.3.2d, 3.3.3d, 3.3.4b, 3.3.5d, and 3.3.7c in both the specified horizontal and vertical planes.

4.5.6 Bandwidth. Tests shall be conducted to determine conformance to the requirements of 3.3.1e. Bandwidth shall be measured at 2.25 MHz, 4 MHz, 14 MHz, and 30 MHz in both HF-only and multifunction modes.

4.5.7 Efficiency. Tests shall be conducted to determine conformance to the requirements of 3.3.1.1. Efficiency measurements shall be conducted at 2 MHz, 2.4 MHz, 3 MHz, 5 MHz, 20 MHz, and 30 MHz.

4.5.8 Gain. Antenna gain of each antenna group production unit shall be measured in accordance with the test procedures specified in APPENDIX A for the UHF dipole antenna, UHF helix antenna, and IFF antenna to determine conformance to the requirements of 3.3.2e, 3.3.3e, and 3.3.5e.

4.5.9 Polarization. Tests shall be conducted to determine conformance to the requirements of 3.3.2f, 3.3.3f, 3.3.4d, and 3.3.5f. Tests shall be made at one point within each specified frequency range.

4.5.10 GPS frequency response. Tests shall be conducted to determine conformance to the requirements of 3.3.4a. Tests shall be conducted at 1217.6 MHz and at increments of 5 MHz from 1217.6 MHz to 1237.6 MHz. Tests shall also be conducted at 1565.42 MHz and at increments of 5 MHz from 1565.42 MHz to 1585.42 MHz.

4.5.11 Effective height. Tests shall be conducted to determine conformance to the requirements of 3.3.7b. The effective height of the VLF antenna shall be measured at 20 kHz and 120 kHz.

4.5.12 VLF frequency response. Tests shall be conducted to determine conformance to the requirements of 3.3.7.1.2. Measurements shall be made at 10 kHz, 14 kHz, and at increments of 10 kHz from 20 kHz to 170 kHz.

4.5.13 VLF phase-shift variation. Tests shall be conducted by applying a 100 kHz input signal through the VLF antenna. The VLF output from the antenna assembly-radome shall be terminated in 50 ohms ±10 ohms.

4.5.14 Insertion loss. Tests to determine conformance to the requirements of 3.3.11 shall be conducted at 150 MHz, 300 MHz, 400 MHz, 950 MHz, 1150 MHz, 1227.6 MHz, and 1575.42 MHz.

4.5.15 RF power input. Tests shall be conducted to determine conformance to the requirements of 3.3.12. MF and HF antenna RF power input shall be maintained at 1000 W CW for 5 minutes at each of four frequencies (one between 2 MHz and 3 MHz, one between 4 MHz and 12 MHz, one between 14 MHz and 20 MHz, and one between 20 MHz and 30 MHz). UHF dipole antenna RF power input shall be maintained at 100 W CW for 15 minutes at each of four frequencies between 225 MHz and 400 MHz. UHF helix antenna RF power input shall be maintained at 100 W CW for 15 minutes at each of four frequencies between 225 MHz and 400 MHz. IFF antenna RF power input shall be maintained at 1000 W with a 10 percent duty cycle for 15 minutes at each of four frequencies between 950 MHz and 1150 MHz.

4.5.16 Mercury contamination. Antenna groups that have passed all required examinations and tests and are ready for packaging shall be tested for mercury contamination. Each unit may be tested individually. The antenna assembly-radome may be tested by assembly. The test specified in a and b shall be conducted to determine whether contamination of mercury exists:

a. The equipment and packaging material shall be enclosed in a polyethylene bag or close-fitting, airtight container and placed in an oven at 52.0°C ±2.8°C for 1 hour.

b. The trapped air in the bag shall be sampled and measured for metallic mercury contamination. If the mercury vapor contamination exceeds 0.01 milligram per cubic meter, the equipment shall be rejected.

4.5.17 SUBSAFE requirements and certification. SUBSAFE requirements and certification shall be as specified in 4.5.17.1 through 4.5.17.1.5.

4.5.17.1 Welding. Welding shall be as specified in 4.5.17.1.1 through 4.5.17.1.5

4.5.17.1.1 Electrodes. Quantitative test reports of the chemical and mechanical properties of electrodes conforming to MIL-E-22200, shall be submitted for approval.

4.5.17.1.2 Procedures. Written procedures covering all welding processes utilized in manufacture of the hull-fitting in accordance with MIL-STD-278 shall be submitted for approval to the Naval Ship Systems Engineering Station (NAVSSES), Code 06, Philadelphia, PA 19112. Welding procedures which have not been previously approved by NAVSSES shall be submitted for approval with the results of the welding procedure qualification as specified in the Welding procedure qualification Section of MIL-STD-248.

4.5.17.1.3 Qualification. Procedures in effect (approved by NAVSSES) and qualification records of each individual welder performing welding shall be in accordance with MIL-STD-248.

4.5.17.1.4 Joint design. Design of welded joints shall be in accordance with MIL-STD-278 and MIL-STD-22. Joint design designation shall be designated on each drawing. Joint designs shall be designated in the weld procedure.

4.5.17.1.5 Nondestructive testing. All welds in the primary boundary (see 6.4.6) and secondary boundary (see 6.4.7) require dye penetrant or magnetic particle inspection. In addition to dye penetrant or magnetic particle inspection, all full-penetration welds shall have 100-percent radiographic inspection. All inspection shall be in accordance with MIL-STD-271.

4.5.18 Temperature test. The equipment shall be tested in accordance with MIL-STD-810, Method 501.2, Procedure I and Procedure II, and Method 502.2, Procedure I and Procedure II, to determine conformance to the requirements of 3.6.1.

4.5.19 Humidity. The equipment shall be tested to determine conformance to the requirements of 3.6.2.

4.5.20 Shock. The antenna group equipment shall be hard-mounted to the shock table by a test fixture and subjected to the shock inputs of MIL-S-901, as modified by APPENDIX B, for Grade A, Class I, Type A equipment. The antenna group shall be mounted to the test fixture in the same way that the antenna group is to be mounted in the ship. The medium weight, high impact shock table shall be used for this test. The equipment shall be energized during each shock blow. The equipment shall be in operating condition before and after each shock blow. Insertion loss and VSWR of the antenna shall be measured before and after the test on the antenna assembly-radome. Operation of the antenna controls and indicators shall be verified before and after the test on the antenna control unit.

4.5.21 Vibration. The antenna group equipment shall be hard-mounted to the vibration table by a test fixture and subjected to the amplitude inputs of MIL-STD-167-1, the Vibratory displacement of environmental vibration table for each of three orthogonal axes (principal axis of units). The frequency range shall be 4 Hz to 33 Hz. The antenna control unit shall be bolted to the test fixture in the same way that the antenna control unit will be mounted to the

rack. The resonant frequency of the fixture shall be greater than 75 Hz. Insertion loss and VSWR of the antenna shall be measured before and after the test on the antenna assembly-radome. Operation of the antenna control unit controls and indicators shall be verified before and after the test on the antenna control unit.

4.5.22 Inclination test. The equipment shall be tested in accordance with the Inclination test paragraph of MIL-E-16400G to determine conformance to the requirements of 3.6.5.

4.5.23 Hydrostatic pressure. Each antenna assembly-radome, outboard cable assembly, and hull-penetration insert shall be subjected to a hydrostatic pressure test to determine conformance to the requirements of 3.6.6.

4.5.23.1 Vacuum leak. Following the hydrostatic pressure test of 4.5.23 on the antenna assembly-radome and stabilization of the unit to room temperature, the unit shall withstand a partial vacuum equivalent to a pressure of 71 centimeters of mercury for a minimum period of 2 hours. Indicated pressure readings taken 15 minutes after evacuation and at the end of the test period shall be compared. The deviation shall be within 10 percent.

4.5.24 EMI suppression. The requirements of 3.7 shall be verified by tests performed in accordance with MIL-STD-462. The tests shall employ swept frequency spectrum analysis and provide annotated data plots.

4.5.25 Leakage current test. Leakage current shall be measured at the steady-state power line voltage and frequency of 115 V, 60 Hz.

WARNING

THIS TEST MAY BE HAZARDOUS DUE 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.

4.5.25.1 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 under test and the source power shall be opened during the test. OBSERVE WARNING STATEMENT. The equipment shall be connected as shown in FIGURE 5.

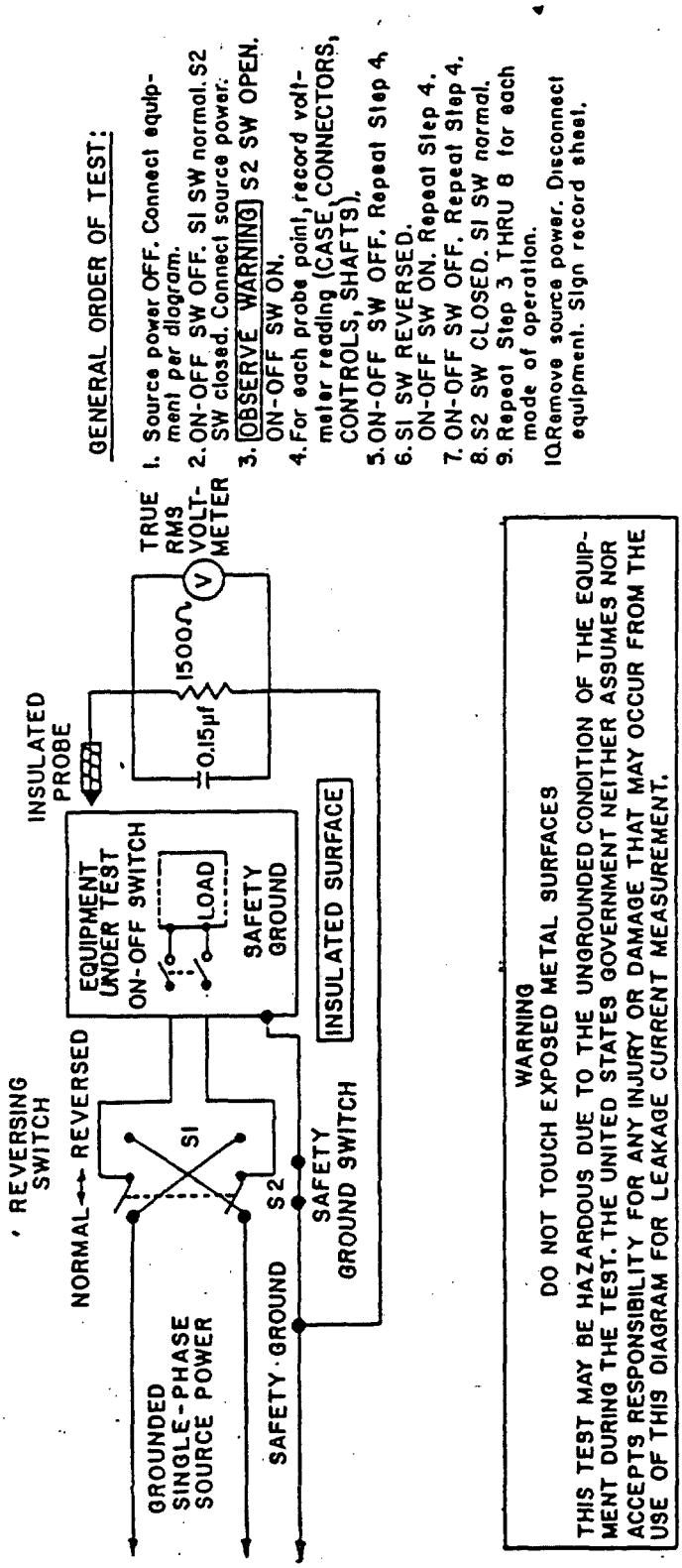


FIGURE 5. Single-phase test diagram for leakage current measurement.

4.5.25.2 Measurement. Leakage current shall be measured on the equipment in its normal operating configuration. 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 1500-ohm resistor, when equal to 7.5 V, represents 5 mA of leakage current. The overall measurement error shall not exceed 5 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 in FIGURE 5. The open safety ground conductor shall be reconnected immediately after the test is completed.

4.6 Identification and marking. Examinations shall be performed to determine conformance to the requirements of 3.10, 3.10.1, 3.10.2.1 through 3.10.2.3.

4.7 Reliability qualification test. The first article antenna group (including all units) shall be subjected to a fixed-duration qualification test in accordance with the general requirements and Task 302 of MIL-STD-781 and MIL-HDBK-781 for Category 3B equipment. Testing shall proceed to a decision in accordance with the criteria specified for Category 3B equipment, Test Plan XXI-D of MIL-HDBK-781. This testing shall be completed to an accept decision before any production antenna groups can be accepted. The operational duty cycle and test conditions shall be as specified 4.7.1 through 4.7.7.1.

4.7.1 Duty cycle. The antenna group undergoing reliability testing shall operate continuously, except for a shutdown period of 4 hours during every 168 hours of testing. The shutdown shall occur when the test temperature is approaching and at 0°C.

4.7.2 RF power testing. During reliability testing, the antenna group shall be subjected to 1 minute of specified MF and HF, UHF, and IFF power transmissions every 24 hours.

4.7.3 Temperature cycling. The antenna group shall be subjected to repetitive temperature cycling. A temperature cycle shall consist of 4 hours approaching and at 0°C followed by 4 hours approaching and at 50°C.

4.7.4 Vibration cycling. The antenna group shall be subjected to continuous repetitive sine sweep vibration with frequency range of 4 Hz to 33 Hz to 4 Hz. The vibration amplitude shall be 0.58 mm ±0.102 mm (0.020 in. ±0.004 in.). The time to sweep the frequency up and down shall be 10 minutes ±2 minutes. There shall be no vibration cycling during the duty cycle shutdown period.

4.7.5 Voltage cycling. Input voltage shall be maintained at 110 percent of nominal for the first 8-hour test temperature cycle, at the nominal value for the second test cycle, and at 90 percent of nominal for the third test cycle. The cycling procedure shall be repeated continuously throughout the test.

4.7.6 Performance measurement. During reliability testing, VSWR and insertion loss measurement within all frequency bands shall be made every 24 hours.

4.7.7 Failure. The procuring activity shall be notified of failures during reliability testing. The procuring activity shall classify failures in accordance with the Failure categories paragraph of MIL-STD-781. When two or more replaceable assemblies fail simultaneously, each shall be counted as a separate failure, even though one or more of the failures may be dependent.

4.7.7.1 Post-testing equipment disposition. At the completion of reliability testing, the tested antenna group shall be refurbished as directed by the procuring activity for delivery as production or training units.

4.8 Maintainability demonstration. The first article antenna group shall be subjected to a maintenance capability and diagnostics demonstration at the organizational level. The demonstration shall be performed by qualified technicians and shall verify conformance to the M_{ct} requirement specified in 3.12.

4.8.1 Demonstration conditions. The maintainability requirements shall be demonstrated in accordance with MIL-STD-471, Test Method 9.

4.8.2 Demonstration environment. The demonstration shall be performed in an environment similar to that in which the antenna group will be installed.

4.8.3 Acceptance or rejection. The maintainability demonstration shall exhibit that the antenna group conforms to the accept criteria prior to delivery. Failure to conform to the requirements shall be cause for rejection of the demonstration. If a reject decision is reached, the procuring activity shall be immediately notified. The contractor shall, at no additional cost to the Government:

a. Develop an approach for redesign or correction of all deficiencies, and

b. Upon approval of an approach, the contractor shall repeat the demonstration until an accept decision is reached.

4.9 Environmental stress screening. Environmental stress screening shall be conducted on the antenna control unit and junction box in accordance with MIL-STD-2164. Prior to proceeding with antenna group environmental stress screening, leakage current of the antenna control unit shall be tested in accordance with 4.5.25, insertion loss of the junction box shall be tested in accordance with 4.5.14, and all control functions of the antenna control unit shall be verified with the antenna group connected as a system. Immediately following environmental stress screening, these tests shall be repeated. Degradation of performance shall be reason for failure.

4.10 Inspection of packaging. Inspection shall be performed to ensure conformance with the requirements of Section 5.

5. PACKAGING

(The preparation for delivery requirements specified herein apply only for direct Government procurements. Preparation for delivery requirements of referenced documents listed in Section 2 do not apply unless specifically stated in the contract. Preparation for delivery requirements for products procured by contractors shall be specified in the individual order.)

5.1 Preservation, packaging, packing, and marking. Unless otherwise specified herein, preparation for delivery shall be in accordance with the applicable levels of preservation, packaging, packing, and marking specified in MIL-E-17555 (see 6.2).

6. NOTES

6.1 Intended use. The antenna group, covered by this specification, is intended for use on SSN submarines.

6.2 Ordering data. Procurement documents should specify:

a. Title, number, and date of this specification
b. Number of first article samples to be submitted if other than specified in 4.3
c. When reinspected production control sample units may not be accepted (see 4.4.4)
d. Levels of preservation, packaging, packing, and marking (see 5.1)

6.3 First article. When a first article inspection is required, the item should be a first production item. The first article should consist of one unit. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired 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 contract.

6.4 Definitions. Definitions of terms used in this specification are given in 6.4.1 through 6.4.7.

6.4.1 Failure. Failure is defined as any malfunction or parameter deviation that prevents the equipment from performing within the operational requirements specified herein.

6.4.2 Fitting. Fittings are defined as all items and assemblies which are attached either mechanically or are welded to pressure-hull penetrations, pressure-hull inserts, or pressure-hull plating. This includes structural piping, mechanical, tubes, antennas and electrical pressure-hull fittings, and mechanical stuffing boxes subject to primary and secondary boundaries.

6.4.3 Inboard. Inboard is defined as the space contained within the submarine pressure hull.

6.4.4 Outboard. Outboard is defined as the space exterior to the submarine pressure hull.

6.4.5 Penetrations. Penetrations are defined as structural compensation parts such as sleeves, hull valve bodies, antennas, and trunks which pass through and are welded to the pressure envelope, closure bulkheads, hard tanks, and other structures subject to the differential of sea pressure to internal hull pressure.

6.4.6 Primary boundary. The primary boundary is defined as any material which excludes sea pressure at all times.

6.4.7 Secondary boundary. The secondary boundary is defined as any material which excludes sea pressure in the event of primary boundary material failure.

6.5 Subject term (key word) listing.

AN/BRA-34(V), AN/BRA-34A(V), AN/BRA-34B(V),
Antenna Group
Antenna Group, AN/BRA-34(V), AN/BRA-34A(V),
AN/BRA-34B(V)
Intended use: SSN submarines

APPENDIX A

RELATIVE GAIN MEASUREMENTS

10. SCOPE

10.1 Scope. This APPENDIX covers the relative gain measurements test approach, test setup, and test procedures. This APPENDIX is a mandatory part of the specification. The information contained herein is intended for compliance.

20. APPLICABLE DOCUMENTS

20.1 This section is not applicable to this APPENDIX.

30. REQUIREMENTS

30.1 Test approach. Antenna gain of each antenna group production unit shall be measured in accordance with the test setup (see 30.2) and test procedures (see 30.3). Results obtained from this test shall be compared to the requirements shown in FIGURE 6, FIGURE 7, and FIGURE 8, for the UHF dipole antenna, UHF helix antenna, and IFF antenna, respectively. Failure of the antenna, as measured, to conform to or exceed the requirements shown in FIGURE 6, FIGURE 7, or FIGURE 8, as applicable, shall be cause for failure.

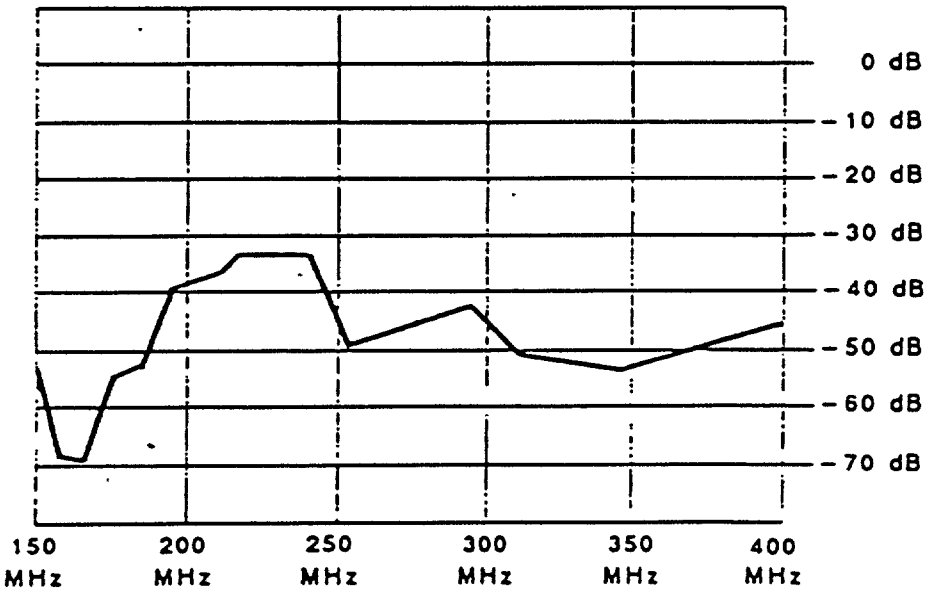


FIGURE 6. UHF dipole antenna gain requirements.

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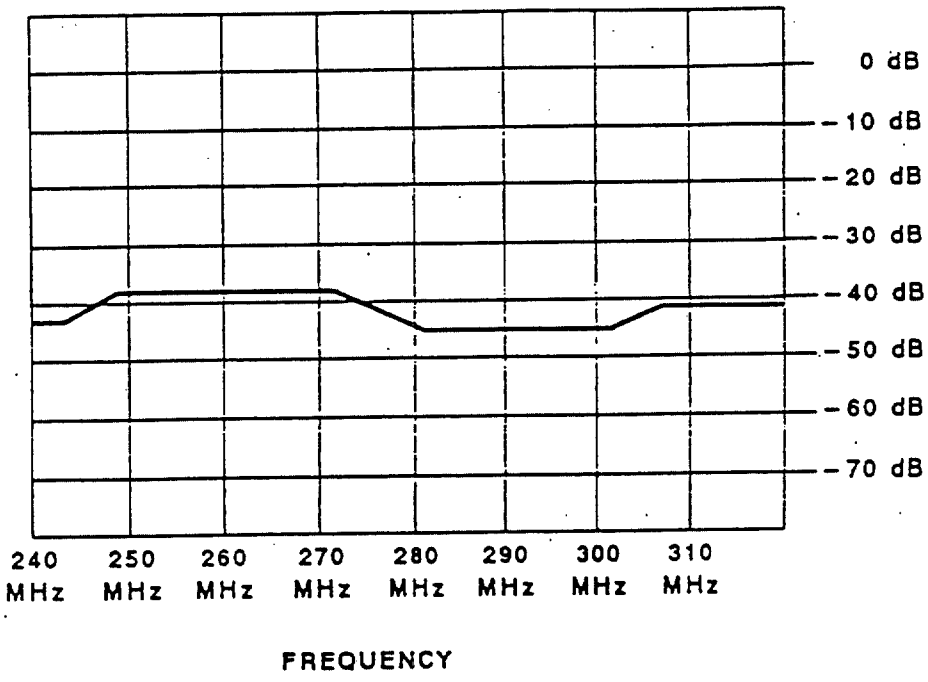

FIGURE 7. UHF helix antenna gain requirements.

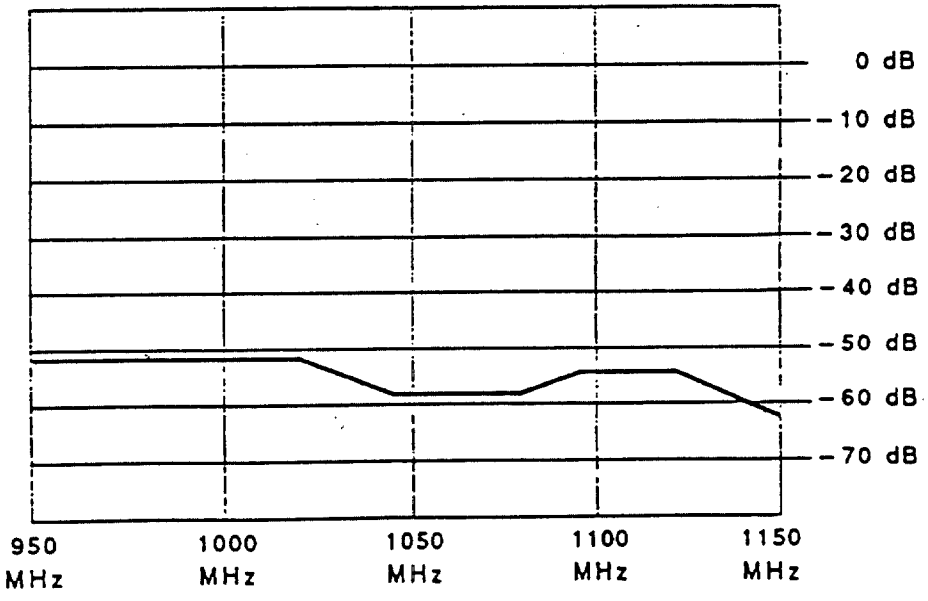

FIGURE 8. IFF antenna gain requirements.

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30.2 Test setup. Relative gain measurement test setup shall be as specified in 30.2.1 through 30.2.3.

30.2.1 Test equipment. Relative gain measurement test equipment shall be as specified in TABLE VI, or equivalent.

TABLE VI. Relative gain measurements test equipment.

Equipment	Manufacturer	Model	Quantity
RF analyzer	Wiltron	6407	1
RF detector	Wiltron	6400-71N50	1
Printer	Wiltron	2225C	1
Commercially-available test dipole antenna	Various	Various	1
Horn antenna	Scientific Atlanta	TAF 1.0	1
RF cable and connector assemblies	Various	Various	As required

30.2.2 Test configuration. The antenna group shall be positioned so that the leading edge of the antenna assembly-radome is facing the test antenna. The UHF dipole antenna shall be vertically oriented so that the antenna is 5.48 m (18 ft) above the ground plane. While taking measurements, the test antenna shall be a horizon angle relative to the UHF dipole antenna and IFF antenna. The test antenna shall be located at an elevation angle of 15 degrees relative to the UHF helix antenna. The test configuration for UHF dipole antenna and UHF helix antenna relative gain measurements shall be as shown in FIGURE 9. The test configuration for IFF antenna relative gain measurements shall be as shown in FIGURE 10.

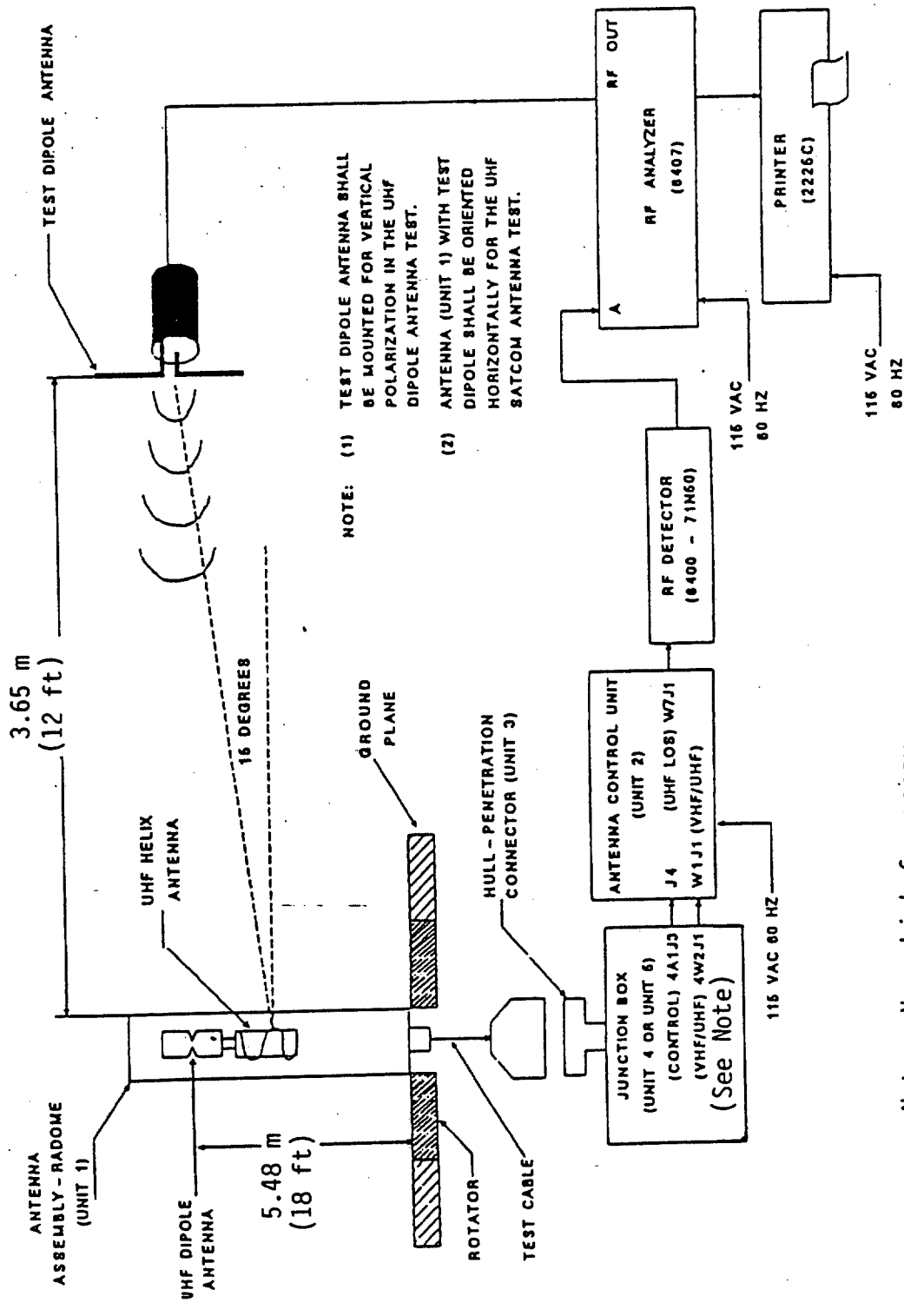
30.2.3 Precautions and safety. Precautions and safety shall be as specified in a and b:

a. Test area shall be free of all personnel not involved in testing operations.

b. Because of the possibility of electric shock in the performance of the test, technicians shall follow electrically safe work practices.

30.3 Test procedures. Relative gain measurement test procedures for the UHF dipole antenna, UHF helix antenna, and IFF antenna shall be as specified in 30.3.1 through 30.3.3.

APPENDIX A



Note: Very high frequency

FIGURE 9. Relative gain measurement test configuration for UHF dipole antenna and UHF helix antenna.

APPENDIX A

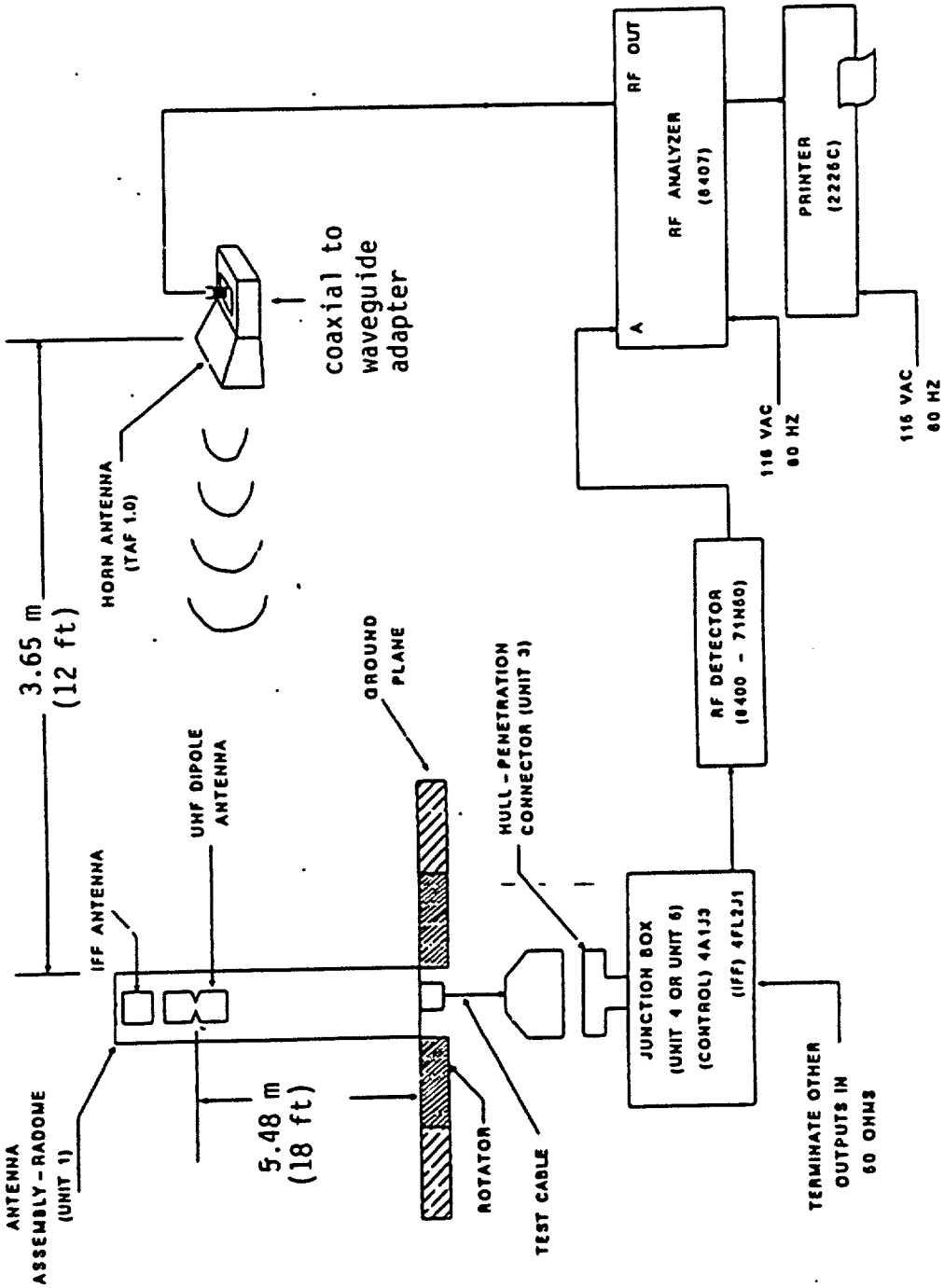


FIGURE 10. Relative gain measurement test configuration for IFF antenna.

APPENDIX A

30.3.1 UHF dipole antenna relative gain test procedure. The UHF dipole antenna relative gain test procedure shall be as specified in steps a through h:

a. Configure equipment as shown in FIGURE 9
b. Energize the antenna control unit, RF analyzer, and printer equipments with power-on switches and allow a 30-minute warm-up period to thermally stabilize the internal circuitry.
c. At the antenna control unit, select UHF dipole antenna (with UHF preamplifier OFF).
d. Set the RF analyzer to sweep the frequency range of 150 MHz to 400 MHz.
e. Calibrate RF analyzer to measure transmission gain
f. Select a test antenna power level of +5 decibels referred to one milliwatt.
g. Initiate RF sweep
h. Swept RF gain data from the printer shall be labeled and retained.

30.3.2 UHF helix antenna relative gain test procedure. The UHF helix antenna relative gain test procedure shall be as specified in steps a through e:

a. Configure equipment as shown in FIGURE 9 except that the antenna assembly-radome (Unit 1) shall be mounted in a horizontal plane so that the main axis of the radome is 1.52 m (5 ft) above the ground plane. The test dipole antenna shall be oriented to maintain compatibility of polarization and shall be positioned at a distance of 3.65 m (12 ft) from the UHF helix antenna along the main axis of the radome (effective zenith relative to the antenna assembly-radome).
b. Energize the antenna control unit, RF analyzer, and printer equipments with POWER ON switches and allow a 30-minute warm-up period to thermally stabilize the internal circuitry.
c. At the antenna control unit, select UHF helix antenna (with UHF preamplifier OFF).
d. Set the RF analyzer to sweep the frequency range of 240 MHz to 320 MHz.
e. Repeat steps 30.3.1e through 30.3.1h

30.3.3 IFF antenna relative gain test procedure. The IFF antenna relative gain test procedure shall be as specified in steps a through d:

a. Configure equipment as shown in FIGURE 10
b. Energize the antenna control unit, RF analyzer, and printer equipments with POWER ON switches and allow a 30-minute warm-up period to thermally stabilize the internal circuitry.
c. Set the RF analyzer to sweep the frequency range of 950 MHz to 1150 MHz.
d. Repeat steps 30.3.1e through 30.3.1h

APPENDIX B

SUBMARINE SHOCK REQUIREMENTS

10. SCOPE

10.1 This APPENDIX is applicable when invoked by procurement documents. This APPENDIX modifies the shock test requirements contained in MIL-S-901C to make them compatible with approved specifications applicable to submarines. This APPENDIX also provides the requirements (compatible with approved submarine specifications) for UNDEX testing of submarine hull penetrations.

20. APPLICABLE DOCUMENTS

20.1 The following document forms a part of this APPENDIX to the extent specified herein.

SPECIFICATION

MILITARY

MIL-S-901C	Shock Tests, H.I. (High-Impact); Shipboard Machinery, Equipment and Systems, Requirements For

30. REQUIREMENTS

30.1 MIL-S-901C shall be modified as follows:

Page 1, 1.1 Scope., last sentence: Delete period, substitute comma, and add "and more particularly to shock induced in ships by noncontact UNDEX."

Page 2, under "MILITARY STANDARDS": Add " MIL-STD-798 Nondestructive Testing, Welding, Quality Control, Material Control and Identification and HI-Shock Test Requirements for Piping System Components for Naval Shipboard Use".

Page 2, under "PUBLICATIONS": Delete "NAVSHIPS 250-423-30 and NAVSHIPS 250-423-31" and add: "NAVSHIPS INSTRUCTION 9690.7" "Location of Class HI-Shock Test Facilities", and: "Design Data Sheet DDS 072-1" "Shock Design Values (Confidential)". Add new subtitle "SUPSHIP THREE" and below that add: "Report SUPSHIP 280-8 of May 1973" "Shock Design Criteria for TRIDENT Submarine".

Page 2, under "NAVAL RESEARCH LABORATORY": Add "Report 7366" "Shipboard Shock and Navy Devices for its Simulation" "NRL ltr report 6260-7A:ROB:kep of 18 Feb 1964".

Page 3, add new paragraph 3.1.2.1.1:

"3.1.2.1.1 Hull mounted (external). External hull mounted items are sonar transducers, antenna housings, and other appendages mounted outside the pressure hull."

Page 4, 3.1.4.1, second line: Delete "applicable...4.2.4.1.2)." and substitute "for equipment which together with the test fixture weighs no more than 550 pounds."

Page 5, 3.1.4.2, second line: Delete "approximately 250 pounds to 6000 pounds." and substitute "up to approximately 6000 pounds."

Page 5, 3.1.4.3: Delete in its entirety and substitute:

"3.1.4.3 Heavy weight. The heavy weight test is applicable to items weighing up to approximately 60,000 pounds in operating condition (see 4.2.3.3, 4.2.4.3, and FIGURE 13); and to external hull-mounted equipment (see 3.1.2.1.1 and 4.2.4.4)."

Page 5, 3.1.5.3, after last sentence add: "If subassemblies associated with a principal unit or subsidiary component are not available at the time the principal unit or subsidiary component is scheduled to be tested, they may be represented in a manner acceptable to the Space and Naval Warfare Systems Command (SPAWAR) for the test. If subassemblies are not tested as part of a principal unit or subsidiary component, they shall be tested separately (see 4.2.2.3)."

Page 6, 3.2.2: Delete in its entirety and substitute:

"3.2.2 Extension of shock tests approval. The shock test approval achieved by test of an item may be extended to cover an identical or similar item, provided that it can be clearly shown that the original item was shock-tested and approved in accordance with this specification, and that the design of the untested equipment, its intended services, and shipboard installation are such as to result in equal to or better degree of shock resistance. Shock test extensions are subject to approval by the designated approval authority. The requirements specified in (a) through (i) apply to extension of shock test approval:

(a) Shock test extension policies apply to items identical to previously tested and approved designs, to items identical to those previously approved on the basis of shock test extension, and to items similar to previously approved designs.

(b) In cases where the design of an item is identical to that of a previously shock-tested and approved item, records of the shock test extension shall reference the original shock test report (plus any post-test reports), and shall certify that any intended variation of service or installation relative to that represented during the original shock test

will not result in lessened shock resistance and shall reference Government correspondence which originally approved the item from a shock standpoint. If information specified herein is not available for previously tested items, reference the shock test report (and any post-test reports) and identify the facility which conducted the test.

(c) In cases where the design of an item is identical to that of an item which was previously approved on the basis of shock test extension, records of the additional extension to new applications shall provide the information indicated in 3.2.2b and shall reference the original extension approval.

(d) In cases where the design of an item is not identical to that of a previously approved item, or in cases where intended variation of service or installation are significant from a shock standpoint, the request for extension of approval shall be accompanied by the supporting evidence specified in 1 through 3, as appropriate:

(1) Detailed drawings of tested and untested items and delineation of orientation of the items as installed in the ship.

(2) A copy of the report of the shock test and post shock test reports upon which the requested extension is based.

(3) A detailed comparison of the differences in materials and design showing that the untested item on its foundation has equal or greater shock resistance than the tested item on its test foundation.

(e) Extension will not be granted for equipments manufactured by different manufacturers unless specific Government approval is obtained.

(f) In case of doubt, general guidance as to allowable variations in component characteristics between tested and untested items may be obtained from the Government approval authority.

(g) Shock tests of valves may be extended to other sizes of the same design in accordance with criteria as specified in MIL-STD-798.

(h) Conditional shock test extensions may be granted for heavyweight items prior to the test of the item upon which the extension is to be based. In such cases, (b), (d)(1), (d)(3), (e), (f), and (g) shall apply. A final shock test extension will be granted when a shock test report is submitted which certifies that the item tested has satisfactorily passed the shock test. The vendor shall, at his expense, make similar necessary corrections to the extended item as may be required to be made to the tested item due to the results of the shock test.

(i) Subject to conforming to the requirements of (d)(1), (d)(2), and (d)(3), items such as those specified below whose degree of similarity is difficult to assess may be extended from tests of generally similar components by reference to calculations furnished to show that the tested item and the untested item are designed to the same criteria and that the untested item is at least equal in shock resistance to the tested item. Typical items in this category include piping system castings, ventilation system fittings, nonbuilt-in tanks, ladders, gratings, floor plates, handrails, tool stowage attachments, and repair parts stowage attachments."

Page 6, 3.2.2.1, first line: Delete "Items" and substitute "Medium weight items".

Page 6, 3.2.2.1, after last sentence: Add "Subject to conforming to the requirements of 3.2.2(d)(1), (d)(2), (d)(3):

(a) All items subjected to the lightweight test and previously qualified to any issue of MIL-S-901 shall be considered to be qualified under MIL-S-901C without any extension action.

(b) All items subjected to the medium weight test and previously qualified to any issue of MIL-S-901 shall be considered to be qualified under MIL-S-901C upon successful completion of the additional test (at 30 degrees or 90 degrees inclination) required under 4.2.4.2. (All such items previously qualified with shock blows imposed along two different principal axes of the item shall be considered to be qualified under MIL-S-901C without additional testing)."

Page 6, 3.3.1, line 3: After "assembly" add "or arrangement".

Page 6, 3.3.1(b): After "letter" add "(if applicable), shock qualification extended from test report number _____" "Approved by _____".

Page 7, 4.2.1: Add "NAVSHIPS Instruction 9690.7 lists the approved Class HI shock test facilities for use in connection with this specification. Machines not listed therein shall be inspected by the cognizant Government authority and certified to NAVSEA to be constructed and installed in accordance with the drawings referenced herein prior to acceptance of equipment tested on those machines."

Page 7, 4.2.1: Delete "equipment" in four places and substitute "tests."

Page 7: Add new paragraph 4.2.1.1:

"4.2.1.1 Platforms. Lightweight equipment may be tested on the medium weight machine or the heavyweight platform. Medium weight equipment may be tested on the heavyweight platform."

Page 7, 4.2.2.1: In first line, after "shall" add "be mounted"; in line 3, delete "can" and substitute "will"; in line 4, insert "as" between "be" and "specified"; and in line 5 after "individual equipment specification" add "or the contract".

Page 7, 4.2.2.2, line 5: Delete "provide a fixture ...principal unit." and substitute "mount the equipment to simulate an equal or more severe condition of installation in service."

Page 7, 4.2.3.1: Delete "equipment" in two places and substitute "tests".

Page 8, 4.2.3.3: Delete "equipment" and substitute "test (internal equipment)" in heading; in line 6, delete "30,000 pounds (40,000 pounds at the San Francisco Naval Shipyard Facility)" and substitute "60,000 pounds (including the foundation and/or test fixture).".

Page 8, after 4.2.3.3: Add new paragraph 4.2.3.4:

"4.2.3.4 Heavyweight test (external equipment). External hull mounted equipment shall be mounted to the underside of the floating shock platform near the edge facing the charge. The mounted bracket shall approximate the structure used for shipboard mounting the equipment."

Page 9, 4.2.4: Add: "This specification is very general so as to cover the entire field of shipboard equipment and systems. In order to apply this specification properly and to avoid post-test disagreements, test procedures shall specify, describe, or define all the features enumerated in 6.1. For heavyweight tests, only the test procedure shall be approved by the procuring activity and the Government review and acceptance authority prior to the shock test. If retest of heavyweight items is required, the extent of retest to verify design modifications shall be as approved by the review and acceptance authority (see 4.2.7.2)."

Page 9, 4.2.4.1: Delete "equipment" and substitute "test".

Page 9, 4.2.4.1.2: Delete in its entirety.

Page 9, 4.2.4.2: Delete "equipment" and substitute "test".

Page 9, 4.2.4.2: Delete first sentence.

Page 9, 4.2.4.2: In second sentence after "as specified in" add "the"; in the sixth sentence after "fixture used" add "for the included orientation", and after "10-2" add "or 10-3".

Page 9, 4.2.4.2: Add at end of paragraph:

"When more than one unit is installed in the ship and when different units are oriented in the ship so that the principal axis of one unit is fore and aft and the principal axis of the other unit is athwartship, the equipment shall be tested with each horizontal axis inclined on fixture, FIGURE 10-1 or 10-3 or equivalent. In this case, a minimum of nine blows is required. Equipment tested on the 30 degrees bulkhead fixture, FIGURE 10-2, will be qualified for either orientation in the ship and the six blow minimum is therefore applicable. Equipments whose orientation in the ship does not vary shall be inclined in the same direction as the equipment would incline were the ship to roll (roll is the motion of the ship around its fore and aft axis). The six blow minimum applies. This inclination of the equipment is to ensure that equipment will be tested in the same direction as if the ship were subjected to a shock from an UNDEX from the athwartship direction. To facilitate installing some equipments on the shock machine, the equipment may be rotated 90 degrees in lieu of 30 degrees. Equipment which is installed at 90 degrees inclination is subject to the six blow minimum regardless of orientation in the ship. Where an equipment has more than one significant operating mode, the series of blows shall be programmed to test the equipment in each of these modes. In this case, the mode of operating and the number and type of blows for each mode shall be specified. The equipment shall undergo a Group III blow in each orientation in each significant mode, except that, regardless of the number of modes, the total number of blows shall not exceed 18. A separate item of equipment may be submitted for each series or part of a series of six blows in excess of six blows, if desired by the manufacturer."

Page 10, TABLE I: Delete: "250" and substitute "0".

Page 10, 4.2.4.3: Delete and substitute:

"4.2.4.3 For heavyweight test (internal equipment). Heavyweight test for internal equipment shall be conducted on the floating shock platform shown on FIGURE 3. The test series shall consist of five shots using standard 60 pound test charges suspended 24 feet (ft) below the water surface, at horizontal ranges of 60 ft, 40 ft, 30 ft, 25 ft, and 20 ft, from the near side of the platform. Shot 2 (40 foot standoff) shall be oriented with respect to the platform so as to load the equipment in the same manner as would an explosion occurring off the bow or stern of the ship in which the equipment is to be installed. All other shots will simulate explosions from an athwartship direction. Except for shot 2, failures experienced during any particular shot shall be corrected and proven on the next shot, for example, an equipment which experienced a failure on shot 4 (25 foot standoff) may be accepted after corrective action and upon satisfactorily withstanding shot 5 (20 foot standoff). A failure experienced during shot 5 will necessitate a sixth shot (repeat of 20 foot standoff), unless the failure is considered by the acceptance authority to be clearly capable of correction by post-test design modifications (see 4.2.7.2(a)(3)). A failure experienced during shot 2 will necessitate a repeat of shot 2. NAVSHIPS Instruction 9690.7 lists those activities which operate floating shock platforms. The commercial activities

may be contacted directly regarding the use of these facilities. SPAWAR should be contacted regarding the use of the Government facilities (see 4.2.9). In certain cases, for subsidiary components or subassemblies, a modified test schedule may be specified based upon the results of shock analysis performed on the associated principal unit."

Page 10: Add new paragraph 4.2.4.4:

"4.2.4.4 For heavyweight tests (external equipment). Tests for external hull-mounted equipment shall be conducted on the floating shock platform shown on FIGURE 3. Unless otherwise specified in the individual equipment specification, the test series shall consist of five shots using 60 pound charges suspended 24 ft below the water surface, at horizontal ranges of 60 ft, 40 ft, 30 ft, 25 ft, and 20 ft from the near side of the platform. Requirements for equipment operation, orientation, inspection, instrumentation, and similar facilities shall be specified by the Bureau or Agency concerned."

Page 11: Add new paragraph 4.2.5.3.1:

"4.2.5.3.1 The shock test report shall include information on the item's hold-down bolts that were used in the shock test. The information shall include the material, size, and type of the hold-down bolts. Also, where prestressing of fasteners is required, the torques on the fasteners will be recorded before and after the shock test, and where prestressing is not required loosening of the fasteners during the shock test will be recorded in the shock test report. Shock test report shall also state type, model, and number of resilient mounts in installation."

Page 11: Add new paragraphs 4.2.5.5 and 4.2.5.6:

"4.2.5.5 Where two or more items are installed on a common subbase and the total operating weight is less than 60,000 pounds, the assembly shall be shock tested. Equivalent dummy weights may be used to simulate all but one of a group of identical units installed on a common subbase.

"4.2.5.6 Post-shock test functional testing and inspection. The contractor or vendor shall prepare such requirements for the item and shall submit the requirements, including associated acceptance criteria, to the review and acceptance authority (see 4.2.7.2) for approval as part of the test report. This approval shall be obtained prior to shock testing for heavyweight equipment. The minimum requirements specified in (a) and (b) shall apply to the post-shock test performance testing and inspection specifications:

(a) Functional testing - After shock testing and unless otherwise specified, prior to disassembly or repair, and prior to the installation in the ship, the equipment shall be given suitable performance and other tests as required to determine whether or not it conforms to the specified operational requirements. In general, the tests shall include, but not necessarily be limited to, checking the input-output of the component or equipment, its operating temperatures (bearing, coil windings), and cyclic tests, as appropriate. Hydraulic, pneumatic, and fluid systems equipment shall be hydrostatically tested in accordance with the applicable component specification to demonstrate strength and to test for leaks, if not previously checked during shock testing. Electrical equipment shall be tested for shorts to detect breakdown of insulation. Grade A equipment shall be considered to have failed the shock test if the equipment is unable to conform to the specified operational requirements. Grade B equipment need only demonstrate that no portion of the equipment will come adrift or otherwise create a hazard to personnel or Grade A systems and equipment. Failure of a Grade B unit to perform its principal function after shock shall not be cause for rejection.

(b) Inspection - In general, all shock-tested equipment shall be disassembled and inspected for breakage, deformation, and misalignment. Areas highly stressed during shock response and areas suspected of yielding shall be dye penetrant or magnetic particle checked for cracks. Critical tolerance areas shall be checked to ensure proper clearances. Equipment shall be considered to have failed the shock test if inspection reveals any condition that could prevent the equipment from performing its intended function, or could create a personnel hazard as a result of the shock. Small cracks, yielding of structure, out-of-tolerance clearances, and similar damage will not be cause for disapproval of the equipment, unless such damage causes impairment of equipment function or substantially shortened equipment life."

Page 12, 4.2.7.2: Delete in its entirety and substitute:

"4.2.7.2 Test report. A test report for all shock-tested equipment shall be submitted to the Supervisor or other designated approval authority for approval (see FIGURES 14 through 18). Copies of each report shall be furnished to Commander, Space and Naval Warfare Systems Command (SPAWAR), Washington, D.C. 20363-5100, for information. Copies of each report shall be furnished to the Naval Underwater Systems Center (NUSC), Code 342, Newport, RI 02840 for information and data storage purposes. The test report shall include (a) through (c):

(a) For lightweight and medium weight tests:

(1) A report by the shock-test facility (including FIGURES 14 and 15 or 16, as applicable) and clear photographs of each test setup and each instance of damage (see 4.2.5.3).

(2) A report by the activity (manufacturer or other) performing the post-shock test inspection and functional testing of the equipment (including FIGURE 18 (see 4.2.5.4)).

(3) A description of the corrective measures taken and recommendations as to proposed design changes which will correct any deficiencies found during the post-test inspection. (In certain cases, the Government may accept the equipment as shock qualified on the basis of the corrective design changes rather than to require retesting.)

(4) Certification of the report describing the shock test shall be by the facility performing the shock test.

(5) Certification of the post-shock test inspection and functional testing report shall be by a Government representative. The Government representative need not witness all tests, but it is desired that a sampling of the tests by each test facility be witnessed by the Government representative.

(b) For heavyweight tests:

(1) As in (a)(1) except that information in FIGURE 17 is applicable.

(2) As in (a)(2)

(3) As in (a)(3)

(4) Certification of the report describing the shock test shall be by a Government representative who shall actually witness the test.

(5) As in (a)(5), except that the Government representative shall witness the actual inspection and functional tests.

(c) All lightweight and medium weight test and post-test inspection reports for equipment shall be reviewed by and all such equipment shall be accepted or rejected for the Navy by the cognizant Supervisor of Shipbuilding, U.S.N., or Naval Shipyard or other Navy procuring agency (for example, SPAWAR). The supervisor or Naval shipyard or other Navy activity may delegate the review and acceptance authority to other Government activities or representatives. If this is done, the procuring activity shall designate the review and acceptance authority in its procurement documents. All heavyweight test and post-test inspection reports shall be reviewed by and all such equipment shall be accepted or rejected by SPAWAR or other designated approval authority."

Page 12, 4.2.7.3: Delete in its entirety.

Page 12, 4.2.8: Delete "NAVSHIPS 250-423-30" and "NAVSHIPS 250-423-31"; add, "SUPSHIP THREE Report 280-8", "Design Data Sheet DDS 072-1" and "Naval Research Laboratory Report 7366".

Page 12: Add new paragraph 4.2.9:

"4.2.9 Use of Government shock facilities. Unless otherwise specified, shock tests shall be conducted at commercial test facilities. Requests for use of Government-owned shock test facilities will be honored, as scheduling permits, when accompanied by certification that commercial test facilities are not available. The information specified in (a) through (g) shall be furnished to SPAWAR with the request for use of Government-owned shock test facilities. (This same information shall be forwarded to the designated Government test facility at least two months prior to the scheduled test):

(a) Three copies of Equipment Identification, FIGURE 14.
(b) Drawings or technical manuals showing:
(1) Outline of equipment.
(2) Sectional assembly of equipment.
(3) Foundation for equipment.
(4) Bedplates and mounting when applicable.
(5) Arrangement in ship.
(6) Plans showing all connnections to the equipment, such as piping, electrical conduit cables, air ducting, and so forth, which may affect the dynamic response of the equipment. These plans shall show the methods of attachment of these connections to the equipment and to the ship's structure, and their arrangement with respect to the equipment.
(7) Weight and center of gravity of the equipment and test foundations and fixtures.
(c) Three copies of the equipment purchase specification.
(d) Agenda and requirements for all equipment inspections to be performed at shock facility.
(e) Requirements for shock test instrumentation, if any. (Use of shock test instrumentation is not required by these specifications.)

(f) Any other special requirements or precautions associated with the shock test.

(g) Outline of required test configuration, detailed design of test fixture, and test conditions as specified in 6.1 of MIL-S-901 (3 copies). These data will be subject to review and approval by SPAWAR to fulfill requirements of this section.

Page 16, 6.2.2: Delete in its entirety.

Page 16, 6.3 (see Amendment 1 of 5 Sept 1963) Delete and substitute:

"6.3 Test report. For shock tested equipment, the applicable test report forms are shown in FIGURE 14 through FIGURE 18. Until the supply is exhausted, the use of NAVEXOS 3373 forms may be continued for reports of lightweight and medium weight tests. Pads of NAVEXOS 3373 forms may be obtained upon application to the cognizant Defense Contract Administration Services (DCAS) office, except that activities of the Department of Defense should make application to the Navy Supply Center, Norfolk, VA 23512 and the Naval Supply Center, Oakland, CA 94625."

After page 31, add FIGURE 10-3 and FIGURE 13 through FIGURE 18 as follows:

30.2 UNDEX qualification of submarine hull penetrations. In addition to the mechanical shock test requirements of MIL-S-901 relating to the continued mission capability of the submarine, the following criteria for maintaining watertight integrity during and after a near lethal attack by UNDEX are established. Loadings resulting from the hull penetration UNDEX testing are much more severe than those specified above for mechanical shock. Items which have been or will be qualified by the hull penetration UNDEX are exempt from the tests specified in MIL-S-901, if after UNDEX the items conform to the acceptance criteria of MIL-S-901.

30.3 Design criteria. Components specified in (a) through (f) shall be capable of withstanding the hull penetration UNDEX.

(a) Those items which penetrate the pressure hull, including but not limited to, hull and backup valves, diesel exhaust backup and hull valves, induction backup and hull valves, access and loading hatches, logistic/escape trunks, main shaft seal housing assembly including the stuffing box, launcher assembly, and trash ejector assembly

(b) Those items in piping systems subject to sea pressure internally and which are between the sea and the inboard flanged joint of the backup valve

(c) Periscope hull fittings
(d) Each size of each design of fittings shall be tested for qualification, except that for sizes eight inches and smaller, testing to two sizes of a design no more than four inches apart will qualify all sizes in between. For allowed size spread for valves, see MIL-STD-798, Section 11
(e) Those items, such as external hatch covers, which could block passage through logistics or escape trunks
(f) Items previously qualified by UNDEX need not be requalified. Items which are similar in design, construction, installation, and function to items which have previously satisfied the hull penetration test requirements of this specification may be considered acceptable for this submarine with no further testing required, subject to SPAWAR approval. Criteria and requirements applicable to extension of hull penetration test qualification are equivalent (as applicable) to those specified in MIL-S-901 for shock test qualification extension.

30.4 Contractor responsibilities. The item specified in (a) and (b) shall be provided to SPAWAR at least four months prior to the scheduled shock test date to support the UNDEX:

(a) Test vehicle installation drawings and procedures, including detailed hanger arrangement and type to simulate the ship installation, bolt torques, and method of simulating piping system loading. SPAWAR approval of the overall installation drawings is required.
(b) A test procedure which details the data which should be obtained, including any special instructions required such as valve assembly and disassembly procedures and bolt tightening procedures. SPAWAR approval of the test procedure is required.

30.4.1 Test items. The contractor shall provide the test item together with any necessary prefabrication work to permit installation on the test vehicle at least one month in advance of the scheduled test date. Hull penetration furnished for test shall be complete and ready to install and shall include (a) through (e):

(a) Operators and handwheels for valves
(b) Piping runs up to the second hanger or to the anchor point, with necessary hangers
(c) Hold-down bolts required for installation
(d) Masses to simulate weight and moment of missing components of a test assembly, such as dummy capstan head or loads due to connecting systems (excepting piping)

(e) Hull inserts required for support of valves and fittings scheduled for test

The contractor shall provide a test site representative to facilitate timely testing and evaluation of items. Valves, fittings, and inserts used for the test shall not be installed on the ship.

30.4.2 Hull penetration test procedure.

30.4.3 General. The UNDEX will be conducted using the Full Scale Section Number 5 as the test vehicle. Items subjected to the UNDEX shall be structurally supported in a manner representing the most vulnerable shipboard installation and shall include weights as necessary on the inboard connections to simulate the loads imposed by connecting systems. When testing items in the closed position, the cavity inboard of the outboard closure shall be filled with the fluid normally used in service (for example, in testing sea water valves use water). For items which are actuated by a hydraulic operator, the hydraulic operator shall be pressurized to the maximum system operating pressure normally required to move the operator.

30.4.4 Double closure test procedure. Piping runs between inboard and outboard closure shall be simulated in the test installation. The test series for components having inboard and outboard closures shall consist of three shots, each of 125 lbs. of HBX-1, with components on a horizontal radius from the centerline of the test vehicle and the charge on an extension of that radius at a standoff of 15 ft (from the closest pressure boundary of the component or test vehicle) for the first two shots and 13.5 ft for the third shot. For the first shot, the outboard closure shall be shut and the inboard closure open. For the second shot this shall be reversed. For the third shot the components shall be in the normal operating position.

30.4.5 Single closure test procedure. The test series for components having only a single closure (that is, no inboard closure) shall consist of two shots, each of 125 lbs. of HBX-1, with the components on a horizontal radius from the centerline of the test vehicle and the charge on an extension of that radius at a standoff of 15 ft (from the closest pressure boundary of the component or test vehicle) for the first shot and 13.5 ft for the second shot. For the first shot the closure shall be in the alternate position (that is, opposite to normal position) and for the second shot the closure shall be in the normal operating position.

30.4.6 Fittings, packings, and seals test procedure. The test for electrical, electronics, or mechanical fittings, packings, or seals (except main shaft seal) penetrating the pressure hull and having only one operating position shall consist of two shots of 125 lbs. of HBX-1, with the fitting or component on a horizontal radius from the centerline of the test vehicle and the charge on an extension of that radius at a standoff of 15 ft (from the closest pressure boundary of the component or test vehicle) for the first shot and 13.5 ft for the second shot.

30.4.6.1 Special fittings or components. Special fittings or components may require test procedures which differ from those specified in 30.4.6. The detailed special procedures where not specified herein, shall be as agreed upon between the contractor and SPAWAR.

30.4.7 General inspection and acceptance criteria. Tests shall be conducted at the Government test facility designated by SPAWAR. After each shot, components shall be visually inspected, without dismantling, for leakage or distortion of the watertight envelope as defined in the test procedure. Those components with moving parts such as valves and hydraulic operators, shall be cycled twice to prove operability. Torques and/or pressures required to cycle components shall be recorded. Following the completion of operability tests, closures shall be hydrostatically tested to the submergence pressure specified. (The pressure shall be applied at the sea side of the closures.)

30.4.7.1 Bolts. Following the completion of hydrostatic tests, bolts shall be checked for tightness and retightened, if necessary, to the specified torque. The amount of retightening required and the calculated loosening thus indicated shall be recorded.

30.4.7.2 Distortion. Distortion will be permitted provided the distortion does not degrade the watertight integrity or operational capabilities.

30.4.7.3 Damage or leakage report. After each shot, if damage or leakage is within the acceptable limits specified herein, the components shall be considered ready for the next shot. If, after any shot, damage is of a more serious nature (such as, loss of watertightness or operability), the component shall be disassembled by the test facility as necessary to evaluate and report extent of damage to SPAWAR, the design agent, and shipbuilder. The test facility shall include the items specified in (a) through (c) in evaluation:

(a) Type and extent of damage
(b) Ability of shipbuilder to make repairs at the test site
(c) Schedule and cost information as appropriate

30.4.7.4 Acceptance criteria. After the final shot the component and watertight envelope shall be given a final examination for leakage, operability, and damage as defined in 30.4.7.3 and in the test procedures. Also after the final shot, nonpiping system components shall be disassembled and inspected for evidence of mechanical binding, distortion, or changes in electrical characteristics, and shall have their housings subjected to magnetic particle or dye penetrant inspection as appropriate.Watertightness and operability acceptance criteria for items are specified in (a) through (d):

(a) Double closure acceptance criteria. For components having inboard and outboard closures, the acceptance criteria specified in (1) and (2) shall apply:

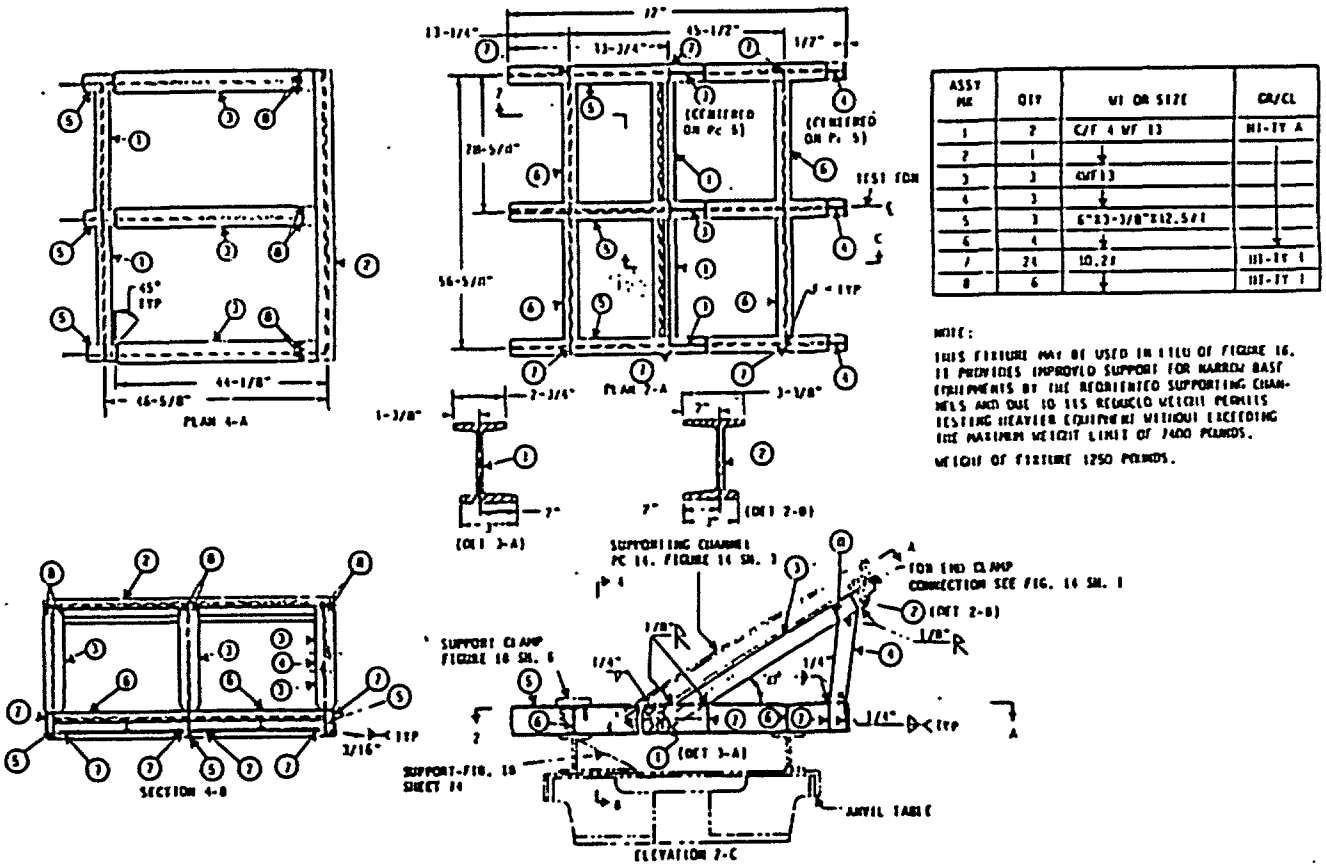
(1) After shots 1 and 2, the outboard closure and the inboard closure shall be operable using the normal operating procedures through two full cycles without exceeding the full design torque of the actuator. For valves so designed, the pressure may be equalized within the valve envelope prior to the operability test. In addition, the envelope (consisting of the connection of the insert to the pressure hull inboard to and including the outboard closure seal or seat, and also inboard to and including the inboard closure seal or seat) shall remain watertight when subjected to hydrostatic pressure as specified in 30.4.7, except for valves, where leakage past each valve seat shall not exceed 0.7 gal/min/inch of valve port diameter.

(2) After shot 3, at least one closure (either the inboard or outboard) shall be operable using the normal operating procedure through two full cycles without exceeding the full design torque of the actuator. For valves so designed, the pressure may be equalized within the valve envelope prior to the operability test. In addition, the envelope (consisting of the connection of the insert to the pressure hull inboard to and including the closure seal or seat of the operable closure) shall remain watertight when subjected to the hydrostatic pressure as specified in (1), except for acceptable valve seat leakage as specified in (1).

(b) Single closure acceptance criteria. Components having only a single closure shall remain operable (using the normal operating procedure) and maintain a watertight envelope between the seat and seal of the closure after both shots.

(c) Fittings, packings, and sales acceptance criteria. Electrical and electronic fittings penetrating the pressure hull must remain operational and watertight following the 15-foot shot, and watertight following the final shot. Acceptance criteria for seals and packings shall be the same as for electrical and electronic fittings, except that seepage not to exceed the limits allowed for normal operation is permitted after any shot.

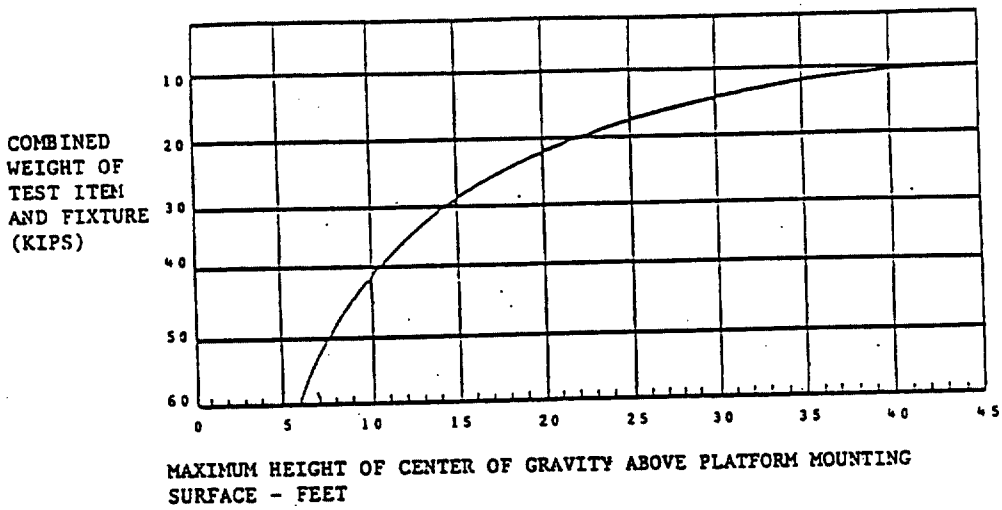
(d) Access covers and closure plate acceptance criteria. Unless otherwise approved by SPAWAR, leakage across covers and closure (regardless of size) shall not exceed 0.5 gal/min after any shot, with leakage measured prior to retightening the cover or closure plate bolting. Furthermore, it shall be demonstrated that this leakage can be reduced to an amount not to exceed 0.05 gal/min by retightening the cover or closure plate bolting.



ASSY NO	QTY	WT OR SIZE	CR/CL
1	2	C/F 4 WF 13	HI-IT A
2	1	↓	
3	3	CUT 13	
4	3	↓	
5	3	6"83-3/8"X12.5#I	
6	4	↓	
7	24	10.2#	III-IT 1
8	6	↓	III-IT 1

FIGURE 10-3. 30 degree mounting fixture for testing base mounted equipment on medium weight shock testing machine.

FLOATING SHOCK PLATFORM
MAXIMUM HEIGHT OF VERTICAL CENTER OF GRAVITY
FOR TESTED ITEMS
14' x 25' WORKING AREA - MAXIMUM
16' x 28' SIZE OVERALL



NOTES:
1. This information is provided for guidance only.
2. These maximums may be exceeded at the discretion ofthe Shipbuilder and shock testing facility.
3. This is for the platform without an outrigger. It is based on a transverse metacentric height of slightly more than one foot.

FIGURE 13. Floating shock platform maximum height of vertical center of gravity for tested items 14' x 26' working area -- maximum 16' x 28' size overall.

Page 1 of _____ Test No _____ Date _____

Class III Shock Test Report
Equipment Identification

1. Item (Name/Type/Nomenclature/Rating)
2. Manufacturer (Name & Address)
3. Model No. _____ 4. Size/Capacity _____
5. Service/Ship _____ 6. Technical Manual No. _____
7. Plan Numbers: Sectional Assy _____ Outline _____
8. Approximate Overall Envelope Size: _____ Long _____ High _____
9. Weight: Wet _____ Dry _____
10. Height of Center-of-Gravity Above Base of Equipment: _____
11. Contract or Purchase Order No. _____
12. Requirements (Para 3 MIL-S-901) (NAVY) Grade _____
    Classification, _____ Class _____
13. Test Procedure Identification _____
14. Major Components and Attached Items Included in Test

	Name	Identification	Manufacturer
a.			
b.			
c.			
d.			
e.			

15. Disposition of Equipment Following Test

16. Remarks

17. Distribution of Report

18. Test Laboratory
19. Address

FIGURE 14. Class HI shock test report.

Page_____of_____Test No._____Date_____

Lightweight Shock Machine Test

(Attach Separate Sheet Wherever Necessary to Fully Describe Item)

1. Type of Test Fixture (Circle one)

   4A 4C 6D-1 6D-2 6E Other

   (attach photo(s) showing test set up on machine)

2. Total Weight on Anvil Plate (Equipment plus fixture)_____lbs.

3. Instrumentation, if any.

   Type Gauge Location Orientation Results

4. Monitored Performance

Blow No.	Drop Feet	Axis	Operating Mode (on, off, open, close etc)	Reference Measurements (volts amps rpm psi etc) a.	b.	c.	d.	Post-Test Measurements volts amps rpm psi etc a.	b.	c.		
1	1	back										
2	3	back										
3	5	back										
4	1	side										
5	3	side										
6	5	side										
7	1	top										
8	3	top										
9	5	top										

5. Survey Findings (Note damage, if any, and attach photos, if available)

6. Modifications, if any, accomplished prior to or during test

7. Remarks

CERTIFICATION OF TEST REPORT

Test Laboratory	Address	Signature of Test Engineer

FIGURE 15. Lightweight shock machine test.

Page_____of_____Test No._____Date_____

Medium Weight Shock Machine Test

(attach Separate Sheet Whenever Necessary to Fully Describe Item)

1. Type of Test Fixture (Circle one)

   Fig 9 Fig 10-1 Fig 10-2 Fig 13 Other

   (attach photo(s) showing test set up or machine)

2. Total Weight on Anvil Table (Equipment Plus Fixture)_____lbs.

3. Instrumentation, if any.

   Type Gauge Location Orientation Results

4. Monitored Performance

Blow No.	Group No.	Drop Feet	Operating Mode (od. off, open close etc)	Reference Measurements volts amps rpm psi etc				Post-Test Measurements volts amps rpm psi etc			
				a.	b.	c.	d.	a.	b.	c.	d.
1	I										
2	inclined										
3	II										
4	inclined										
5	III										
6	inclined										

5. Survey Findings (Note damage, if any, and attach photos, if available)

6. Modifications, if any, accomplished prior to or during test.

7. Remarks

CERTIFICATION OF TEST REPORT		
Test Laboratory	Address	Signature of Test Engineer

FIGURE 16. Medium weight shock machine test.

Page_____of_____Test No._____Date_____

Heavyweight Shock Test on Floating Shock Platform (FSP)

This sheet outlines required information only. Additional pages will undoubtedly be required.

1. Type of test fixture and details of installation
2. Total weight installed on Floating Shock Platform (FSP)_____
3. Instrumentation (include sketch or photo if necessary)

Type Gauge	Location	Orientation	Results

4. Monitored Performance

Shot	Range	Date	Operating Mode (on, off running, idle rated speed, etc)	Reference Measurements volts amps rpm psi etc				Post-Test Measurements volts amps rpm psi etc			
				a	b	c	d	a	b	c	d
1	60										
2	40										
3	30										
4	25										
5	20										
6											

5. Survey Findings (Note damage, if any, and include photos)
6. Modification, if any, accomplished prior to or during test.
7. Remarks

Government Activity	Address	Signature of Government Rep.

FIGURE 17. Heavyweight shock test on floating shock platform (FSP).

Page_____of_____Date_____

Refer to Test Lab_____Test No._____of Date_____

Post Shock Inspection Report

TO:
FROM:

Contract (s) -
Component Tested -
Manufacturer -
Component Dwg. No. -
Contractor Purchase Order -

Type of Test (check one)	Specification	Test Report No.
HI Shock Test	MIL-S-901	
Hydraulic Shock Test		
Sub-Hull Penetration Test		
Other		

Inspection Method	Check as Applicable		Inspection Initial and Date			
	Required	Accomplished	Vendor	Date	Gov't	Date
1. Hydrostatic Test						
2. Dye Penetrant Insp.						
3. Magnetic Particle Insp.						
4. Radiographic Insp.						
5. Dielectric Test						
6. Electrical Continuity						
7.						

Repairs (were) (were not) necessary. If necessary, describe fully under remarks attach separate sheet(s).

REMARKS:

Disposition of Unit_____

I certify that the above represents a true report of the tested unit.

Government Inspector

FIGURE 18. Post shock inspection report.

Preparing Activity
NAVY - EC

(Project No. 5985-N576(EC))

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-A-29521(EC)	Antenna Group, AN/BRA-34(V) AN/BRA-34A(V), AN/BRA-34B(V)

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR ☐ USER ☐ MANUFACTURER ☐ OTHER *(Specify)*: _____
b. ADDRESS *(Street, City, State, ZIP Code)*	

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

DD FORM 82 MAR 1426 PREVIOUS EDITION IS OBSOLETE.

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)