INCH-POUND

MIL-T-29516(EC)
15 January 1988

MILITARY SPECIFICATION

TRANSCEIVER, SECURE, AND ANCILLARY EQUIPMENT

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 requirements for the Secure Transceiver, hereinafter referred to as the transceiver, and ancillary equipments consisting of:

a. Vehicular adapter
b. Power amplifier (if not included in vehicular adapter)
c. Loudspeaker (if not included in vehicular adapter)
d. Cable, Special Purpose Electrical, CX-13016( )/U, or equivalent
e. Battery Box, CY-7518( )/U, or equivalent
f. Handset, H-250( )/U, or equivalent
g. Tape Antenna, AT-892( )/PRC, or equivalent

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 5820

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2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards 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-B-18	Batteries, Non-chargeable, Dry
MIL-P-116	Preservation, Methods Of
MIL-S-901	Shock Tests, H.I. (High-Impact), Shipboard Machinery, Equipment And Systems, Requirements For
MIL-L-3891	Luminescent Material And Equipment, (Nonradioactive)
MIL-P-11268	Parts, Materials, And Processes Used In Electronic Equipment
MIL-M-13231	Marking Of Electronic Items
MIL-F-14072	Finishes For Ground Electronic Equipment
MIL-E-16400G	Electronic, Interior Communication And Navigation Equipment, Naval Ship And Shore: General Specification For
MIL-E-17555	Electronic And Electrical Equipment Accessories, And Provisioned Items (Repair Parts): Packaging Of
MIL-M-38510	Microcircuits, General Specification For
MIL-I-46058	Insulating Compound, Electrical (For Coating Printed Circuit Assemblies)
MIL-H-49078	Handset H-250( )/U
MIL-P-55110	Printed-Wiring Boards, General Specification For
MIL-P-55127	Control, Frequency Selector C-2742( )/VRC
MIL-M-55167	Mounting MT-1029( )/VRC And Mounting MT-1898 ( )/VRC
MIL-A-55288	Antenna AS-1729( )/VRC
MIL-V-55341	Valve, Pressure Relief

NAVAL AIR SYSTEMS COMMAND (NAVAIR)

WS-6536E, with SCN 1, SCN 2, and SCN 3	Process Specification Procedures And Requirements For Preparation And Soldering Of Electrical Connections

STANDARDS

FEDERAL

FED-STD-595	Colors

MILITARY

MIL-STD-105	Sampling Procedures And Tables For Inspection By Attributes
MIL-STD-109	Quality Assurance Terms And Definitions
MIL-STD-188-242	Interoperability And Performance Standards For Tactical Single Channel Very High Frequency (VHF) Radio Equipment
MIL-STD-252	Classification Of Visual And Mechanical Defects For Equipment, Electronic, Wired, And Other Devices
MIL-STD-276	Impregnation Of Porous Nonferrous Metal Castings
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	Electromagnetic Interference Characteristics, Measurement Of
MIL-STD-471	Maintainability Verification/ Demonstration/Evaluation
MIL-STD-681	Identification Coding And Application Of Hook Up And Lead Wire
MIL-STD-781	Reliability Testing For Engineering Development, Qualification, And Production
MIL-STD-810	Environmental Test Methods And Engineering Guidelines
MIL-STD-1275	Characteristics Of 28 Volt DC Electrical Systems In Military Vehicles
DoD-STD-2167	Defense System Software Development

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

NATIONAL SECURITY AGENCY (NSA)

ON014681	Plate, Equipment Modification Record
ON143326	Modification Nameplates
ON241618	Input Recovery Board (E-DTG)
ON241620	VPRC Board (E-DTF)

ON241622	Trans Alarm (E-DTE)
ON241624	CVSD Board (E-DTB)
ON241626	Clock Control Board (E-DTC)
ON241635	Power Supply Board (E-DTH)
ON241639	Audio Board (E-DTA)
ON241641	Interconnect Board
ON241775	Six Pin Audio Connector
ON503181	ISSR Board (E-DTD)

US ARMY COMMUNICATIONS ELECTRONICS COMMAND (USACEC)

SC-DL-135893	Antenna, AT-892( )/PRC
SC-DL-414975	Mounting Base, MT-1029/VRC

NAVAL ELECTRONIC SYSTEMS SECURITY ENGINEERING CENTER (NESSEC)

0110278	Battery Box, CY-7518( )/U
0110283	Cable, Special Purpose, CX-13016 ( )/U

PUBLICATIONS

NSA

CSESD-14( )	Communication Security Equipment System Document For TSEC/KY57/58
KAG-30A/TSEC	Compromising Emanation Standards For Cryptographic Equipments
NACSEM 5112	NONSTOP Evaluation Techniques
NSA-2	Nameplates And Marking Of Electronic And Electromechanical Equipment

SPAWAR

PMW 151-22A/CD29516	Criteria Document For Specification MIL-T-29516

(Copies of specifications, standards, 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 Order of precedence. In the event of 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.

will maintain audio output ... 100 millivolts (mv)

3. REQUIREMENTS

3.1 General. The equipment (see 6.4.9) shall be nondevelopment items (NDI) (see 6.4.10). The equipment shall be capable of operation in backpack or vehicular applications. Unless otherwise specified herein, the equipment shall comply with MIL-STD-188-242 requirements.

3.1.1 Transceiver. The transceiver is a backpack very high frequency-frequency modulation (VHF-FM) transmitter-receiver with integrated communications security (COMSEC) in a watertight case. The transceiver shall operate over the frequency range of 30.00 megahertz (MHz) to 75.975 MHz with a channel spacing of 25 kilohertz (kHz). A transceiver operating over the frequency range of 30.000 MHz to 87.975 MHz with 25-kHz spacing is acceptable. The front panel shall contain the features and functions specified in 3.1.1.1. The transceiver shall contain COMSEC circuitry as specified in 3.1.1.2. The transceiver is not required to incorporate a frequency hopping capability (see 3.1.1.3).

3.1.1.1 Transceiver front panel. The transceiver front panel shall contain as a minimum the display, connectors, and switches specified in a through p:

a. A mounting post antenna stud to mount an Antenna, AT-892 ( )/PRC, or equivalent
b. A 50-ohm antenna connector BNC series, or equivalent, tied internally to the mounting post antenna stud
c. An AUDIO connector to accept a Handset, H-250( )/U, or equivalent (see 3.18.3.5)
d. A data connector (see 3.18.3.5) which may be combined with the AUDIO connector. The input may be analog or digital data.
e. A FILL connector to accept COMSEC variables from any of the common fill devices specified in 1 through 3:
    1. Net Control Device, KYX-15
    2. Electronic Transfer Device, KYK-13
    3. General Purpose Tape Reader, KOI-18
f. A retransmit connector to allow two transceivers, when connected together via a Cable Assembly, CX-13016( )/U, or equivalent, to be used as a retransmission station (see 3.18.3.4 and 3.18.3.8).
g. A frequency display indicator to provide a readout of the operating frequency. The frequency display indicator shall contain five digits (minimum) with the two digits on the left (facing the panel) providing a display of MHz and the three digits on the right providing a display of kHz (see 3.18.4.3).
h. A MHz frequency selection control switch to raise or lower the frequency displayed in 1-MHz increments
i. A kHz frequency selection control switch to raise or lower the frequency displayed in 25-kHz increments. The kHz control will not cause changes in the MHz setting when the control rolls over at 000 or 975.
j. A frequency display brightness control switch (see 3.18.4.3)
k. A volume control switch to allow an operator to choose handset volume level

1. An ON-OFF power control switch which controls input power. A third position shall be included for time delay (see 3.18.3.4).

m. A mode selection switch which allows selection of the operating modes specified in 1 through 5:

1. Squelch off. The squelch (see 3.18.1.9, 3.18.1.10, and 3.18.2.4) is disabled.

2. Operate. The squelch is on for normal reception or transmission.

3. Retransmit. The transceiver when connected via Cable, CX-13016( )/U, or equivalent, to another transceiver, shall be capable of use as a retransmission station (see 3.18.3.8)

4. Load. The transceiver shall allow loading of COMSEC variables or presetting of frequency into a channel selector selection switch position.

5. Receive variable. The transceiver shall receive and store a new COMSEC variable via the receiver as part of the manual rekeying operation.

n. A FILL selector selection switch which contains eight positions. Positions 1, 2, 3, 4, 5, and 6 shall indicate six possible locations for COMSEC variable storage. A seventh position shall permit the operator (via positive action such as push-in-switch-to-enter-position) to zeroize or erase the COMSEC variables stored in positions 1, 2, 3, 4, and 5. The last position shall permit the operator via positive action to zeroize the COMSEC variables stored in all positions.

o. A channel selector selection switch shall include five preset frequency channels as a minimum. Selection of position P or position C shall determine whether the preset channel is transmitting plain text (PT) or cipher text (CT). One preset channel shall allow manual frequency selection. When the mode switch is set to the SQUELCH OFF or OPERATE or RETRANSMIT position, the channel selector selection switch shall automatically select COMSEC variables 1 through 4 to correspond to preset frequency channels 1 through 4. When set to the preset frequency channel reserved for manual frequency selection, the switch shall provide the operator the capability to select any COMSEC variable.

p. The front panel shall include an interlock (see 3.18.3.9). The contractor may include other switches or connectors, at his option, and may shift the functions specified herein for one switch to another switch specified herein. None of the specified functions shall be omitted. The contractor may increase the number of preset channels to 10 with five reserved for PT and five reserved for CT; however, setting the frequency for a PT preset channel shall automatically set the same frequency for a corresponding CT preset channel. Front panel marking shall be luminescent (see 3.5.6).

3.1.1.2 Integrated COMSEC. The transceiver shall contain COMSEC circuitry. The COMSEC shall be in accordance with the applicable NSA drawing set. The COMSEC shall be completely interoperable with the system specified in CSESD-14( ). The contractor may use COMSEC circuitry implementations other than those specified in 3.18.3.6 for Government-furnished equipment (GFE) boards to use his NDI design. The Government will not provide any other COMSEC circuitry implementations as GFE.

3.1.1.3 Frequency hopping. If the contractor has included a frequency hopping capability in the NDI equipment, it is not required to delete the capability; however, the Government may require that the capability operational use be inhibited if it is not compatible with the Government-approved frequency hopping technique.

3.1.2 Vehicular system configuration (see 6.4.11). A vehicular system configuration shall include a transceiver (see 3.1.1) and the ancillary equipments specified in 3.1.2.1 through 3.1.2.3. A contractor, at his option, may combine the equipments specified in 3.1.2.1 through 3.1.2.3 into one watertight case.

3.1.2.1 Vehicular adapter. The vehicular adapter shall:

a. Provide the interfacing required to use the transceiver (see 3.1.1) in vehicular applications
b. Contain circuitry to regulate the power supplied to the transceiver as specified in 3.18.5.1
c. Interface with the vehicular intercommunication system (ICS) as specified in 3.18.5.3 through 3.18.5.5
d. Mate with the Mount, MT-1029/VRC, or equivalent
e. Be enclosed in a watertight case

The front panel shall contain the features and functions specified in 3.1.2.1.1.

3.1.2.1.1 Vehicular adapter front panel. Front panel marking shall be luminescent. The vehicular adapter front panel shall contain as a minimum, the connectors and switches specified in a through f:

a. An ON-OFF power control switch which controls input power. The switch shall have positions for OFF, LOW POWER (see 3.18.2.1), HIGH POWER (10 watts (W)) or 40 W (minimum) (see 3.18.6), and REMOTE which allows remote control using the Control Box, C-2742/VRC (see 3.18.5.3)
b. A two-position radio frequency (RF) power level selection switch shall be capable of selecting either the 10-W or the 40-W output (see 3.18.6). Whenever the ON-OFF power switch is set to high power, the vehicular system configuration shall output either 10 W or 40 W as selected by the RF power level selection switch.
c. An antenna control connector which shall provide antenna band control signals for the Vehicular Antenna, AS-1729/VRC matching unit, or equivalent (see 3.18.5.3)
d. A REMOTE connector which provides interfacing with the remote cable to the Control Box, C-2742/VRC (see 3.18.5.3)
e. A RF output connector Type BNC series, or equivalent, to provide connection for 50-ohm antenna cable.
f. An AUDIO control switch to control the audio level to the loudspeaker. At the minimum volume setting, the audio level shall be fed to the intercom system (see 3.18.5.2).

3.1.2.2 RF power amplifier. The power amplifier shall be capable of increasing the RF output of the transceiver to either 10 W or 40 W as selected on the vehicular adapter front panel (see 3.18.6). The power amplifier shall be enclosed in a watertight case.

3.1.2.3 Loudspeaker. The loudspeaker shall provide audio output of received signals. During transmit, there shall be no speaker output (see 3.18.5.2).

3.1.2.4 Vehicular adapter mount. The physical volume specified in 3.19 includes a Mount, MT-1029/VRC with interfacing vehicular cabling. A contractor, at his option, may use a different mount; which shall be supplied at no cost to the Government and shall not require any change in the interfacing vehicular cabling. The mount shall use the same mounting holes as the Mount, MT-1029/VRC and occupy the same footprint as the Mount, MT-1029. All mounts shall conform to the Vibration bounce and shock paragraph of MIL-M-55167.

3.1.3 Ancillary equipments. The Battery Box, CY-7518( )/U shall be constructed in accordance with NESSEC drawing (DWG) 0110278. The Antenna, AT-892( )/PRC, shall be constructed in accordance with USACEC DWG SC-DL-135893. The Handset, H-250( )/U, shall be constructed in accordance with MIL-H-49078. The Cable, CX-13016( )/U, shall be constructed in accordance with NESSEC DWG 0110283.

3.2 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).

3.3 Parts, materials, and processes. The requirements of MIL-P-11268, including the selection requirements specified therein, shall apply (see 4.4). Soldering shall be in accordance with WS-6536E, with SCN 1, SCN 2, and SCN 3.

3.3.1 Printed wiring assemblies. Materials and processes for printed wiring assemblies shall conform to MIL-P-55110. Multilayer printed wiring boards employing plated through holes shall be in accordance with MIL-P-55110 (see 4.4). The use of jumper wires for printed wiring board repairs is prohibited.

3.3.2 Castings. All castings required to be waterproof shall be impregnated in accordance with MIL-STD-276 (see 4.4).

3.3.3 Conformal coating. Printed wiring assemblies shall be conformally coated with a coating material in accordance with MIL-I-46058. The coating shall be applied to both sides of the cleaned printed wiring assemblies. These assemblies shall be cleaned of flux and other contaminants prior to coating. Cleaning compounds shall have no deleterious effects on any part of the printed wiring assemblies. The conformal coating shall be compatible with all parts of the printed wiring assembly and the thickness shall be 0.088 millimeter (mm) (0.0035 inch (in.) ±0.064 mm (0.0025 in.). Assemblies having adjustable components shall not have the adjustable portion covered with the coating. Electrical and mechanical mating surfaces such as connector contact points, test points, screw threads, bearing surfaces, and so forth, shall not be coated (see 4.4).

3.3.4 Microelectronic devices. All microelectronic integrated circuit devices used in this equipment shall conform to the requirements of MIL-M-38510 for Class B devices and their individual drawing requirements (see 4.4).

3.3.5 Unacceptable materials. Equipment design shall not include the materials specified in a through f:

a. Polychlorinated biphenyls
b. Asbestos and asbestos compounds
c. Flammable or combustible materials
d. Fragile or brittle materials
e. Beryllium and beryllium compounds, unless so identified
f. Lithium and lithium compounds, unless specifically approved by the procuring activity

The Unacceptable materials paragraph of MIL-E-16400G shall apply.

3.4 Protective finish. Equipment shall be given a protective finish in accordance with MIL-F-14072. This includes finish of hardware, such as handles, hinges, screws, and so forth, and necessary touch up after mounting. The final paint film on Type I surfaces shall be in accordance with color chip number X24087 of FED-STD-595 (see 4.4).

3.5 Marking (see 4.4). Marking shall be in accordance with MIL-M-13231, except as otherwise specified for nameplates. Front panel marking shall be Group I as specified in MIL-M-13231.

3.5.1 Nameplates for equipment and ancillaries. Nameplates for equipment and ancillaries shall conform to NSA-2, Type B, Class 1 or Class 2, color as specified for security classification nameplates. The location of the nameplates on the ancillaries and equipment and method of fastening them to the ancillaries and equipment shall be in accordance with NSA-2. Nameplates shall include bar-coding.

3.5.2 Accounting numbers. The transceiver shall receive an accounting number as specified in NSA-2. The accounting number shall be permanently marked on the nameplate and duplicated on the surface underneath the equipment nameplate using a marking technique in accordance with NSA-2, Group I.

3.5.3 Visibility. Whenever practicable, parts shall be so mounted that their identification markings will be readily visible with minimum disassembly of the equipment.

3.5.4 Modification record. The modification record shall be as specified in 3.5.4.1 and 3.5.4.2.

3.5.4.1 Equipment. A modification record nameplate shall be mounted on each production equipment delivered by the contractor. The plate shall conform to NSA-2, Type A, Class 9, FIGURE 11 (see NSA DWG ON014681). The plate shall reflect an accurately marked record of both the optional and mandatory modifications which have been incorporated into the equipment by the contractor.

3.5.4.2 Subassembly or element. When a subassembly or element is modified with an optional or mandatory modification which the contractor has incorporated into the equipment, the subassembly or element shall be identified with a modification plate in accordance with NSA-2, Type A, Class 2 (see NSA DWG ON143326) or marked in accordance with NSA-2, Group II, or Group III.

3.5.5 Luminescent front panel connector and control marking. Luminescent paints shall be in accordance with MIL-L-3891. The use of radioactive material as an exciter for luminescent paint is prohibited.

3.6 Identification of wiring. Wiring shall be identified by color-coding or, if approved by the contracting officer, may be identified by other means, such as marking of terminals at both ends of each lead. Color-coding for chassis wiring shall conform to MIL-STD-681 (see 4.4).

3.7 Interchangeability. Like units, subassemblies, and replaceable parts shall conform to MIL-STD-454, Requirement 7 (see 4.12).

3.8 Air-seal. The case of the transceiver, the battery box, the vehicular adapter, and the power amplifier shall be sealed such that if the seal is broken and then remade, the case shall hold a vacuum of 0.0731 kilograms per square centimeter (kg/cm^2) (1 pound per square inch (psi)) -0.731 grams per square centimeter (g/cm^2) (+0.00, -0.10 psi) less than the surrounding atmospheric pressure for 1 minute (see 4.7).

3.9 Battery box pressure relief valves. The battery box pressure relief valves shall be set to open at an internal overpressure of 1.46 g/cm^2 (0.2 psi) and shall conform to the requirements of MIL-V-55341 (see 4.8).

3.10 Service conditions. The equipment shall conform to the requirements specified in 3.10.1 through 3.10.10 under the specified service conditions. Where a test is referenced, conformance to the test shall be considered as compliance with the requirement.

3.10.1 Temperature. The temperature requirements shall be as specified in a through c:

a. Low:
1. Operating. The equipment shall conform to the performance tests specified in 4.19, at ambient temperature as low as -40° Celsius (C) (-40° Fahrenheit (F)) (see 4.13.1a)
2. Storage and transportation. The equipment shall withstand exposure to ambient air temperatures as low as -57°C (-70°F).

b. High:
1. Operating. The equipment shall conform to the performance tests specified in 4.19, at ambient temperatures as high as 55°C (131°F).
2. Storage and transportation. The equipment shall withstand exposure to ambient temperatures as high as 71°C (160°F) (includes effect of solar radiation) (see 4.13.1b).

c. Thermal shock. The equipment shall not be damaged by the effects of temperature shock (change in surrounding atmospheric temperature from 71°C (160°F) to -57° (-70°F) and vice versa). The equipment shall conform to the performance tests specified in 4.19 before and after thermal shock (see 4.13.1c).

3.10.2 Humidity. The equipment shall be operable without degradation in specified performance, and shall sustain no physical damage, during and after prolonged exposure to extreme high humidity levels (95 percent) as encountered in tropical areas (see 4.13.2).

3.10.3 Altitude. The equipment shall be operable without degradation in specified performance at altitudes up to 4.57 kilometers (km) (15,000 feet (ft)) above sea level and shall withstand transportation at altitudes up to 12.19 km (40,000 ft) above sea level (see 4.13.3).

3.10.4 Immersion. The equipment shall show no evidence of leakage when immersed to a covering depth of 0.91 meters (m) (3 ft) of water for 2 hours (see 4.13.4).

3.10.5 Orientation. The equipment shall be capable of full operation with any of its six sides downward. During each orientation, the equipment shall conform to the performance requirements specified in 3.18.2.1. Degradation shall be less than 1 decibel (dB) into a 50-ohm load (see 4.13.5).

3.10.6 Dust. The equipment shall withstand exposure to fine dust particles with wind speeds of 32.38 kilometers per hour (km/hr) (17.5 knots (kn)) ±4.63 km/hr) (±2.5 kn). There shall be no clogging or binding of controls or other moving parts and no evidence of dust within the equipments (see 4.13.6).

3.10.7 Salt fog. The equipment shall be capable of withstanding the effects of a salt fog atmosphere (see 4.13.7).

3.10.8 Vibration and shock. The equipment shall withstand shock and vibration induced during field transport by military vehicle over all types of roads and cross-country terrain. The equipment shall withstand this environment when installed in a military wheeled or armored vehicle on the vehicle mounting base. The equipment shall withstand the shocks induced during rough handling and servicing.

3.10.8.1 Vibration. After experiencing vibrations in accordance with MIL-STD-810, Method 514.3, Procedure I, Category 8, the equipment shall conform to the performance requirements specified in 3.18.1.8 and 3.18.2.2 (see 4.13.8).

3.10.8.2 Bounce, loose cargo. After exposure to loose cargo vibrations, the equipment shall conform to the performance tests specified in 4.19. Physical damage shall be minor only, as specified in MIL-STD-252 (see 4.13.9).

3.10.8.3 Bench handling shock. After exposure to bench handling shock, the equipment shall conform to the performance tests specified in 4.19 (see 4.13.10.1).

3.10.8.4 Shock-drop. After being dropped on each face, each edge, and each corner from a 1.22-m (48-in.) height, the equipment shall conform to the performance tests specified in 4.19. Physical damage shall be minor only, as specified in MIL-STD-252 (see 4.13.10.2).

3.10.8.5 Shock-ballistic. After exposure to ballistic shock, the equipment shall conform to performance tests specified in 4.19. Physical damage shall be minor only, as specified in MIL-STD-252 (see 4.13.10.3).

3.10.9 Fungus. The equipment shall not contain nutrient materials that support the growth of fungus. The equipment shall demonstrate resistance to fungi (see 4.13.11).

3.10.10 Rain. After undergoing a blowing rainfall of 10.16 centimeters (cm) (4.0 in.) ±1.27 cm (±0.5 in.) per hour, the equipment shall conform to the performance tests specified in 4.19 (see 4.13.12).

3.11 Workmanship screen. All complete equipments, including all repair parts and assemblies submitted for Government acceptance, shall withstand a defect detection vibration screen of random type vibration (see 4.6.1.1) at $0.04g^2/Hz$ ±3 dB from 80 hertz (Hz) to 350 Hz and temperature cycling as specified in 4.6.1.2.

3.12 Operational. Operational requirements shall be as specified in 3.12.1 through 3.12.2.

3.12.1 Transceiver. Each transceiver shall be subjected to a final operational test in accordance with 4.18.1 after all other inspections and tests are completed, to determine that the transceiver is operational. The transceiver shall demonstrate the operational capability to transmit and receive messages in PT and CT and the capability to receive, store, and process fill (see 4.18.1).

3.12.1.1 End-to-end audio output. The total end-to-end audio output shall not exceed 5 percent and shall be not less than 6 milliwatts (mW) when received from a transceiver with an audio input tone of 500 Hz at 1.0 millivolt (mV) in either PT or CT. This measurement shall be made with squelch on and all alert signals disabled (see 4.18.1.3).

3.12.2 Vehicular system configuration. Each vehicular system configuration shall be subjected to a final operational test in accordance with 4.18.2 after all other inspections and tests are completed, to determine that the vehicular system configuration units are operational. The vehicular system configuration shall demonstrate the operational capability to transmit and receive messages in PT and CT under the limits specified in MIL-STD-1275 for vehicular input voltages (see 4.18.2).

3.13 Reliability. The lower test mean-time-between-failures (MTBF) (O_1 as defined in MIL-STD-781) of the vehicular system configuration shall be 250 hours (see 4.15).

3.14 Nuclear survivability. All contractor-furnished mechanical configurations, electronic assemblages, electronic equipment, electronic circuits, and electronic components shall withstand the nuclear environment as specified in SPAWAR PMW 151-22A/CD29516. The equipment shall conform to the operational requirements specified in 3.12 immediately after being subjected to the specified nuclear environments (see 4.10). The equipment shall be energized during exposure.

3.15 TEMPEST. The equipment shall conform to the requirements of NACSEM 5112 and KAG-30A/TSEC for compromising emanations related to the classified information processed (see 4.11).

3.16 Electromagnetic compatibility (EMC). The equipment shall conform to the interference emission and susceptibility requirements of MIL-STD-461 for Class A3 equipments as specified in a through m (see 4.9):

a. CE01
b. CE03
c. CE06
d. CE07
e. CS01
f. CS02
g. CS03
h. CS04
i. CS06
j. CS07
k. RE02
l. RS02
m. RS03

The limits for the CS06, RS02, and RS03 requirements shall be the limits specified for Army procurements in MIL-STD-461.

3.17 Safety criteria. Equipment design shall conform to the Safety criteria paragraph of MIL-E-16400G, except as specified in 3.17.1 through 3.17.3 (see 4.14).

3.17.1 Printed circuit assembly protection. With power applied to the equipment, removal or insertion of printed circuit assemblies shall not damage the assembly or any other part of the equipment. Each assembly shall be keyed to prevent incorrect insertion.

3.17.2 Edge rounding. Exposed edges shall be rounded to a minimum radius of 1 mm (0.04 in.), and exposed corners rounded to a minimum radius of 5 mm (0.2 in.).

3.17.3 Radioactive materials. Radioactive materials (for example, luminous dials and luminous markings, electron tubes, surge arrestors, and lenses) shall not be used in the equipment.

3.18 Performance characteristics. Performance characteristics shall be as specified in 3.18.1 through 3.18.8.

3.18.1 Receiver. The receiver shall be as specified in 3.18.1.1 through 3.18.1.13.

3.18.1.1 Sensitivity. Using a 500-Hz tone to frequency modulate an RF signal with a deviation of 8 kHz ±1.5 kHz to either side of the carrier and with the transceiver in PT mode, the alert signal disabled, and the mode switch set to the SQUELCH OFF position, an input level of 0.5 microvolts (μV) applied to the 50-ohm antenna connector of the receiver shall produce a signal-plus-noise-plus-distortion to-noise-plus-distortion ratio (SINAD) of at least 10 dB in the demodulated 500-Hz signal at any frequency in the range of 30.000 MHz to 75.975 MHz (see 4.16.1.1).

3.18.1.2 Selectivity. With the transceiver in PT and the mode switch set to the SQUELCH OFF position, the receiver intermediate frequency selectivity shall be as specified in a through d (see 4.16.1.2):

a. 15 kHz minimum bandwidth at the 6 dB points
b. 90 kHz maximum bandwidth at the 60 dB points
c. Within a 25-kHz range beyond the 60 dB points in both the positive and negative directions, there shall be no returns above the 60 dB response.
d. Response characteristics in the passband shall have no irregularities greater than 2 dB.

3.18.1.3 Limiting. The limiting characteristics of the receiver shall be such that the audio signal output shall not vary more than 3 dB when a 500-Hz frequency modulated RF input signal with a deviation of 8 kHz ±1.5 kHz either side of the carrier and with the transceiver in the PT mode and the mode switch set to the SQUELCH OFF position is varied from 1.0 μV to 100,000 μV (see 4.16.1.3).

3.18.1.4 Spurious responses. The response to any RF signal, including the image frequency, differing in frequency from the tuned center frequency by more than 200 kHz shall be a minimum of 80 dB below the level of the center frequency. Within 200 kHz the spurious responses shall be at least 60 dB below the level of the center frequency (see 4.16.1.4).

3.18.1.5 Desensitization. An RF signal which is 132 dB stronger than the desired signal and is removed by ±10 percent in frequency from the desired RF signal, shall not degrade a 20-dB SINAD signal by more than 2 dB. An RF signal which is 57 dB stronger than the desired signal and is removed by ±50 kHz in frequency from the desired signal shall not degrade a 20-dB SINAD signal by more than 2 dB. The desired RF input shall be a 500-Hz frequency modulated RF signal in the PT mode, with the mode switch set to the SQUELCH OFF position and with a deviation of 8 kHz ±0.5 kHz either side of the carrier set to a level which produces a 20-dB SINAD signal on the demodulated 500-Hz tone (see 4.16.1.5).

3.18.1.6 Intermodulation. Any intermodulation distortion resulting from two undesired carrier frequencies of the same level shall be at least 66 dB down from the desired response (see 4.16.1.6).

3.18.1.7 Offset. Receiver performance in the PT mode shall not be degraded by more than 1 dB as the input signal frequency is offset by the transmitter frequency stability of ±20 parts per million (ppm) (see 4.16.1.7).

3.18.1.8 Audio distortion. The total audio distortion in the receiver output shall not exceed 10 percent at full audio output while receiving a 1.0-µV, 500-Hz frequency modulated RF signal with a deviation of 8 kHz ±1.5 kHz either side of the carrier. The audio distortion shall be reduced to 5 percent or less when the RF signal is increased to 1.0 mV. These measurements shall be made in the PT mode with the alert signal disabled and with the mode switch set to the SQUELCH OFF position (see 4.16.1.8).

3.18.1.9 Squelch sensitivity. In the PT mode, the squelch shall open on signals which produce a SINAD of 10 dB. False operation of the squelch shall not occur when the incoming signal is voice modulated. The squelch, once opened, shall hold when the SINAD is reduced to 7 dB. Squelch performance shall be measured with a 150-Hz ±1.5-Hz squelch tone present on the received signal (see 4.16.1.9). The received signal shall be a composite of the 150-Hz squelch tone and the 500-Hz modulation specified in 3.18.1.1.

3.18.1.10 Squelch operating time. In the PT mode, the squelch shall open in less than 100 milliseconds (ms), turn off in less than 200 ms, and shall have a turn-around time (release of push-to-talk (PTT) to squelch turn on) of less than 175 ms. The test signal input shall be the level necessary to produce a 20-dB SINAD (see 4.16.1.10).

3.18.1.11 Audio response. The receiver audio response in the PT mode shall be within ±3 dB from 300 Hz to 2500 Hz (see 4.16.1.11).

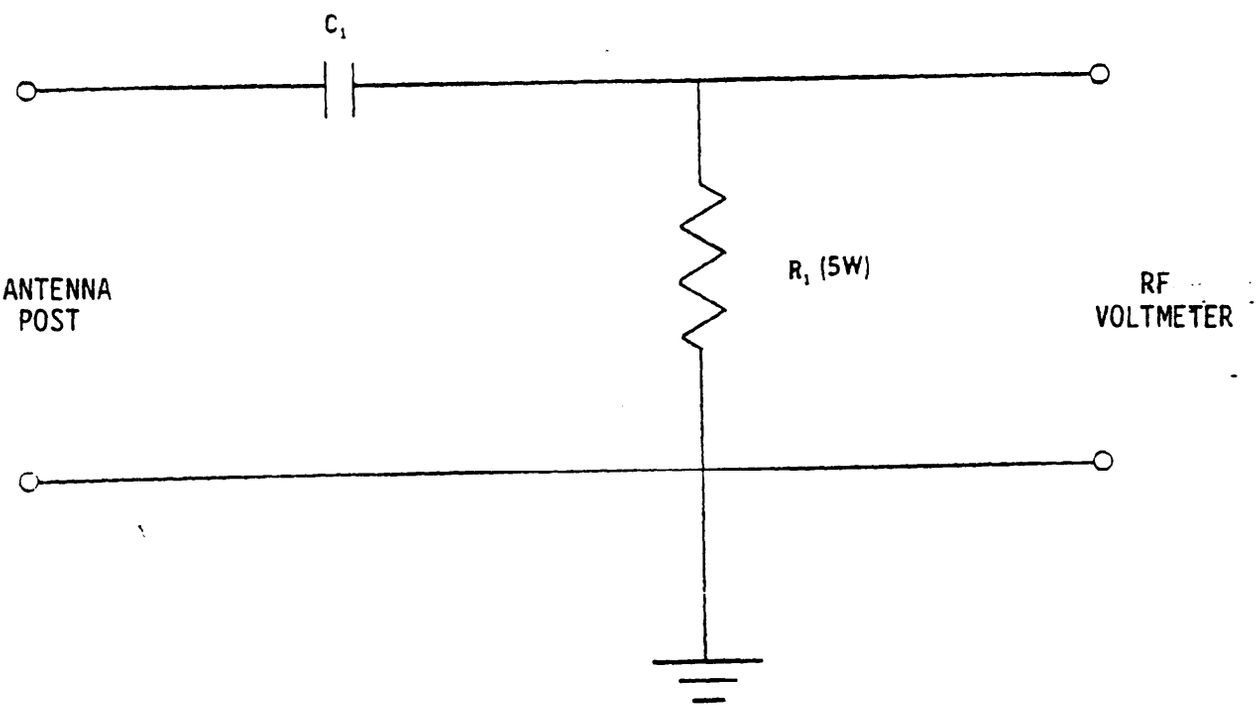
3.18.1.12 Wideband response. The attenuation measured relative to the peak response shall be (see 4.16.1.12):

Frequency	Response
10 Hz to 10.24 kHz	3 dB maximum
12.8 kHz	10 dB maximum
14.9 kHz	20 dB maximum
17.0 kHz	30 dB maximum

3.18.1.13 Audio output. Receiver audio output shall be adjustable using the volume control for 0.00142 mW ±4.5 dB at the minimum setting and 6 mW minimum before clipping into a 1000-ohm load. The volume control shall provide approximate audio taper control (see 4.16.1.13).

3.18.2 Transmitter. The transmitter shall be as specified in 3.18.2.1 through 3.18.2.7.

3.18.2.1 Power output. The RF power output delivered to the 50-ohm antenna connector shall be not less than 2 W over the frequency range of 30.000 MHz to 75.975 MHz. The RF power output to the backpack antenna mounting post shall be measured using an antenna load simulator in accordance with FIGURE 1.



A LOW INPUT CAPACITANCE RF VOLTMETER SHALL BE USED TO MEASURE THE RMS VOLTAGE ACROSS THE LOAD RESISTOR.

FIGURE 1. Antenna load simulator.

The stray capacitance of the antenna load shall be held to a minimum. The test shall be made at the specified frequencies using the corresponding values of resistance and capacitance.

Frequency (MHz)	Resistance, R_1 (ohms)	Capacitance, C_1 (Picofarads)
30.000	26.1	12
37.500	34.8	12
47.500	51.1	16
50.000	51.1	15
52.500	56.2	18
53.500	56.2	18
65.000	61.9	29
75.000	61.9	82

This load simulates the backpack antenna, the 0.91-m (3-ft) Tape Antenna, AT-892( )/PRC, as specified in USACEC DWG SC-DL-135893. An antenna matching network shall be provided to automatically match the power amplifier to the Antenna, AT-892( )/PRC, over the operating frequency range of 30.000 MHz to 75.975 MHz. The power amplifier shall not be damaged due to impedance mismatch causing high voltage standing wave ratio (VSWR) conditions (see 4.16.2.1).

3.18.2.2 Modulation distortion. Total distortion in the transmitter output shall be less than 5 percent when the system is in the PT mode and the audio input is 1.0 mV root-mean-square (rms) (see 4.16.2.2).

3.18.2.3 Spurious outputs. Spurious outputs from the transmitter shall be at least 75 dB below the fundamental frequency. All harmonics shall be 55 dB below the fundamental frequency. Band switching crossover spurious outputs within ±500 kHz of the fundamental frequency when the fundamental is within 500 kHz of the crossover frequency shall be 55 dB below the fundamental frequency (see 4.16.2.3).

3.18.2.4 Deviation. The transmitter RF output signal deviation to either side of the carrier shall be as specified in a through c (see 4.16.2.4):

a. PT audio (no squelch tone): 8 kHz ±1.5 kHz
b. CT (16 kilobits per second): 5.5 kHz ±1.0 kHz
c. Squelch tone (150 Hz ±1.5 Hz): 2.5 kHz ±0.5 kHz

3.18.2.5 Frequency stability. The carrier frequency of the transmitter shall be not more than ±20 ppm (±600 Hz to 1520 Hz over the 30.000-MHz to 75.975-MHz operating frequency range) from the specified channel frequency (see 4.16.2.5).

3.18.2.6 Sidetone. Transmit sidetone shall include the alert and alarm tones and shall be at least 1 dB, but no more than 6 dB, lower than the received audio for the same volume control setting (see 4.16.2.6).

3.18.2.7 Transmit spectrum. Premodulation filtering shall limit the spectrum of the transmitted RF modulated signal such that 99 percent of the energy or the 18 dB point is within ±12.5 kHz of the actual selected frequency. This shall apply to both the PT and CT modes (see 4.16.2.7).

3.18.3 Digital subsystem. The digital subsystem shall be as specified in 3.18.3.1 through 3.18.3.10.5.

3.18.3.1 Alarms. During an alarm condition, CT operation shall be precluded, however, PT operation shall be possible unless the failure has occurred in the shared audio, power supply, or control circuitry with the COMSEC subsystem. In the alarm condition, CT RF transmission shall be inhibited until the condition is cleared or the PT mode is selected (see 4.16.3.1).

3.18.3.2 Plain-cipher mode selection. The strapable options provided on the COMSEC subsystem shall be arranged to provide the capability to receive either PT or CT in any mode switch position. Transmit PT or CT mode selection shall be provided by the preset frequency control switch (see 4.16.3.2).

3.18.3.3 Alerts. Alert signals shall be separately strap-selectable and shall be provided as sidetone in transmit or along with receive audio. (The alert signals shall not be transmitted except when there is excessive crosstalk in the associated audio accessories or ICS.) Any time the equipment is actually receiving or transmitting in PT, a 1200-Hz ±10 percent audio frequency tone shall be added to the sidetone or received audio. This alert signal shall be 6 dB less than the audio signal and shall be on for 50 ms ±10 percent and off for 800 ms ±10 percent. When the equipment receives a CT transmission and is not in the cipher mode position on the front panel selector switch, an alternating high-low tone (600-Hz ±10 percent and 1200-Hz ±10 percent) shall be added to the receive audio. It is not intended that the operator be able to monitor the received traffic under this condition as in the case of PT, but rather that the operator switch the mode selector switch to the proper mode for operation; for this reason, the PT slow beep may also be present. The CT alert signal shall be 6 dB less than the audio signal level and shall be alternately keyed on for 50 ms ±10 percent (see 4.16.3.3).

3.18.3.4 Retransmission delay. When the transceiver is to be used as a retransmission station in the cipher mode, the initial phasing of 200 ms shall be extended by 800 ms through the use of the time delay position of the power control switch on the front panel of the transceiver (see 4.16.3.4).

3.18.3.5 Data. The COMSEC subsystem, shall accept data as well as voice input signals using the front panel six-pin audio connector as specified in NSA DWG ON241775. Analog or digital data may be used dependent on how the six-pin audio connector is programmed by the external input/output (I/O) equipment. Normal voice operation shall be possible using the Handset, H-250( )/U, or equal. Analog or digital data operation shall be possible with the connector programming and I/O signal characteristics specified in CSESD-14( ) (see 4.16.3.5).

3.18.3.6 GFE boards (see 6.7). The Government shall provide the contractor, for each transceiver procured, with one set of printed wiring boards which make up the COMSEC portion of the transceiver. The electrical and mechanical function and interconnection shall be in accordance with NSA drawings specified in TABLE I. The contractor shall be responsible for proper electrical and mechanical interfacing of the GFE boards in accordance with the NSA drawing set for each board. In each case, the drawing set shall consist of the necessary electrical, mechanical, and interface drawings. Performance testing of the integrated equipment shall show proper interfacing of the COMSEC subsystem (see 4.18).

TABLE I. NSA drawings for GFE boards.

Board title	NSA drawing package number
Transalarm	ON241622
Power supply	ON241635
Input recovery	ON241618
VPRC	ON241620
ISSR	ON503181
Clock control	ON241626
CVSD	ON241624
Audio	ON241639
Interconnect	ON241641

3.18.3.7 CT performance degradation. In the secure mode, operating range reduction shall be kept to an absolute minimum when compared to operation in the PT mode. The maximum range reduction shall be less than 2 dB (see 4.16.3.6).

3.18.3.8 Retransmit operation. Two transceivers with batteries and battery boxes shall provide operation in the Retransmit Mode when the two units are interconnected with Cable Assembly, CX-13016( )/U, or equivalent (see 4.16.3.7).

3.18.3.9 Interlocks. Circuitry shall be provided to zeroize all fill positions if any equipment case cover is removed, except for memory battery compartment cover when main power is applied (see 4.16.3.8).

3.18.3.10 Control circuitry. Circuitry that employs a microprocessor in the control of the COMSEC subsystem and the radio subsystem shall conform to the requirements of 3.18.3.10.1 through 3.18.3.10.5.

3.18.3.10.1 Resource allocation and reserves. Total system memory, input and output channels, and processing time reserves of at least 20 percent shall exist at the time of software acceptance by the Government for equipments procured to this specification. The reserve capacity shall be expressed as a percentage of available capacity at full operational loading over the duty cycle specified in 4.15.1.1.

3.18.3.10.2 Computer program regeneration. All software delivered for equipments procured to this specification shall be capable of being generated from Government-owned support software and contractually generated support software.

3.18.3.10.3 Computer programming standards and conventions. The software product, including changes, modifications, and enhancements, shall conform to the design and coding standards of DoD-STD-2167. The contractor shall:

a. Use a high order language (HOL), which is subject to Government approval, to specify the detailed software design
b. Use the HOL representation of the software as a design tool to permit verification of conformance to software performance requirements

3.18.3.10.4 Self-test. Equipments that include a self-test feature under the control of the microprocessor shall display operational status when the self-test function is activated. The self-test capability shall detect 98 percent of all equipment malfunctions and failures. The transceiver shall display unique codes to provide the status indications specified in a through h:

a. Equipment is operational
b. Deficient main battery
c. Deficient memory battery
d. Faulty transceiver module (isolated to a particular module)
e. Faulty vehicular adapter module (isolated to a particular module)
f. Faulty power amplifier module (isolated to a particular module, if applicable)
g. Faulty COMSEC subsystem
h. Any additional self-test features not specified in a through g

Display of the COMSEC subsystem failure isolated to a particular module is not required (see 4.16.3.9).

3.18.3.10.5 Microprocessor tampering. The microprocessor shall be mounted so as to be tamper-resistant. Microprocessor tampering shall be visually apparent.

3.18.4 Input power. Input power shall be as specified in 3.18.4.1 through 3.18.4.3.

3.18.4.1 Supply voltage range. In the backpack configuration, the equipment shall conform to the specified performance when operating over the maximum voltage range of the main battery (see 6.4.8), or the memory battery (see 6.4.7), as specified in MIL-B-18 (see 4.16.4.1).

3.18.4.2 Power consumption. The maximum input current at nominal input voltage shall be as specified in TABLE II (see 4.16.4.2).

TABLE II. Power consumption.

Radio portion (12.5 V)	Receive	Transmit	Standby
Display off	240 mA[1/]	1.85 A	240 mA
Display on maximum brightness	800 mA	2.8 A	800 mA
Interface circuitry (25 V)	45 mA	70 mA	8 mA

1/ Milliamperes

3.18.4.3 Display brightness. An ON-OFF switch shall control display brightness. At least four brightness control positions shall be provided. In the OFF position, frequency change to other than existing presets shall be precluded. Operation of the switch to the ON position at any time shall cause the display to light for at least 4 seconds, but not for more than 6 seconds. Initiation of a PTT action shall cause the display to turn off. At the minimum ON setting, the display digits shall be readable in a completely darkened room. At the maximum ON setting, the display shall be readable in bright sunlight (see 4.16.4.3).

3.18.5 Vehicular adapter. The vehicular adapter shall mate with the Shock Mount, MT-1029/VRC, or equivalent, as specified in USACEC DWG SC-DL-414975 and shall contain circuitry to provide the capabilities specified in 3.18.5.1 through 3.18.5.5.

3.18.5.1 Radio power regulator. The vehicular adapter shall regulate within ±1.5 volts direct current (VDC) while powering the radio portion of the transceiver. The voltage regulator shall be capable of operating under the vehicle conditions as specified in MIL-STD-1275 for combined generator-battery power supply and for battery only condition, except that initial engagement surges may be ignored (see 4.16.5.1).

3.18.5.2 Speaker amplifier. The vehicular adapter shall provide at least 2 W of audio output with a distortion level of 5 percent (maximum) into the associated loudspeaker load derived from the fixed level audio output signal from the transceiver. There shall be no speaker output during transmit. When the speaker volume control is in the full counterclockwise position, the 2 W of receive audio shall be provided to a 150-ohm load simulating the intercom system load. This audio output level shall be adjustable by each vehicle operator using the individual Control Boxes, C-11133 (see 4.16.5.2).

3.18.5.3 Vehicle ICS interface. The vehicular adapter shall provide audio and control signals necessary to properly interface with the VIC-2 ICS as specified in MIL-C-55127 and USACEC DWG SC-DL-414975. Audio I/O, PTT, direct current (DC) power control, high-low RF power control and remote preset frequency selection shall be included. Remote DC power control shall be provided as part of the vehicular adapter by using the Control Boxes, AM-7162 or C-2742 (part of the VIC-2 ICS) (see 4.16.5.3).

3.18.5.4 Transmit audio processing. A high pass filter shall be included in the vehicular adapter to reduce the noise level in the transmit audio input due to generator-alternator hash. The filter shall have less than 1.5-dB ripple between 300 Hz and 4000 Hz and shall be at least 20 dB down at 100 Hz (see 4.16.5.4).

3.18.5.5 Vehicle antenna tuning switch. The vehicular adapter shall automatically provide the control signals necessary to properly tune the Vehicular Antenna, AS-1729, or equal, as specified in MIL-A-55288, based upon frequency information from the transceiver (see 4.16.5.5).

3.18.6 RF power amplifier (RFPA). The RFPA shall be capable of increasing the RF output of the transceiver from 2 W to 10 W +2 dB to -1 dB or 40 W (minimum) ±1 dB into a 50-ohm load; the requirements of 3.18.2.7 shall apply. Maximum power output shall be switch-selectable from the front panel, or remotely controlled, using the Control Box, C-2742. For remote control operation, the high power position of the Control Box, C-2742 shall provide whatever power output is selected on the vehicular adapter front panel. The power amplifier mounted on the vehicular adapter shall be capable of continuous operation under high temperature conditions at the 40-W power setting. The power amplifier shall not be damaged due to impedance mismatch causing high VSWR conditions (see 4.16.6).

3.18.6.1 Noise floor. The noise floor of the power amplifier when used with the transceiver and vehicular adapter (if the power amplifier is not part of the adapter) at the 40-W level shall be greater than 140 dB below the carrier level at frequencies ±20 percent removed, measured over a bandwidth of 30 kHz (see 4.16.6.1).

3.18.6.2 Spurious output. Spurious outputs of the transmitter shall be at least 75 dB down, except for the second and third harmonics and band switching crossover frequencies, which shall be at least 55 dB down (see 4.16.6.2).

3.18.6.3 Power output. The minimum power output shall be 40 W ±1 dB and 10 W +2 dB to -1 dB into a 50-ohm load with an input voltage between 25 VDC and 30 VDC. Power output shall not be reduced by more than 4 dB when the input power is reduced to between 20 VDC and 25 VDC (see 4.16.6.3).

3.18.7 Sensitivity (vehicular). Using a 500-Hz tone to frequency modulate an RF signal with a deviation of 8 kHz ±1.5 kHz to either side of the carrier, with the transceiver in the PT mode, the alert signal disabled, and the mode switch set to the SQUELCH OFF position, an input level of 0.71 µV at the RF input connector of the vehicular adapter shall produce a SINAD of at least 10 dB in the demodulated 500-Hz signal at any frequency in the range of 30.000 MHz to 75.975 MHz (see 4.16.7).

3.18.8 Power consumption (vehicular). In the vehicular system configuration with the power amplifier operating at the 40-W level, the current draw to the vehicular adapter shall not exceed 1.3 amperes (A) during standby and receive, and 6.8 A during transmit (see 4.16.8).

3.19 Dimensions and weight. The dimensions and weight of the equipment shall be not greater than the dimensions and weight specified in TABLE III (see 4.17).

TABLE III. Dimensions and weight.

Item 1/	Weight 2/		Height		Width		Depth	
	kg	(lbs)	cm	(in.)	cm	(in.)	cm	(in.)
Vehicular system configuration, including transceiver and mount	27.21	(60.0)	22.48	(8.85)	39.62	(15.6)	37.3	(14.7)
Battery Box, CY-7518 3/	0.68	(1.5)	7.26	(2.86)	29.92	(11.78)	13.54	(5.33)
Cable, CX-13016 3/	0.91	(2.0)	Length = 3.2 m (10.5 ft)					

1/ All dimensions and weights are maximum
2/ Uncrated
3/ Or equivalent

No individual unit of the vehicular system configuration, including transceiver and mount, shall exceed 75 percent of the specified volume nor weigh more than 18.14 kilograms (kg) (40.0 pounds (lbs)).

3.20 Quantitative maintainability. Each unit of the vehicular system configuration, including Government-furnished material (GFM) (see 6.7) (GFE boards), shall have a mean-time-to-repair (MTTR) time not exceeding 30 minutes with a maximum-corrective-maintenance-time (M_{maxct}) of 60 minutes (95th percentile) when corrective maintenance is accomplished at the organizational-intermediate level of maintenance by the replacement of subassemblies (individual printed circuit boards and chassis-mounted electromechanical and mechanical parts). For depot level of maintenance, the MTTR shall be 60 minutes with a M_{maxct} of 120 minutes (see 4.21).

3.21 Standard conditions. The values specified in a through c shall be used as a basis for room ambient conditions to establish normal performance levels:

a. Temperature: room ambient 25°C (77°F) ±5°C (±9°F)
b. Humidity: 50 percent ±30 percent relative
c. Atmospheric pressure: 723.9 millimeters of mercury (mm Hg) (28.5 in. Hg) +50.8 mm Hg (+2.0 in. Hg) -114.3 mm Hg to (-4.5 in. Hg)

3.22 Workmanship. The equipment shall be manufactured and assembled in accordance with MIL-STD-454, Requirement 9, and the applicable portions of the paragraphs of MIL-P-11268 specified in a through n (see 4.20):

a. Brazing
b. Capacitors

c. Cleaning
d. Connectors (electrical)
e. Switches
f. Plastic materials and parts
g. Relays
h. Resistors
i. Screws, other threaded devices, and related parts
j. Semiconductor devices
k. Transformers, inductors, and coils
l. Waveguides, waveguide assemblies, coaxial transmission lines
m. Welding
n. Wiring practices, internal
    1. Cabling
    2. Protection
    3. Clearance
    4. Splicing and stretching

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 verificaton. 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 d:

a. First article inspection (see 4.3)
b. Inspections covered by subsidiary documents (see 4.4)
c. Quality conformance inspection (see 4.5)
   1. Production inspection (Group A) (see 4.5.1)
   2. Production control inspection (Group B) (see 4.5.2)
   3. Environmental inspection (Group C) (see 4.5.3)
   4. Group D inspection (see 4.5.5)
d. Inspection of packaging (see 4.22)

4.2.1 Test configuration. Unless otherwise specified herein, testing of the vehicular adapter shall include the transceiver as part of the test. Unless otherwise specified herein, testing of the power amplifier (if not part of the vehicular adapter) shall include the transceiver and vehicular adapter as part of the test. Standard conditions shall be in accordance with 3.21.

4.3 First article inspection. Unless otherwise specified (see 6.2.1), the minimum equipments required for first article inspection shall be as specified in 4.3.1. First article inspection shall consist of all examination and testing necessary to determine compliance with the requirements of this specification. Failures of Government-furnished ancillary equipment that occur during first article inspections shall not be cause for rejection, except if the failure was caused by contractor-furnished first article equipments. First article inspection shall include the tests specified in TABLE IV.

TABLE IV. First article inspection.

Inspection 1/	Requirement paragraph	Test paragraph	Unit 2/ 1	2	3	4	5	6	7	8	9	10 and 11	12 and 13	14 to 25
1. Inspection covered by subsidiary documents	3.3, 3.3.1, 3.3.2, 3.3.3, 3.3.4, 3.4, 3.5, 3.6	4.4												
2. Group A inspection	(See TABLE VI)													
3. Group B inspection	(See TABLE VII)													

TABLE IV. First article inspection - Continued.

Inspection 1/	Requirement paragraph	Test paragraph	Unit 2/ 1	2	3	4	5	6	7	8	9	10 and 11	12 and 13	14 to 25
4. Group C inspection:														
Temperature														
Low	3.10.1a	4.13.1a		1										
High	3.10.1b	4.13.1b		2										
Thermal shock	3.10.1c	4.13.1c		3						2				
Humidity	3.10.2	4.13.2												
Altitude	3.10.3	4.13.3	1											
Orientation	3.10.5	4.13.5		4										
Dust	3.10.6	4.13.6				1								
Salt fog 3/	3.10.7	4.13.7	2											
Vibration	3.10.8.1	4.13.8					1							
Bounce, loose cargo	3.10.8.2	4.13.9								1				
Bench handling shock	3.10.8.3	4.13.10.1					2							
Shock-drop	3.10.8.4	4.13.10.2						1						
Shock-ballistic	3.10.8.5	4.13.10.3						2						
Fungus 3/	3.10.9	4.13.11							1					
Rain	3.10.10	4.13.12				1								
Safety	3.17	4.14										1		
Nuclear	3.14	4.10											1	
TEMPEST	3.15	4.11											2	
EMC	3.16	4.9												
5. Group D inspection														
Reliability	3.13	4.15												4/

1/ The inspections 1 through 3, in the order shown, shall be performed on all first article units before subjecting these units to any other inspection requirements specified in TABLE IV.

2/ The numbers in the unit columns in TABLE IV specify the order of inspections for the indicated unit.

3/ The equipment shall be thoroughly washed, cleaned, dried, and refurbished after this inspection before proceeding with subsequent inspections.

4/ Four units shall be selected at random for Group D inspection, the remaining 21 units shall be used for contractor training and Government testing as specified in the contract.

4.3.1 First article units. The contractor shall furnish the number of first article equipments completely representative of production equipments as specified in a through h:

a. Twenty-five transceivers
b. Twenty-five vehicular adapters
c. Twenty-five power amplifiers (if not included in vehicular adapter)
d. Twenty-five loudspeakers (if not included in vehicular adapter)
e. Twenty-five Battery Boxes, CY-7518( )/U, or equivalent
f. Twenty-five Handsets, H-250( )/U, or equivalent
g. Twenty-five Tape Antennas, AT-892( )/PRC, or equivalent
h. Five Special Purpose Electrical Cables, CX-13016( )/U, or equivalent

4.4 Inspections covered by subsidiary documents. The inspections specified in TABLE V shall be performed in accordance with the applicable reference documents as part of the inspection required by this specification, and the inspection requirements specified in the contract (see 6.2.1).

TABLE V. Inspections covered by subsidiary documents.

Inspection	Requirement paragraph	Applicable document
Parts, materials, and processes	3.3	MIL-P-11268 and MIL-E-16400G
Printed wiring assemblies	3.3.1	MIL-P-55110
Castings	3.3.2	MIL-STD-276
Conformal coating	3.3.3	MIL-I-46058
Microelectronic devices	3.3.4	MIL-M-38510
Protective finish	3.4	MIL-F-14072
Marking	3.5	MIL-M-13231, MIL-L-3891, and NSA-2
Identification of wiring	3.6	MIL-STD-681

In addition to the requirements specified in TABLE V, 100 percent incoming inspection shall be performed on all semiconductors, microprocessors, integrated circuits, and filters. The 100 percent incoming inspection shall consist of a visual examination and an electrical test of the component function used in the circuitry. The electrical test shall exceed by at least 5 percent the upper and lower maximum operating conditions to be experienced by the component.

4.5 Quality conformance inspection. The contractor shall perform the inspections specified in 4.4, 4.5.1 through 4.5.5, and 4.6. This does not relieve the contractor of his responsibility for performing any additional inspection which is necessary to control the quality of the product and to ensure compliance with all specification requirements.

4.5.1 Production inspection (Group A). Production inspection shall be performed on each unit offered for delivery. Production inspection shall be in accordance with the examinations and tests specified in TABLE VI.

TABLE VI. Production inspection (Group A).

Inspection	Requirement paragraph	Test paragraph
Workmanship screen:	3.11	4.6.1
Visual and mechanical:		
Module subassemblies	3.22	4.6, 4.20
Case	3.22	4.6, 4.20
Transceiver assembly	3.22	4.6, 4.20
Vehicular system configuration assembly	3.22	4.6, 4.20
Electrical performance:		
Receiver:		
Sensitivity	3.18.1.1	4.16.1.1
Limiting	3.18.1.3	4.16.1.3
Offset	3.18.1.7	4.16.1.7
Audio distortion	3.18.1.8	4.16.1.8
Squelch sensitivity	3.18.1.9	4.16.1.9
Squelch operating time	3.18.1.10	4.16.1.10
Audio response	3.18.1.11	4.16.1.11
Wideband response	3.18.1.12	4.16.1.12
Audio output	3.18.1.13	4.16.1.13
Transmitter:		
Power output	3.18.2.1	4.16.2.1
Modulation distortion	3.18.2.2	4.16.2.2
Spurious outputs	3.18.2.3	4.16.2.3
Deviation	3.18.2.4	4.16.2.4
Frequency stability	3.18.2.5	4.16.2.5
Sidetone	3.18.2.6	4.16.2.6
Self-test:	3.18.3.10.4	4.16.3.9
Vehicular adapter:		
Radio power regulator	3.18.5.1	4.16.5.1
Speaker amplifier	3.18.5.2	4.16.5.2
Vehicle antenna tuning switch	3.18.5.5	4.16.5.5
Sensitivity	3.18.7	4.16.7
Operational:		
Transceiver assembly:		
Transmit	3.12.1	4.18.1.1
Receive	3.12.1	4.18.1.1
Fill	3.12.1	4.18.1.2
End-to-end audio output	3.12.1.1	4.18.1.3
Vehicular system configuration:		
Transmit	3.12.2	4.18.2.1
Receive	3.12.2	4.18.2.2
Air-seal	3.8	4.7

4.5.1.1 Order of inspection within Group A. Group A inspection shall be performed in an order satisfactory to the Government, except that the air-seal test shall be next to last and the operational tests shall be last (see 6.6).

4.5.2 Production control inspection (Group B). Production control inspection shall be conducted on a sampling basis as specified in 4.5.2.1. Production control inspection shall encompass tests which will detect deterioration of the design by wear of such items as dies, molds, and jigs; tests which detect deviations in the processing of materials; and tests of the performance in a system. These tests shall be performed on equipments that have passed production inspection (Group A). Production control inspection shall include the examinations and tests specified in TABLE VII and shall conform to the special inspection levels of MIL-STD-105. The equipment shall conform to the requirements of production control inspection prior to releasing the lot for shipment.

TABLE VII. Production control inspection (Group B).

Inspection	Requirement paragraph	Test paragraph	AQL (percent)
Transceiver:			
Receiver:			
Selectivity	3.18.1.2	4.16.1.2	0.4
Spurious responses	3.18.1.4	4.16.1.4	0.4
Desensitization	3.18.1.5	4.16.1.5	0.4
Intermodulation	3.18.1.6	4.16.1.6	0.4
Transmitter:			
Transmit spectrum	3.18.2.7	4.16.2.7	0.4
Digital subsystem:			
Alarms	3.18.3.1	4.16.3.1	0.4
Plain-cipher mode selection	3.18.3.2	4.16.3.2	0.4
Alerts	3.18.3.3	4.16.3.3	0.4
Retransmission delay	3.18.3.4	4.16.3.4	0.4
Data	3.18.3.5	4.16.3.5	0.4
CT performance degradation	3.18.3.7	4.16.3.6	0.4
Retransmission	3.18.3.8	4.16.3.7	0.4
Interlocks	3.18.3.9	4.16.3.8	0.4
Supply voltage range	3.18.4.1	4.16.4.1	0.4
Power consumption	3.18.4.2	4.16.4.2	0.4
Display brightness	3.18.4.3	4.16.4.3	0.4
Vehicular adapter:			
Vehicle ICS interface	3.18.5.3	4.16.5.3	0.4
Transmit audio processing	3.18.5.4	4.16.5.4	0.4
RFPA:			
Noise floor	3.18.6.1	4.16.6.1	0.4

TABLE VII. Production control inspection (Group B) - Continued.

Inspection	Requirement paragraph	Test paragraph	AQL (percent)
Spurious output	3.18.6.2	4.16.6.2	0.4
Power output	3.18.6.3	4.16.6.3	0.4
Power consumption	3.18.8	4.16.8	0.4
Immersion	3.10.4	4.13.4	0.4
Dimensional inter-changeability	3.7	4.12	0.65
Dimensions and weight	3.19	4.17	0.65

4.5.2.1 Sampling plan for production control inspection. Equipment selected for production control inspection shall be selected by the contractor under the supervision of the Government quality assurance representative (QAR) and shall be representative of current production. Sampling shall conform to the procedures of MIL-STD-105 using the special inspection levels. The acceptable quality level (AQL) and inspection level as specified in 4.5.2 shall be:

AQL	Inspection level
0.4 percent	S-4
0.65 percent	S-4

4.5.2.2 Order of inspection within Group B. Group B inspection shall be performed in an order satisfactory to the Government.

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

4.5.3 Environmental inspection (Group C). Environmental inspection shall be performed on units that have passed Group A and Group B inspection. Group C inspection shall consist of the examinations and tests specified in TABLE VIII. Samples shall be selected in accordance with 4.5.3.1.

TABLE VIII. Environmental inspection (Group C).

Inspection	Requirement paragraph	Test paragraph	Unit 1	Unit 2
Subgroup I:				
Temperature:				
Low	3.10.1a	4.13.1a	1	1
High	3.10.1b	4.13.1b	2	2
Thermal shock	3.10.1c	4.13.1c	3	

TABLE VIII. Environmental inspection (Group C) - Continued.

Inspection	Requirement paragraph	Test paragraph	Unit 1	Unit 2
Vibration	3.10.8.1	4.13.8	4	
Bounce, loose cargo	3.10.8.2	4.13.9		3
Subgroup II:				
Bench handling shock	3.10.8.3	4.13.10.1	1	
Shock-drop	3.10.8.4	4.13.10.2	2	
Shock-ballistic	3.10.8.5	4.13.10.3	3	
Orientation	3.10.5	4.13.5		1
Humidity	3.10.2	4.13.2		2
Subgroup III:				
Fungus 1/	3.10.9	4.13.11	2	
Salt fog 1/	3.10.7	4.13.7		5
Rain	3.10.10	4.13.12		4
Dust	3.10.6	4.13.6		3
Altitude	3.10.3	4.13.3		2
TEMPEST	3.15	4.11	1	
EMC	3.16	4.9		1
Subgroup IV 2/				

1/ The equipment shall be thoroughly washed, cleaned, dried, and refurbished after this inspection before proceeding with subsequent inspections.
2/ Units in Subgroup IV shall pass Group B tests before proceeding with Subgroups I, II, and III inspections.

4.5.3.1 Sampling for environmental inspection (Group C). Sampling for environmental inspection shall be as specified in 4.5.3.1.1 through 4.5.3.1.4.

4.5.3.1.1 Subgroup I. For Subgroup I, two units shall be selected at random from the first production lot. For subsequent Group C inspection, two units shall be selected every 2 months.

4.5.3.1.2 Subgroup II. For Subgroup II, two units shall be selected at random from the first production lot. For subsequent Group C inspection, two units shall be selected every 4 months.

4.5.3.1.3 Subgroup III. For Subgroup III, two units shall be selected at random from the first production lot. For subsequent Group C inspection, two units shall be selected every 8 months or 500 units of one type, whichever is sooner.

4.5.3.1.4 Subgroup IV. For Subgroup IV, two units from the first production lot shall be selected at random prior to final lot formation. The units shall be subjected to Group A and Group B tests specified in TABLE VI and TABLE VII and successfully pass the tests prior to being subjected to the tests specified in TABLE VIII. For subsequent Group C inspection, two units shall be selected every

8 months in the manner specified herein. These two sample units shall count toward the total required samples to be selected from Group A and Group B tests as specified in 4.5.1 and 4.5.2.

4.5.3.2 Order of inspection within Group C. Group C inspections shall be performed on sample units in the order shown in TABLE VIII.

4.5.3.3 Nonconforming environmental sample units. If a sample unit fails the inspection specified in 4.5.3, the contractor shall immediately investigate the cause of failure and shall report to the QAR the results thereof and details of the corrective action taken to correct units of production which were manufactured under the same conditions, with the same materials, processes, and so forth. If the QAR does not consider that the corrective action will enable the product to conform to specified requirements, or if the contractor cannot determine the cause of failure, the matter shall be referred to the contracting officer (see 6.5).

4.5.4 Reinspection of conforming production control and environmental sample units. Unless otherwise specified (see 6.2.1), sample units which have been subjected to, and have passed, both production control and environmental inspection may be accepted on the contract, provided all damage is repaired and the sample units are resubjected to, and pass, production inspection. If nonconforming production control and environmental sample units fail reinspection, they shall not be accepted for delivery.

4.5.5 Group D inspection. Group D inspection shall consist of the tests specified in 4.15 and shall be performed on units from lots which have been subjected to, and have conformed to, Group A and Group B inspection.

4.5.5.1 Group D failures. Within 1 working day after occurrence of failures, the contractor shall verbally notify the contracting officer or his designee. Within 30 working days, the contractor shall submit to the contracting officer an analysis of failures, and shall propose corrective action. Implementation of the proposed corrective action shall occur upon written approval by the contracting officer. All units in the failed lot shall receive the corrective action. New test samples shall be selected and Group D testing shall be rerun starting at zero operating time. Lot acceptance and shipment approval will be withheld until test results substantiate that the corrective action was effective.

4.5.5.2 Reinspection of conforming Group D sample units. Unless otherwise specified (see 6.2.1), sample units which have been subjected to, and have passed, Group D inspection may be accepted on the contract provided all visible and known damage is repaired and the sample units are resubjected to, and pass, Group A inspection.

4.5.5.3 Sampling for Group D inspection. For reliability purposes, a lot shall be 1 month's production.

4.6 General workmanship. The equipment, including subassemblies, assemblies, and repair parts, shall be examined for workmanship and soldering during the fabrication and assembly process and at the end item level for conformance to the requirements of 3.22. Each solder connection and associated wiring or leads shall be visually examined.

4.6.1 Workmanship screen. Vibration and temperature cycling shall be performed on each equipment. Vibration shall be performed before temperature cycling. The vibration may be performed at the module or end item level. All the hardware, including cables and connectors, shall be exposed to vibration.

4.6.1.1 Vibration. The vibration shall be random, or subject to procuring activity approval, pseudo-random or complex waveform vibration, for an accumulated time of 10 minutes in the axis deemed most susceptible to vibration excitation. All items shall be hard-mounted (without shock isolators) and subjected to the vibration conditions of FIGURE 2. Input vibration levels shall be measured at the mounting points of the item under vibration. If variations are found at these points, the level used for control purposes shall be the average of the levels at the mounting points. Control equipment having a bandwidth no greater than 10 Hz for vibration frequencies up to 500 Hz and 100 Hz for vibration frequencies above 500 Hz shall be used for the control and analyses of the acceleration spectral density (ASD). The instantaneous acceleration peaks shall be limited to three times the rms acceleration level. The equipment shall be energized during vibration and the testing specified in 4.18.1.1, 4.18.2.1, and 4.18.2.2 shall be conducted, as appropriate, in PT only at 46.000 MHz. Observe any abnormal conditions of the output functional characteristics. All failures occurring during screening shall be corrected and the vibration resumed.

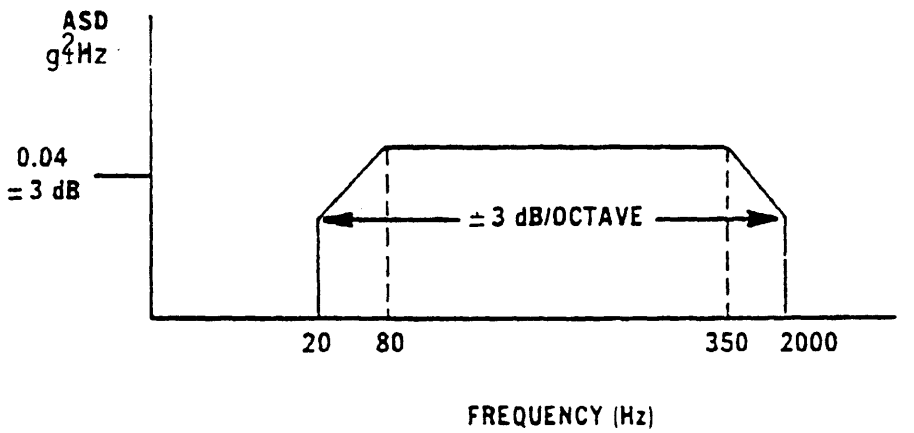


FIGURE 2. Random vibration curve.

4.6.1.2 Temperature cycling. Each equipment shall be subjected to 10 cycles of temperature cycling shown in FIGURE 3. The temperature rate of change shall be not less than 5°C per minute. Unit power shall be turned on and off at the indicated times. The unit shall be positioned for maximum exposure to the changing temperature. Where performance requirements are called for, the testing specified in 4.6.1.1 shall be performed. The dwell time shall be maintained until the largest electrical or electronic part in the unit reaches 80 percent of the chamber temperature. When failures occur, the unit shall be reworked and the cycling continued for a cumulative total of 10 cycles. For temperatures below 0°C (32°F), the memory battery and the main battery shall each be replaced with suitable power supplies.

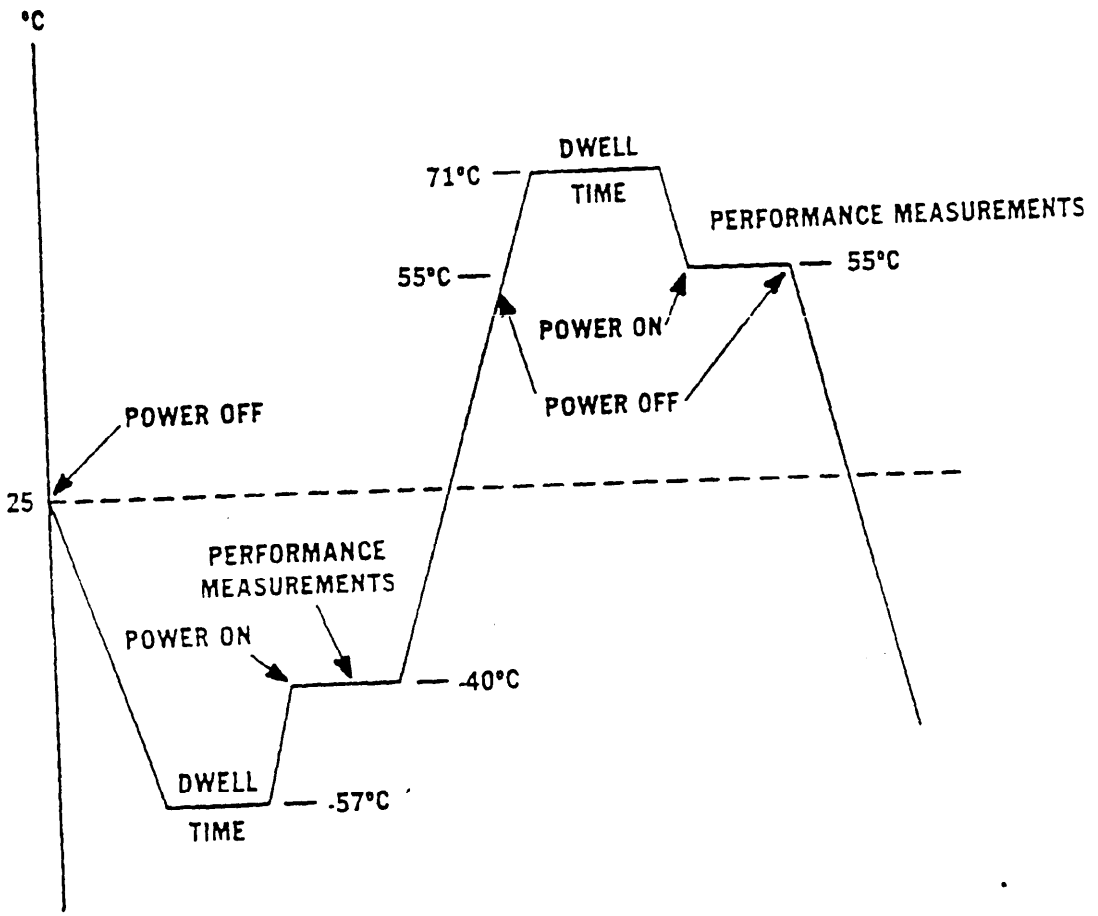


FIGURE 3. Temperature curve (one-cycle) (not to scale).

4.7 Air-seal test. The transceiver, with and without the battery box, and the vehicular adapter, shall be opened and closed again in such a manner as to break and remake the seal. Immediately thereafter, the equipment, as field transported, shall be subjected to a vacuum of 0.0731 kg/cm^2 (1 psi) (0.0731 kg/cm^2 (1 psi) less than the atmospheric pressure surrounding the equipment) applied to the interior of the equipment enclosure when no transit case is provided. The test instrument creating the vacuum shall then be valved-off and the interior pressure measured during the ensuing period of 1 minute. During this 1-minute period, the decrease in vacuum shall not exceed 0.731 g/cm^2 (0.01 psi). The gage used for measurement of the vacuum shall be of such accuracy that a difference of 0.731 g/cm^2 (0.01 psi) may be determined readily (see 3.8).

4.8 Battery box one way pressure relief valve. The battery box shall be fastened to the transceiver after the basic unit has passed the air-seal test. The equipment shall be subjected to a vacuum at a rate of 0.01 psi per second. As the vacuum is valved-off, ensure that each of the two battery vents open at 1.46 g/cm^2 (0.2 psi). The gage used for measurement of vacuum shall be such that a difference of 0.731 g/cm^2 (0.01 psi) may be readily determined (see 3.9).

4.9 EMC. The equipment shall be tested for compliance with the requirements of 3.16, using the approved measurement techniques of MIL-STD-462, as implemented by a Government-approved test plan. The unit shall be tested in both receive and transmit modes of operation at the frequencies specified in a through g (see 3.16 and 6.8.5):

a. CE01, CE03, CE06, and CE07:
   1. Transmit: three frequencies; 32.300 MHz, 53.000 MHz, and 73.700 MHz
   2. Receive: one frequency; 53.000 MHz

The switch transient tests of CE03 and CE06 shall be performed on the following switches through the full switch range:

Unit	Switch
Transceiver	Channel select
Transceiver	Power control
Transceiver	Mode select
Vehicular adapter	Power control

The limits specified for the switch transient tests of CE03 and CE06 shall be modified as follows: CE06; above 10 MHz increase 20 dB (60 decibels microvolts per megahertz (dBμV/MHz)), below 10 MHz increase limits by 40 dB per decade to 100 dBμV/MHz at 1.0 MHz, below 1.0 MHz a constant 100 dBμV/MHz. CE03; change the breakpoint between the constant 50 dBμV/MHz and the 30 dB per decade slope from 2 MHz to 4 MHz.

b. CS01 and CS02:
   1. Transmit: one frequency; 53.000 MHz
   2. Receive: three frequencies; 32.300 MHz, 53.000 MHz, and 73.700 MHz

The susceptibility signal shall be applied to the positive power lead only. For CS02 the interfering signal shall be amplitude modulated 30 percent with a 1000-Hz sinewave.

c. CS03, CS04, and CS07:
   1. Receive: three frequencies; 32.300 MHz, 53.000 MHz, and 73.700 MHz

d. CS06:
   1. Transmit: one frequency; 53.000 MHz
   2. Receive: one frequency; 53.000 MHz

The susceptibility signal shall be applied to the positive lead only.

e. RS02:
   1. Transmit: one frequency; 53.000 MHz
   2. Receive: one frequency; 53.000 MHz

The susceptibility signal shall be 20 A at 60 Hz. Both the steady-state 20-A test and spike test shall be performed.

f. RS03:
   1. Transmit: one frequency; 53.000 MHz
   2. Receive: three frequencies; 32.300 MHz, 53.000 MHz, and 73.700 MHz

The interfering signal shall be amplitude modulated 50 percent with a 1000-Hz sinewave.

g. RE02:
   1. Transmit: one frequency; 32.300 MHz
   2. Receive: one frequency; 53.000 MHz

Receiver susceptiblity criteria shall be such that the 500-Hz audio output SINAD shall not be degraded below 10 dB with an RF input signal of -113 decibels referred to one milliwatt (dBm) using a frequency modulation deviation of 8 kHz ±1.5 kHz in PT and with the mode switch set to the SQUELCH OFF position. Transmitter susceptibility criteria shall be such that the total distortion on the transmitted output shall not be degraded to more than 5 percent. The test setup for all susceptiblity tests shall include a suitable low pass filter to reject harmonics and spurious outputs of the RF signal generators used.

4.10 Nuclear test. Nuclear test (blast, thermal, electromagnetic pulse, initial nuclear radiation) shall be performed on the equipment in accordance with SPAWAR PMW 151-22A/CD 29516. The equipment shall conform to the operational requirements specified in 3.12 following each test (see 3.14).

4.11 TEMPEST test. The equipment shall be tested to demonstrate compliance with the requirements of NACSEM 5112 and KAG-30A/TSEC in accordance with a TEMPEST test plan approved by the procuring activity. Approval shall be obtained prior to commencement of tests (see 3.15).

4.12 Inspection for dimensional interchangeability. The dimensions specified in a through e shall be inspected for conformance to the interchangeability requirements of 3.7. When a listed dimension is not within specified or design limits, it shall be considered a major defect (see 3.7).

a. External and internal dimensions of cases, covers, and insertable assemblies when such dimensions affect mating of parts
b. Dimensions of cavities, when such dimensions affect insertion of items
c. Location of hinges and fasteners on separable parts or assemblies which shall mate, such as cases, covers, and mountings
d. Location of connectors, locking pins, fasteners, slides, and mountings which receive mating parts of plug-in assemblies and major units; and location of the mating parts on the plug-in assembly or major unit
e. Dimensions and form of special threads

4.13 Service condition tests. The service condition tests specified in 4.13.1 through 4.13.12 shall be performed on the equipment (see 4.19).

4.13.1 Temperature. Temperature tests shall be as specified in a through c:

a. Low temperature (see 3.10.1a). The equipment shall be subjected to the low temperature test of MIL-STD-810, Method 502.2, Procedure I and Procedure II. The storage temperature shall be -57°C (-70°F), and shall be maintained for a period not less than 2 hours following stabilization of the test item. Low operating temperature shall be -40°C (-40°F). For low temperature storage and operation testing, the memory battery and the main battery shall each be replaced with suitable power supplies.
b. High temperature (see 3.10.1b). The equipment shall be subjected to the high temperature test of MIL-STD-810, Method 501.2, Procedure I and Procedure II. For the induced storage temperature maximum, the chamber temperature shall be 71°C (160°F) for seven cycles. For steady-state operational temperature the chamber temperature shall be adjusted to 55°C (131°F) for test item operation. This includes the effects of solar radiation.
c. Thermal shock. The equipment shall be subjected to the temperature shock test of MIL-STD-810, Method 503.2 for temperature extremes of -57°C (-70°F) and 71°C (160°F).

4.13.2 Humidity. All humidity testing shall be performed with the equipment covers in place. The equipment shall be tested in accordance with the humidity test of MIL-STD-810, Method 507.2, Procedure I for a constant high humidity (cycle 2) at a temperature of 30°C (86°F) for 20 cycles. Before, during, and after testing, the equipment shall conform to full performance for the measurements specified in 4.19. If the equipment fails to conform to specified performance during cycling, or fails subsequently, the equipment shall not pass the test. If the equipment fails to conform to specified requirements after final conditioning and adjustment, the equipment shall not pass the test (see 3.10.2).

4.13.3 Altitude. The equipment shall be subjected to the altitude test of MIL-STD-810, Method 500.2, Procedure I and Procedure II. The equipment shall conform to full performance for the measurements specified in 4.19 (see 3.10.3).

4.13.4 Immersion. The equipment shall be subjected to the immersion test of MIL-STD-810, Method 512.2, Procedure I. Before and after testing, the equipment shall conform to full performance for the measurements specified in 4.19 (see 3.10.4).

4.13.5 Orientation. The transceiver shall be oriented with each of the six sides downward and tested for power output (see 4.16.2.1.) degradation in each of the orientations. Degradation shall be less than 1 dB into a 50-ohm load. Each orientation shall be tested for a minimum of 30 seconds (see 3.10.5).

4.13.6 Dust. The equipment shall be subjected to the dust test of MIL-STD-810, Method 510.2, Procedure I. Before and after testing, the equipment shall conform to full performance for the measurements specified in 4.19 (see 3.10.6)

4.13.7 Salt fog. The equipment shall be subjected to the salt fog test of MIL-STD-810, Method 509.2, Procedure I. After exposure to the salt fog test (5 ±1 percent by weight salt content) for 48 hours, the equipment, when examined visually with the aid of a 10-power magnifier, shall show no evidence or degradation, such as flaking, pitting, blistering, or loosening of finish of metal surface; or exfoliation (see 6.4.6) of metal. There shall be no clogging or binding of controls or other moving parts after subjecting the equipment to the 48-hour salt fog exposure period or after subjection to the subsequent 48-hour drying period. Electrical operation is not required (see 3.10.7).

4.13.8 Vibration. The equipment, including the Mounting Base, MT-1029/VRC, or equivalent as normally mounted in a vehicle, shall be subjected to the vibration test of MIL-STD-810, Method 514.3, Procedure I, Category 8. Vibration shall be as shown in FIGURE 2. The equipment shall be operated during the last cycle of each axis and shall conform to the performance requirements of 3.18.1.8 and 3.18.2.2 (see 3.10.8.1).

4.13.9 Bounce, loose cargo. The transceiver in the backpack configuration with batteries and battery box attached, and the vehicular adapter alone, the power amplifier alone, and the loudspeaker alone, shall be subjected to the loose cargo test of MIL-STD-810, Method 514.3, Procedure II. The test shall be conducted without the use of a transit case. The test shall be conducted on all six faces for 3 hours total test time. If desired, a test sample different than the one subjected to the vibration test specified in 4.13.8 may be used since it is not intended that one item shall survive both tests (see 3.10.8.2).

4.13.10 Shock. Shock tests shall be as specified in 4.13.10.1 through 4.13.10.3.

4.13.10.1 Bench handling. The equipment shall be subjected to the bench handling shock test of MIL-STD-810, Method 516.3, Procedure VI and shall conform to the performance specified in 4.19 (see 3.10.8.3).

4.13.10.2 Drop. The equipment shall be subjected to the transit drop test of MIL-STD-810, Method 516.3, Procedure IV (see 3.10.8.4).

4.13.10.3 Ballistic. The test shall be conducted on the shock testing machine for lightweight equipment specified in MIL-S-901. The equipment, including shock mounts (if any), shall be secured in the normal operating position to the steel test plate by the same fasteners used for vehicular installation of the equipment. The test shall consist of a total of nine blows: one each, 0.3-m (1-ft) blow, 0.91-m (3-ft) blow, and 1.52-m (5-ft) blow on the back, side, and top of the test plate. As an alternative to reorienting the test plate for the blows on the side of plate, equivalent rotation of the equipment under test is permissible. Before and after testing, the equipment shall conform to full performance for the measurements specified in 4.19 (see 3.10.8.5).

4.13.11 Fungus test. The equipment shall be subjected to the fungus test of MIL-STD-810, Method 508.3. There shall be abundant growth colonization (see 6.4.2) on 50 percent or more of the control item after 14 days and 28 days. Cleaning of the equipment shall not be permitted for 72 hours prior to the fungus test. Handling before and during testing, shall be accomplished without contamination of the equipment. After the fungus test, the equipment shall be visually examined, using a 10-power magnifier. The equipment shall show no more than six minute unrelated spots, each no greater than 0.096 square cm (0.015 square in.) in area, of sparse microbial growth (see 6.4.3) as evidenced by growth colonization (see 6.4.2) (which includes branching (see 6.4.1) and sporulation (see 6.4.4)) on or within each 0.028 cubic m (1 cubic ft), or fraction thereof, of equipment assembly volume. Isolated instances of partial tubular germination (see 6.4.5) shall not be included in the evaluation (see 3.10.9).

4.13.12 Rain. The equipment shall be subjected to the rain test of MIL-STD-810, Method 506.2, Procedure I. The equipment shall be operated during the last 10 minutes of the 30-minute period (see 3.10.10).

4.14 Safety inspection. An inspection shall be performed to verify compliance with those portions of 3.17 which may be determined visually.

4.15 Reliability. The equipment shall demonstrate a specified MTBF of 500 hours when operated under the conditions specified in 4.15.1. The equipment in a vehicular system configuration shall be hard-mounted between 5 Hz to 36 Hz (low frequency). The equipment shall incorporate the Mount, MT-1029/VRC, or equivalent, (using isolators) between 36 Hz to 500 Hz (high frequency). The contractor shall partition the low frequency and high frequency sweeps so that total test time closely (within 5 percent) simulates the vibration sweeps that would have resulted if the equipment had been run continuously from 5 Hz to 500 Hz. MIL-STD-781 shall apply.

4.15.1 Reliability test conditions. All reliability testing shall be conducted under the environmental conditions specified in a through n:

a. Temperature operation: -40°C (-40°F) to +55°C (+131°F)
b. Temperature nonoperation: -57°C (-70°F) to +71°C (+160°F)
c. Temperature cycle time: 14 hours (see cycling specified herein)
d. Rate of change: 5°C per minute (C/min) (9°Fahrenheit per minute (F/min))
e. Vibration: MIL-STD-810, Method 514.3, Procedure I, Category 8, as shown in FIGURE 2
f. Vibration cycle time: 15-minute sweep rate from 5 Hz to 500 Hz and back to 5 Hz
g. Vibration duration: 15 minutes per operating hour
h. Input voltage: nominal
i. Voltage cycling: one cycle at 20 VDC, one cycle at nominal voltage, and one cycle at 30 VDC (see 6.8.4)
j. Voltage spikes: Method CS06 of MIL-STD-461, once every 200 hours
k. Humidity: Condensation and freezing, once per temperature cycle
l. Duty cycle: During on-time: receive 9 minutes; transmit 1 minute; operate continuously in CT with daily check in PT and daily changes in fill variables
m. Temperature cycling: The procedure specified in n shall be used throughout the reliability test. For temperatures below 0°C (32°F), the memory battery shall be replaced with a suitable power supply.
n. Temperature cycling procedure:
1. Step 1. With the equipment OFF, lower the chamber temperature to -57°C (-70°F) ±2°C (±3.6°F)
2. Step 2. Maintain the chamber temperature at -57°C (-70°F) ±2°C (±3.6°F) for a period of 1 hour.
3. Step 3. Raise the chamber temperature to -40°C (-40°F) ±2°C (±3.6°F) at a rate of temperature change not less than 5°C/min (9°F/min). When the chamber temperature reaches -40°C (-40°F) ±2°C (±3.6°F) turn the equipment ON.
4. Step 4. Maintain the chamber temperature at -40°C (-40°F) ±2°C (±3.6°F) for a period of 2.50 hours.
5. Step 5. Raise the chamber temperature to 55°C (131°F) ±2°C (±3.6°F) at a rate of temperature change not less than 5°C/min (9°F/min).
6. Step 6. Maintain the chamber temperature at 55°C (131°F) ±2°C (±3.6°F) for a period of 3 hours.
7. Step 7. Turn the equipment OFF and raise the chamber temperature to 71°C (160°F) ±2°C (±3.6°F).
8. Step 8. Maintain the chamber temperature at 71°C (160°F) ±2°C (±3.6°F) for a period of 1 hour.
9. Step 9. Lower the chamber temperature to 55°C (131°F) ±2°C (±3.6°F) and turn the equipment ON.
10. Step 10. With the equipment ON, maintain the chamber temperature at 55°C (131°F) ±2°C (±3.6°F) for a period of 2.50 hours.
11. Step 11. Lower the chamber temperature to -40°C (-40°F) ±2°C (±3.6°F) at a rate of temperature change not less than 5°C/min (9°F/min).

12. Step 12. Maintain the chamber temperature at -40°C (-40°F) ±2°C (±3.6°F) for a period of 3 hours.
13. Step 13. Turn the equipment OFF and lower the chamber temperature to -57°C (-70°F) ±2°C (±3.6°F).

Repeat Step 2 through Step 13 throughout the reliability test. Completion of Step 2 through Step 13 shall be referred to as one temperature cycle. If the thermal survey indicates that the soak periods called for in Step 2, Step 4, Step 6, Step 8, Step 10, and Step 12 are insufficient for equipment thermal stabilization, these soak periods shall be modified so that stabilization is obtained.

4.15.1.1 Humidity procedure. Humidity shall be injected into the chamber at least once per temperature cycle in such a way that condensation shall form on the equipment and shall form frost.

4.15.2 Reliability test failures. Proper instrumentation shall be provided to ensure detection of a failure (see 6.4.12). A failure shall be considered to have occurred at the time the equipment was last known to be operating properly. Total test time per equipment shall be in accordance with MIL-STD-781. The Problem and failure action, Problem and failure investigations, Failure verification, and Corrective action paragraphs of MIL-STD-781 shall also apply. The presence of a pattern failure as specified in MIL-STD-781 shall result in a reject decision. Failures occurring in the eight GFE digital communication security boards shall not be counted toward the calculation of the demonstrated MTBF unless the failure is induced by contractor-designed equipment.

4.15.3 First article inspection reliability verification test. A sample of four equipments shall be subjected to 925 unit hours of reliability testing in accordance with the accept or reject criteria of MIL-STD-781.

4.15.4 Production inspection reliability verification test. From each fourth lot or 400 units, whichever is sooner, a random sample of four equipments shall be selected and subjected to 925 unit hours of reliability testing in accordance with the accept or reject criteria of MIL-STD-781. A random sample of four equipments shall be selected from the first month's production and subjected to 925 unit hours of reliability testing in accordance with the accept or reject criteria of MIL-STD-781.

4.15.5 Reliability performance measurements. During reliability testing and workmanship screen, the parameters specified in a through h, shall be measured, as a minimum, at least daily. Measurements shall be taken at various points throughout the temperature cycling (high temperature, low temperature, midrange temperature) and during vibration. The number of times measurements are taken at the various points should be approximately equal. If a failure is detected, the failure shall be presumed to have occurred immediately after the last successful measurement of the same parameter.

a. Receiver sensitivity (see 4.16.1.1)
b. Audio distortion (see 4.16.1.8)

c. Audio output (see 4.16.1.13)
d. RF power output (see 4.16.2.1)
e. Modulation distortion (see 4.16.2.2)
f. Deviation (see 4.16.2.4)
g. Frequency stability (see 4.16.2.5)
h. Power output (at only the following frequencies: 31.000 MHz, 38.000 MHz, 46.000 MHz, 57.000 MHz, 75.000 MHz) (see 4.16.6.3)

Performance measurements shall be taken immediately before and immediately after changing the shock mount isolators.

4.16 Electrical performance. Electrical performance shall be as specified in 4.16.1 through 4.16.8.

4.16.1 Receiver. Receiver tests shall be as specified in 4.16.1.1 through 4.16.1.13.

4.16.1.1 Sensitivity test. With the transceiver in PT, the alert signal disabled, and the mode switch in SQUELCH OFF, apply an RF signal with an input level of 0.5 µV and a deviation of 8 kHz ±1.5 kHz to the 50-ohm connector. Measure the SINAD at the front panel AUDIO connector for the following frequencies: 30.000 MHz, 31.000 MHz, 33.000 MHz, 35.500 MHz, 37.500 MHz, 40.000 MHz, 40.975 MHz, 41.000 MHz, 44.000 MHz, 47.500 MHz, 51.500 MHz, 55.000 MHz, 55.975 MHz, 56.000 MHz, 61.000 MHz, 65.500 MHz, 70.500 MHz, 75.000 MHz, and 75.975 MHz (see 3.18.1.1 and 6.8.7).

4.16.1.2 Selectivity test. With the transceiver in PT, the frequency set to 31.000 MHz, and the mode switch in the SQUELCH OFF position, apply an RF signal of continuous wave (CW), minimum attenuation, 31.000 MHz to the 50-ohm antenna connector. Adjust the RF signal to obtain a 10-dB reduction in noise output at the front panel AUDIO connector. Increase the RF signal input by 6 dB. Increase the RF signal frequency until the noise increases to the 10-dB reduced level as obtained herein and record the frequency. Reduce the RF signal frequency to again obtain the 10-dB reduced level and record the frequency. Increase the RF signal input by 54 dB and repeat the upper and lower bandwidth measurements (total of 60 dB). Increase the RF signal frequency 50 kHz above and below the 60-dB frequencies and check that no flybacks above the 60-dB rejection are present (see 3.18.1.2).

4.16.1.3 Limiting test. With the transceiver in PT, the volume control set at mid position, and the mode switch in the SQUELCH OFF position, apply a 1.0-µV RF signal at a 500-Hz rate to the 50-ohm antenna connector. Measure the transceiver audio output level at the front panel AUDIO connector. Increase the RF signal in 10-dB steps to 1 V. Note changes in audio output level (see 3.18.1.3).

4.16.1.4 Spurious responses test. Apply an RF input signal to the 50-ohm antenna connector and adjust the RF voltage level for 20-dB quieting at the audio connector output. Increase the RF signal 80 dB. The transceiver passes this test if the audio quieting level is less than 20 dB for the frequencies specified in TABLE IX. Perform this measurement at each of the frequencies specified in TABLE IX.

TABLE IX. Spurious responses test.

Transceiver frequencies	Input frequencies (MHz)
Transceiver frequency	30.000
Test frequency	11.500, 53.000, 219.000, 426.500
Transceiver frequency	40.975
Test frequency	11.500, 63.975, 250.875, 408.300
Transceiver frequency	41.000
Test frequency	11.500, 64.000, 251.000, 408.500
Transceiver frequency	55.975
Test frequency	11.500, 32.975, 233.875, 244.350
Transceiver frequency	56.000
Test frequency	11.500, 33.000, 234.000, 255.500
Transceiver frequency	75.975
Test frequency	11.500, 42.975, 269.400, 310.875

For the first article testing, in addition to the frequencies specified in TABLE IX, the input signal shall be swept through a frequency range of 10 MHz to 500 MHz and any responses noted. The input signal level shall be reduced 20 dB within 200 kHz of the center frequency (see 3.18.1.4, 6.8.1, 6.8.2, and 6.8.7).

4.16.1.5 Desensitization test (see 3.18.1.5, 6.8.2, and 6.8.7). The desensitization test shall be performed as specified in a and b:

a. With the transceiver in PT, and the mode switch in SQUELCH OFF, apply a 500-Hz tone at the 50-ohm antenna connector to modulate a signal with a deviation of 8 kHz ±0.5 kHz. The input level of the 500 Hz shall produce a 20-dB SINAD ratio at the front panel AUDIO connector for each of the following transceiver frequencies: 30.000 MHz, 40.975 MHz, 41.000 MHz, 55.975 MHz, 56.000 MHz, and 75.975 MHz. The test equipment readings shall be noted.

b. To the test equipment used in a, add a second signal generator. The transceiver and signal generator No. 1 shall be set to the following transceiver frequencies while signal generator No. 2 shall be set to the desensitization frequencies. Set signal generator No. 1 to obtain a 20-dB SINAD ratio at the front panel AUDIO connector. Remove the test equipment connected to the 50-ohm antenna connector and connect the test equipment to an RF voltmeter 50-ohm probe. Increase signal generator No. 2 output to obtain the desensitization level. Desensitization level equals 20 dB SINAD reference level, in dBm +132 dB or 57 dB. Remove the test equipment from the RF voltmeter 50-ohm probe and connect to transceiver. The SINAD ratio shall be not less than 18 dB.

Transceiver frequency (MHz)	Desensitization frequency (MHz)
30.000	33.000
40.975	36.880
40.975	45.070
41.000	36.900
41.000	45.100
55.975	50.380

Transceiver frequency (MHz)	Desensitization frequency (MHz)
55.975	61.570
56.000	50.400
56.000	61.600
75.975	68.300

4.16.1.6 Intermodulation test. Apply to the tape antenna connector of the transceiver under test a composite RF signal at a -47-dBm level. Set RF signal No. 1 to 8-kHz ±1.5-kHz deviation at a 500-Hz rate and No. 2 to CW. Set the transceiver and the RF signal frequencies as specified herein. Set the transceiver to PT and the mode switch to the SQUELCH OFF position. For each combination of frequencies specified, measure the SINAD ratio of the audio output at the front panel AUDIO connector. The transceiver passes this test if the SINAD is less than that previously recorded at the corresponding transceiver frequency on the data sheet (see 4.16.1.1). Perform this measurement at each of the following combinations of frequencies (see 3.18.1.6 and 6.8.7):

Transceiver frequency (MHz)	RF signal No. 1 frequency (MHz)	RF signal No. 2 frequency (MHz)
31.000	31.100	31.200
40.000	40.100	40.200
41.000	40.900	40.800
55.000	55.100	55.200
56.000	55.900	55.800
75.000	75.100	75.200

4.16.1.7 Offset test. With the transceiver in PT mode, apply a -112-dBm signal with an 8-kHz ±1.5-kHz deviation at a 500-Hz rate for the noted frequencies at the 50-ohm antenna connector. Measure the SINAD ratio of the transceiver audio output and determine that it does not go below 10 dB at the following frequencies: 30.000 MHz, 40.975 MHz, 41.000 MHz, 52.975 MHz, 53.000 MHz, 55.975 MHz, 56.000 MHz, and 75.975 MHz. Change the input signal frequency ±20 ppm from the specified frequencies and record any change in SINAD (see 3.18.1.7, 6.8.2, and 6.8.7).

4.16.1.8 Audio distortion test. With the transceiver in the PT mode, the alert signal disabled, the mode switch in the SQUELCH OFF position and set to a frequency of 31.000 MHz, adjust the transceiver volume control to obtain maximum unclipped AUDIO output level at the front panel AUDIO connector. Apply a 31.000-MHz, 1.0-μV input signal to the 50-ohm antenna connector and measure the distortion of the transceiver output (see 3.18.1.8).

4.16.1.9 Squelch sensitivity test. Set the transceiver in PT and the mode switch to OPERATE. At the 50-ohm antenna connector, apply 150-Hz ±1-Hz and 500-Hz ±5-Hz tones, respectively, to modulate the composite signal input to produce a 2.5-kHz ±0.5-kHz of 150-Hz deviation and 5.5-kHz ±1.5-kHz of 500-Hz deviation, respectively. At each of the following frequencies start the composite signal

input at -110 dBm and slowly increase the composite signal until the transceiver squelch opens: 31.000 MHz, 40.000 MHz, 41.000 MHz, 55.000 MHz, 56.000 MHz, and 75.000 MHz (see 3.18.1.9 and 6.8.7). Measure the SINAD ratio of the audio output at the front panel AUDIO connector. Slowly reduce the composite signal until the transceiver squelch closes. Switch the mode switch to SQUELCH OFF and measure the SINAD ratio of the audio output at the front panel AUDIO connector. Perform these measurements at each of the specified frequencies.

4.16.1.10 Squelch operating time test. Set the transceiver in PT, the mode switch in OPERATE, and the frequency to 41.000 MHz. At the 50-ohm antenna connector, apply 150-Hz ±1-Hz and 500-Hz ±5-Hz tones, respectively, to modulate a composite signal input to produce 2.5-kHz ±0.5-kHz of 150-Hz deviation and 5.5-kHz ±1.5-kHz of 500-Hz deviation, respectively. The composite signal input shall be at 41.000 MHz with an output level that will produce a 20-dB SINAD ratio at the front panel AUDIO connector. Measure squelch open time as the interval between composite signal input and 500-Hz audio tone output. Measure turnoff time as the interval between composite signal input off and audio noise output. Turnaround time shall be measured by having the transceiver transmitting and releasing the PTT switch on the handset. Measure turnaround time as the interval between the release of the PTT switch and the start of the 500-Hz audio signal (see 3.18.1.10).

4.16.1.11 Audio response test. With the transceiver in PT and the mode switch in the SQUELCH OFF position, measure the audio output of the transceiver at the front panel AUDIO connector. Adjust the test equipment to obtain a zero dB reading at 500 Hz. Apply each of the following audio frequencies keeping the input level at 1.0 mV and record the output of the transceiver in dB relative to the 500-Hz reference: 50 Hz, 100 Hz, 150 Hz, 200 Hz, 300 Hz, 400 Hz, 500 Hz, 600 Hz, 900 Hz, 1500 Hz, 2000 Hz, 2500 Hz, 3000 Hz, 4000 Hz, 5000 Hz, and 10,000 Hz (see 3.18.1.11). Perform these measurements at each of the specified frequencies.

4.16.1.12 Wideband response test. Apply a 1-kHz tone to modulate a signal with a deviation of 5.5 kHz ±0.5 kHz to the backpack antenna mounting post of the transceiver. Measure the frequency response at the input to the GFE digital subsystem, at the following frequencies: 10 Hz, 100 Hz, 1.0 kHz, 10.24 kHz, 12.8 kHz, 14.9 kHz, 17.0 kHz, 18.0 kHz, and 20.0 kHz to establish compliance with 3.18.1.12. Measure for compliance at 35.000 MHz and 65.000 MHz. RF input level shall be 1 mV ±1 dB (see 3.18.1.12).

4.16.1.13 Audio output test. Use two transceivers. Connect the 50-ohm antenna connector output of transceiver No. 1 to the 50-ohm antenna connector of transceiver No. 2 (the equipment under test) via a 60-dB attenuator. Apply a 500-Hz audio input signal with a level from 0.5 mV to 200 mV into the audio connector of transceiver No. 1. Set both transceivers in PT for each of the frequencies specified. Adjust the volume control on transceiver No. 2 to obtain maximum audio output without clipping. Record the audio output level of transceiver No. 2, then turn the volume control full counterclockwise and record the audio output level. Set both transceivers in CT. Verify that transceiver No. 2 has retained all the variables stored in all six positions. Repeat the specified measurements for the following frequencies: 31.000 MHz, 38.000 MHz, 45.000 MHz, 57.000 MHz, and 75.000 MHz (see 3.18.1.13 and 6.8.7).

4.16.2 Transmitter. Transmitter tests shall be as specified in 4.16.2.1 through 4.16.2.7.

4.16.2.1 Power output test. The power output test shall be performed as specified in a and b (see 3.18.2.1, 6.8.3, 6.8.7, and 6.8.9):

a. At the 50-ohm antenna connector, verify that there is not less than 2 W output into 50 ohms at the following frequencies: 30.000 MHz, 37.500 MHz, 47.500 MHz, 50.000 MHz, 52.500 MHz, 53.500 MHz, 65.000 MHz, and 75.000 MHz. Verify that neither a short circuit nor open circuit condition damages the power amplifier.

b. At the backpack antenna mounting post, verify that the RF voltage measured across the antenna loading resistor is not less than:

Frequency MHz	Volts root-mean-square (Vrms)
30.000	4.0
37.500	4.5
47.500	6.0
50.000	6.0
52.500	7.0
53.500	5.0
65.000	6.0
75.000	7.0

Verify that neither a short circuit nor open circuit condition damages the power amplifier.

4.16.2.2 Modulation distortion test. With an audio tone input of 500 Hz at the front panel AUDIO connector, measure the distortion at the 50-ohm antenna connector with the 150-Hz squelch tone filtered out internally or disabled. The equipment shall be rejected if the distortion is greater than 5 percent for any of the following frequencies: 31.000 MHz, 35.000 MHz, 38.000 MHz, 42.000 MHz, 49.000 MHz, 53.000 MHz, 57.000 MHz, 60.000 MHz, 66.000 MHz, 68.000 MHz, and 71.000 MHz (see 3.18.2.2 and 6.8.7).

4.16.2.3 Spurious outputs test (see 3.18.2.3). Set the transceiver frequency to 34.500 MHz. Connect the 50-ohm antenna connector to a spectrum analyzer or equivalent instrument. Key the transmitter and calibrate the radiated output level on the spectrum analyzer for 0-dB reference. Specify all spurious and harmonic products relative to the fundamental frequency. The procedure specified herein shall be repeated at the frequencies of 46.000 MHz, 57.500 MHz, and 69.000 MHz (see 3.18.2.3 and 6.8.7).

4.16.2.4 Deviation test. With the transceiver set to 31.000 MHz in the PT mode, turn the PTT switch ON and measure the deviation of the 150-Hz squelch tone. Measure the frequency of the squelch tone at the front panel AUDIO connector. With an input of 500 Hz and a level for 0.5 mV to 1 volt (V) into the AUDIO connector, measure the deviation of the 500-Hz component of the modulation with the 150 Hz filtered out. Change to CT and measure the carrier deviation. Measurements shall be made at the following frequencies: 31.000 MHz, 38.000 MHz, 45.000 MHz, 57.000 MHz, and 75.000 MHz (see 3.18.2.4 and 6.8.7).

4.16.2.5 Frequency stability test. At each of the following transceiver frequencies, with the transceiver in the PT mode, measure the transmitted frequency to the nearest 10 Hz: 30.000 MHz, 30.025 MHz, 30.050 MHz, 30.075 MHz, 30.100 MHz, 30.200 MHz, 30.300 MHz, 30.400 MHz, 30.500 MHz, 30.600 MHz, 30.700 MHz, 30.800 MHz 30.900 MHz, 31.000 MHz, 32.000 MHz, 33.000 MHz, 34.000 MHz, 35.000 MHz, 36.000 MHz, 37.000 MHz, 38.000 MHz, 39.000 MHz, 40.000 MHz, 50.000 MHz, 52.000 MHz, 53.000 MHz, 60.000 MHz, 70.000 MHz, and 75.000 MHz (see 3.18.2.5).

4.16.2.6 Sidetone test. Use two transceivers. Connect the 50-ohm antenna connector of transceiver No. 1 to the 50-ohm antenna connector of transceiver No. 2 (the equipment under test). Transmit a tone from transceiver No. 1 to transceiver No. 2 and measure the audio output in dB of transceiver No. 2 in PT and CT. Transmit a tone from transceiver No. 2 to transceiver No. 1 and specify the audio output in dB of transceiver No. 2 in PT and CT. Calculate the sidetone attenuation as the difference between the two outputs in PT and CT, respectively. Perform this measurement at the following frequencies: 30.000 MHz, 35.000 MHz, 44.000 MHz, 56.000 MHz, and 71.000 MHz (see 3.18.2.6 and 6.8.7).

4.16.2.7 Transmit spectrum test. Operate the equipment in the CT mode and measure the transmitted signal at the 50-ohm antenna connector with an audio input of 500 Hz and a level from 0.5 mV to 1 V into the audio connector. The signal spectrum shall be 18 dB below carrier at the ±12.5 kHz points at the following frequencies: 31.000 MHz, 38.000 MHz, 45.000 MHz, 57.000 MHz, and 75.000 MHz. Repeat the test for PT with composite modulation (see 3.18.2.7 and 6.8.7).

4.16.3 Digital subsystem. Digital subsystem tests shall be as specified in 4.16.3.1 through 4.16.3.9.

4.16.3.1 Alarms test. Load known good variables in fill positions 1 to 6. Set transceiver power switch to OFF then ON. Set channel switch to manual PT and listen to handset. Check that the high rate system alarm beeping is heard in earphone. Depress and release PTT switch on handset and check that beeping stops. Switch to CT and check for good variables (no parity alarm when PTT is depressed) in fill positions 1 to 6. Turn FILL SEL to Z5 and then to 1. Check for parity alarm when PTT is depressed with FILL SEL in position 1 to 5 and no alarm in position 6. Reload good variables in positions 1 to 5 and verify as specified herein. Turn FILL SEL to Z6 and then to 6. Check for parity alarm in all six positions as specified herein (see 3.18.3.1).

4.16.3.2 Plain-cipher mode select test. Use two transceivers. Connect the 50-ohm antenna connector of transceiver No. 1 using a 60-dB 50-W attenuator to the 50-ohm antenna connector of transceiver No. 2 (the equipment under test). Set both transceivers to 31.000 MHz. Perform the tests specified in a through c (see 3.18.3.2):

a. Place transceiver No. 1 in PT and transceiver No. 2 in CT. Use common fill between transceiver No. 1 and transceiver No. 2. Key transceiver No. 1 using a 500-Hz tone which shall be heard on transceiver No. 2 along with the PT

cross mode alert signal specified in 3.18.3.3. Change transceiver No. 1 to cipher, key the transmitter, and listen for the 500-Hz tone.

b. Place transceiver No. 2 in PT and repeat the test listening for the CT cross mode alert signal.

c. Strap out the alert signals and repeat a and b.

4.16.3.3 Alerts test. Use two transceivers. Connect the 50-ohm antenna connector of transceiver No. 1 using a 60-dB 50-W attenuator to the 50-ohm antenna connector of transceiver No. 2 (the equipment under test). Set both transceivers to 31.000 MHz and PT mode. Listen to the handset of transceiver No. 2. Depress the PTT on transceiver No. 1. Check that the slow PT alert tone is heard. Release PTT. Switch transceiver No. 2 to CT and repeat. Switch transceiver No. 1 to CT and repeat, noting initial ready beep only. Switch transciever No. 2 to PT and depress PTT of transceiver No. 1. Note high duty cycle CT cross mode alert beeping. Release PTT of transceiver No. 1 and depress PTT of transceiver No. 2. Note PT alert and release PTT. Switch transceiver No. 2 to CT and depress PTT. Note initial ready beep only (see 3.18.3.3 and 6.8.8).

4.16.3.4 Retransmission delay test. Use two transceivers with both in CT. Set the power switch of the equipment under test to ON. Key the transceiver and determine the phase interval between message transmission and message reception at the known good transceiver. Set the power switch to the time delay (TD) position. Key the transceiver and determine that the phasing interval is extended in the TD position and determine the phase interval between message transmission and message reception (see 3.18.3.4).

4.16.3.5 Data test. Use two transceivers. Set both at 31.000 MHz. Connect the 50-ohm antenna connector of transceiver No. 1 using a 60-dB, 50-W attenuator to the 50-ohm antenna connector of transceiver No. 2 (the equipment under test) (see 3.18.3.5). Perform the tests specified in a through c:

a. Apply a 500-Hz, 200-mV rms signal to the front panel AUDIO connector of transceiver No. 1 and key the trarsmitter. Verify that the 500-Hz signal is received at transceiver No. 2 in both plain and cipher mode.

b. Apply a 1-kHz, 200-mV rms signal to the front panel AUDIO connector of transceiver No. 1 and program both transceiver No. 1 and transceiver No. 2 to the analog data mode. Verify that the 1-kHz signal is received at transceiver No. 2 in the CT mode.

c. Program both transceiver No. 1 and transceiver No. 2 to the digital data mode. Apply a one-zero-zero-zero-digital signal pattern of appropriate level at the rate of the 16-kHz clock to the front panel AUDIO connector of transceiver No. 1. Key transceiver No. 1 and verify that a one-zero-zero-zero pattern if received at transceiver No. 2 and that a 16-kHz clock is available at the proper pin of the audio connectors of both sets. Verify that the digital data signal is not inverted between the transmitting and receiving transceivers.

4.16.3.6 CT performance degradation. Two equipments shall be utilized, one inside a screen room operating as a receiver, and one outside the screen room operating as a transmitter. The transmitter output shall be connected to the receiver input through suitable RF attenuators. The equipment shall be operated in the PT mode. The transmitter shall be modulated by a 500-Hz tone and the output of the receiver shall be connected through a 300-Hz high pass filter to a distortion analyzer. Sufficient attenuation shall be added between the transmitter and receiver to produce a 10-dB SINAD. The sets shall then be operated in the secure mode and the attenuation adjusted to again produce a 10-dB SINAD ratio. The difference in the path loss shall not exceed 2 dB (see 3.18.3.7).

4.16.3.7 Retransmission. Verify operation in the retransmission mode using four transceivers as: distant transmitter on frequency F_1, retransmission receiver on frequency F_1, retransmission transmitter on frequency F_2, and distant receiver on frequency F_2. Both CT and PT operation shall be possible with F_1 and F_2 frequencies separated by a minimum of ±10 percent. Verify that in the digital data configuration, data are not inverted between the distant transmitting and receiving transceivers when going through the retransmission station (see 3.18.3.8).

4.16.3.8 Interlocks. Establish a good variable in fill position 1 and verify by absence of parity alarm. Remove any cover and verify that the transceiver will not operate. Reinstall the cover and verify, by parity alarm, that the variable has been removed. Re-establish a good variable in fill position 1. Repeat the test specified herein until all covers have been checked. Install an interlock switch depressor and re-establish a good variable in fill position 3. Remove a card (any card from the digital subsystem). Verify that the transceiver will not operate with card removed. Remove switch depressor and reinstall card and cover (see 3.18.3.9).

4.16.3.9 Self-test test. Set the transceiver brightness control to the maximum setting. Turn the equipment on and activate the self-test function. Within 5 seconds the display shall indicate the unique code indicating operationally ready status. If any other code is displayed, the equipment fails the test (see 3.18.3.10.4 and 6.8.6). For first article testing only, two equipments shall be selected and subjected to test conditions to demonstrate the unique codes for:

a. Deficient memory battery
b. Deficient main battery
c. Faulty transceiver module with test repeated to demonstrate each module's unique code
d. Faulty vehicular adapter module with test repeated to demonstrate each module's unique code
e. Faulty power amplifier module with test repeated to demonstrate each module's unique code, if applicable
f. Faulty COMSEC subsystem
g. Any additional self-test features not specified in a through f

4.16.4 Input power tests. Input power tests shall be as specified in 4.16.4.1 through 4.16.4.3

4.16.4.1 Supply voltage range test. Set input voltages at the transceiver main batteries connectors to the low limit of the battery voltage range. Depress the PTT switch on the handset and speak into the microphone. Check that transmit power is at least 2 W, voice sidetone is normal, and no alarms are heard. Set the input voltages to the high limit of battery voltage range. Repeat the specified check (see 3.18.4.1 and 6.8.9).

4.16.4.2 Power consumption test. Measure the current drain of the batteries with the transceiver in receive, but no signal being received. Depress the PTT switch on the handset and measure the current. Be sure that the voltage at the input main battery connector is set to nominal values during current measurements. In addition, current to the GFE digital subsystem shall be subtracted from the current measured on the appropriate supply line. Release the PTT switch. Measure current drain on each supply line with the transceiver in receive mode with a receive signal input. Repeat the entire procedure for both plain and cipher mode (see 3.18.4.2).

4.16.4.3 Display brightness test. Turn the transceiver set ON and measure the time from the display lamps lighting to display lamps extinguish. Turn off the transceiver and then turn on again. Activate the PTT switch and verify that the lamps extinguish. Verify in the OFF position that frequency change to other than presets is precluded. In a completely darkened room, with the switch at the minimum setting, verify that all lamp digits are readable from a distance of 1.83 m (6 ft). In a normally illuminated room, with the switch at the maximum setting and a 1000-W lamp positioned at 0 degree relative to the display at a distance of 0.91 m (3 ft), verify that all lamp digits are readable from a distance of 1.83 m (6 ft) (see 3.18.4.3).

4.16.5 Vehicular adapter tests. Vehicular adapter tests shall be as specified in 4.16.5.1 through 4.16.5.5.

4.16.5.1 Radio power regulator test. A known good transceiver shall be mounted on the vehicular adapter under test. A regulated DC power supply shall supply 24 V to the vehicular adapter under test. Measure the voltage of the radio power regulator at the transceiver/vehicular adapter interface connector. Verify that the voltage varies no more than ±1.5 VDC while the supply voltage is varied (see 3.18.5.1).

4.16.5.2 Speaker amplifier test. A known good transceiver shall be mounted on the vehicular adapter under test. Apply a 500-Hz tone to modulate a signal with a peak deviation of 8 kHz ±0.4 kHz to the 50-ohm antenna connector of the transceiver. Set the AUDIO control to ICS. The minimum reading shall be 17.3 Vrms. Turn the AUDIO control clockwise and verify that the speaker output is loud (see 3.18.5.2).

4.16.5.3 Vehicle ICS interface test. Use two known good transceivers. Transceiver No. 1 shall be in the backpack configuration. Transceiver No. 2 shall be mounted on the vehicular system configuration under test. The vehicular system configuration shall be mounted on a Mount, MT-1029/VRC, or equivalent. A regulated DC power supply shall supply 24 V to the vehicular adapter under test. A Control Box, C-2742, shall be connected to the REMOTE connector of the vehicular adapter under test. An Amplifier, AM-7162, shall be connected to the Mount, MT-1029/VRC, or equivalent. A Control Box, C-11133, shall be connected to the Amplifier, AM-7162. The power link in the Mount, MT-1029, or equivalent, shall be in appropriate configuration. A headset shall be connected to the Control Box, C-11133.

a. With the power switch of the Amplifier, AM-7162 in the OFF position, verify that there is no power to the vehicular adapter. Turn the power switch of the Amplifier, AM-7162 to NORMAL and verify the power up mode of the vehicular adapter.

b. With the power switch of the Amplifier, AM-7162 ON, key transceiver No. 2 via the Control Box, C-11133, and speak into the microphone. Verify the keying action of the transmitter and reception of audio at transceiver No. 1.

c. With the power switch of the Amplifier, AM-7162 ON and in the CDR and CREW position, key transceiver No. 1 and transmit a 500-Hz tone to transceiver No. 2 within the Control Box, C-11133, in position A. Verify that the Control Box, C-11133, receives 500 mW of audio from the vehicular adapter. Switch the Control Box, C-11133, to the ALL position. Verify that the Control Box, C-11133, receives 200 mW of audio from the power switch of the Amplifier, AM-1762.

d. With the Control Box, C-11133, in the ALL position, key transceiver No. 2 via the Control Box, C-11133, and modulate with a 500-Hz audio signal. Verify that this produces 220 mV into the vehicular adapter. With transceiver No. 2 in PT, measure the modulation distortion received at transceiver No. 1. Verify compliance with 3.18.5.3.

4.16.5.4 Transmit audio processing. At the following frequencies: 50 Hz, 100 Hz, 200 Hz, 300 Hz, 1000 Hz, 2000 Hz, 3000 Hz, and 4000 Hz, measure the audio output at the interface connector between the transceiver and the vehicular adapter for a vehicular system configuration (see 3.18.5.4).

4.16.5.5 Vehicle antenna tuning switch test. Measure the tuning signals to the Antenna, AS-1729, at the RF OUT connector of the vehicular adapter at the following frequencies: 31.000 MHz, 35.000 MHz, 38.000 MHz, 46.000 MHz, 50.000 MHz, 55.000 MHz, 57.000 MHz, 64.000 MHz, 68.000 MHz, and 71.000 MHz. Tuning information shall be in accordance with the following (see 3.18.5.5 and 6.8.7):

Band	Frequency (MHz)	Voltage at pins (24 VDC +1 VDC)
1	30.000 to 32.975	A to C D to C N to C
2	33.000 to 36.975	A to C E to C N to C
3	37.000 to 41.975	A to C F to C N to C
4	42.000 to 47.475	A to C H to C N to C
5	47.500 to 52.975	A to C J to C N to C
6	53.000 to 55.975	B to C D to C N to C
7	56.000 to 59.975	B to C E to C N to C

Band	Frequency (MHz)	Voltage at pins (24 VDC +1 VDC)
8	60.000 to 64.975	B to C F to C N to C
9	65.000 to 70.475	B to C H to C N to C
10	70.500 to 75.975	B to C J to C N to C

As an alternate test method, connect a known good Antenna, AS-1729, to the vehicular adapter and observe that it is switched to the proper band at each specified frequency.

4.16.6 RFPA test. For 4.16.6.1 through 4.16.6.3, if not part of the vehicular adapter, the power amplifier shall be mounted on a known good vehicular adapter. A known good secure transceiver shall be inserted into the vehicular adapter. If part of the vehicular adapter, a known good transceiver shall also be used.

4.16.6.1 Noise floor test. At the vehicular adapter RF OUT connector, check that the noise floor is 140 dB down over a bandwidth of 30 kHz at ±20 percent of the following frequencies: 31.000 MHz, 35.000 MHz, 38.000 MHz, 42.000 MHz, 46.000 MHz, 49.000 MHz, 53.000 MHz, 57.000 MHz, 60.000 MHz, 64.000 MHz, 68.000 MHz, 71.000 MHz, and 75.000 MHz (see 3.18.6.1 and 6.8.7).

4.16.6.2 Spurious output test. Insert the transceiver and set for 40-W operation. At each frequency, measure the fundamental RF frequency at the RF OUT connector on the vehicular adapter using a spectrum analyzer or equivalent instrument. Reference the RF output to 0 dB on the spectrum analyzer. Specify all spurious and harmonic products (second through fifth) relative to the following fundamental frequencies: 31.000 MHz, 35.000 MHz, 38.000 MHz, 42.000 MHz, 46.000 MHz, 49.000 MHz, 53.000 MHz, 57.000 MHz, 60.000 MHz, 64.000 MHz, 68.000 MHz, 71.000 MHz, and 75.000 MHz (see 3.18.6.2, 6.8.7, and 6.8.9).

4.16.6.3 Power output. Set the vehicular system configuration output power to 40 W. Key the transmitter via the handset and measure the power output at the vehicular adapter OUT connector at the following frequencies: 31.000 MHz, 35.000 MHz, 38.000 MHz, 42.000 MHz, 46.000 MHz, 49.000 MHz, 53.000 MHz, 57.000 MHz, 60.000 MHz, 64.000 MHz, 68.000 MHz, 71.000 MHz, and 75.000 MHz. Minimum power output shall be 40 W +1 dB into a 50-ohm load with input voltage between 25 VDC and 30 VDC. Power output shall not be reduced more than 4 dB between 20 VDC and 25 VDC. Verify that neither a short circuit nor open circuit condition damages the power amplifier. The vehicular system configuration shall also pass the test of 4.16.2.7. Set the vehicular system configuration output power to LOW. Repeat the test specified herein, except power output shall be 10 W +2 dB, -1 dB (see 3.18.6.3, 6.8.4, 6.8.7, and 6.8.9).

4.16.7 Sensitivity test (vehicular). A known good transceiver shall be mounted on the vehicular adapter under test. The transceiver shall be in PT, the alert signal disabled, and the mode switch in the SQUELCH OFF position. Apply a 500-Hz tone with an input level of 0.71 μV at the vehicular adapter RF OUT connector to modulate a signal with a deviation of 8 kHz. Measure the SINAD at the

vehicular adapter power input connector for the following frequencies: 30.000 MHz, 35.500 MHz, 40.975 MHz, 41.000 MHz, 47.500 MHz, 55.975 MHz, 56.000 MHz, 65.500 MHz, and 75.975 MHz (see 3.18.7, 6.8.2, and 6.8.7).

4.16.8 Power consumption test (vehicular). Measure the current drain on the vehicular supply line in receive but no signal being received and in receive with a signal being received. Depress the PTT switch on the handset and measure the current drain. Repeat the entire procedure for both PT and CT (see 3.18.8).

4.17 Dimensions and weight. The equipment shall be weighed and measured to verify compliance with 3.19.

4.18 Operational test. Operational tests shall be as specified in 4.18.1 through 4.18.2.2.

4.18.1 Transceiver (see 3.12.1). Use two transceivers. Connect the 50-ohm antenna connector of transceiver No. 1 (the equipment under test) to the 50-ohm antenna connector of transceiver No. 2. Transceiver No. 1 shall be in the backpack configuration while transceiver No. 2 may be set up in backpack or vehicular adapter configuration.

4.18.1.1 Transmit and receive test (CT and PT). Operate the transceiver in the backpack configuration in the CT and PT modes (voice) for a minimum of 30 seconds each. Send three 10-second messages, at each of the following frequencies: 36.000 MHz, 46.000 MHz, and 56.000 MHz. Perform test for both CT and PT, transmit and receive.

4.18.1.2 Fill test. The known good transceiver shall be fully operational, complete with fills. The equipment under test shall be filled as the transceiver test unit is. CT transmission and reception between the equipments shall verify that the equipment under test has properly received, stored, and processed the fill.

4.18.1.3 End-to-end audio output test. Using two transceivers, connect the 50-ohm antenna connector of transceiver No. 1 (the equipment under test) to the 50-ohm antenna connector of transceiver No. 2 through a 60-dB, 5-W attenuator. Set both transceivers to 36.000 MHz. Transmit a 500-Hz, 1.0-mV audio tone via the audio connector of transceiver No. 2 to transceiver No. 1. Measure the audio distortion and output level at the audio connector of transceiver No. 1 at full unclipped audio power in both PT and CT (see 3.12.1.1).

4.18.2 Vehicular system configuration (see 3.12.2, 6.8.4, and 6.8.9). Vehicular system configuration tests shall be as specified in 4.18.2.1 and 4.18.2.2.

4.18.2.1 Transmit. A regulated DC power supply shall supply 24 V to the vehicular system configuration under test. A transceiver shall be secured to the vehicular adapter. Use the handset to key the transmitter and ensure that the output of the transceiver at the 50-ohm antenna connector is not less than 2 W at 36.000 MHz, 46.000 MHz, and 56.000 MHz. Reduce the input voltage to the vehicular adapter to 20 V and repeat the test. Increase the input voltage to the vehicular

adapter to 30 V and repeat the test. The transceiver shall provide not less than 2-W RF output under all the conditions specified herein for both plain and cipher modes.

4.18.2.2 Receive. Use two known good transceivers. Connect the 50-ohm antenna connector of transceiver No. 1 to the 50-ohm connector of transceiver No. 2. Transceiver No. 2 shall be mounted on the vehicular adapter under test. A regulated DC power supply shall supply 24 V to the vehicular adapter under test. Transceiver No. 1 shall run off battery power and transmit in both PT and CT to transceiver No. 2 at each of the following frequencies: 36.000 MHz, 46.000 MHz, and 56.000 MHz. The speaker shall be on to ensure that the vehicular adapter provides audio from the speaker. Reduce the input voltage to 20 V and repeat the test. Increase the input voltage to 30 V and repeat the test. The vehicular adapter shall power transceiver No. 2 and provide speaker audio output for each voltage.

4.19 Environmental electrical performance test. Unless otherwise specified herein, the tests specified in a through m shall be performed to determine satisfactory operation of the equipment before, during, and after the environmental tests specified in 4.13 (see 3.10):

a. Sensitivity (at only the following frequencies: 32.250 MHz on preset channel 1, 51.500 MHz on preset channel 2, and 75.975 MHz on preset channel 3) (see 4.16.1.1)

b. Audio output (PT and CT) (measure only maximum unclipped audio output voltage at 51.500 MHz on preset channel 2 and measure the audio voltage level from transceiver No. 1) (see 4.16.1.13)

c. Power output (at only the following frequencies: 32.250 MHz on preset channel 1, 51.500 MHz on preset channel 2, and 75.975 MHz on preset channel 3. Short circuit and open circuit tests are not required.) (See 4.16.2.1a)

d. Power output (at only the following frequencies: 37.500 MHz on preset channel 4 and 65.000 MHz on the preset manual channel. Short circuit and open circuit tests are not required.) (See 4.16.2.1b)

e. Frequency stability (at only the following frequencies: 32.250 MHz on preset channel 1, 51.500 MHz on preset channel 2, and 75.975 MHz on preset channel 3) (see 4.16.2.5)

f. Alarms (at only the following frequencies: 32.250 MHz on preset channel 1, 51.500 MHz on preset channel 2, and 75.975 MHz on preset channel 3) (see 4.16.3.1)

g. Modulation distortion (at only the following frequencies: 32.250 MHz on preset channel 1, 51.500 MHz on preset channel 2, and 75.975 MHz on preset channel 3) (see 4.16.2.2)

h. Operational test (only one 10-second voice message at each of the following frequencies: 32.250 MHz on preset channel 1, 51.500 MHz on preset channel 2, 75.975 MHz on preset channel 3, 37.500 MHz on preset channel 4, 65.000 MHz on the preset manual channel using fill position 5 followed by 48.450 MHz on the preset manual channel using fill position 6. Voice verification in both PT and CT between both transceivers is required. Verify self-test, if applicable (see 4.18 and 4.16.3.9)

i. Vehicular sensitivity (vehicular adapter only) (at only the following frequencies: 32.250 MHz, 51.500 MHz, 75.975 MHz) (see 4.16.7)
j. Vehicular radio power regulator (vehicular adapter only) (see 4.16.5.1)
k. Vehicle antenna tuning switch (vehicular adapter only) (at only the following frequencies: 32.250 MHz, 51.500 MHz, 75.975 MHz) (see 4.16.5.5)
l. Vehicular speaker amplifier (vehicular adapter and loudspeaker) (see 4.16.5.2)
m. Vehicular power output (vehicular adapter, power amplifier, and loudspeaker) (at only the following frequencies 32.250 MHz, 51.500 MHz, 75.975 MHz) (see 4.16.6.3)

4.20 Visual and mechanical examination. The equipment shall be examined for the defects listed in MIL-STD-252 (see 3.22).

4.21 Maintainability demonstration (see 3.20). When specified (see 6.2.1), the contractor shall perform a maintainability demonstration.

4.21.1 Maintainability equipment demonstration. The contractor shall perform a maintainability demonstration at the organizational-intermediate level of maintenance. The demonstration shall be performed by qualified technicians and shall verify conformance to the corrective maintenance time requirements.

4.21.1.1 Organizational-intermediate maintainability. The organizational-intermediate level maintainability requirements shall be demonstrated in accordance with MIL-STD-471 by replacement of subassemblies (individual printed circuit boards or assemblies) and chassis-mounted electronic, electrical, electromechanical, and mechanical components or parts at the organizational-intermediate level. Forty candidate corrective maintenance tasks shall be identified. The information specified in a through c shall be made available for each candidate task:

a. Designation of specific faulty part
b. Failure mode
c. Means of introducing fault (substitution of faulty part or simulation thereof)

The procuring activity or its authorized representative shall use the candidate tasks as a guide to determine a sample of 25 tasks for the demonstration.

4.21.2 Accept or reject criteria. Accept or reject criteria shall be as specified in 4.21.2.1.

4.21.2.1 Corrective maintenance. The accept or reject criteria for the demonstration of the corrective maintenance times for the organizational-intermediate level shall be as specified in TABLE X.

TABLE X. Acceptance criteria.

	MTTR	M_{maxct}
Acceptance level Sample size	10 25	0 25

Acceptance shall occur when the number of observed maintenance task times, which exceeds the required value of each specified index (MTTR, M_{maxct}), is less than or equal to that shown in TABLE X. The duration of each task shall be compared to the required value(s) and determined as greater than or lesser than each index. The actual value shall also be determined. Accept or reject criteria for preventive maintenance shall be the capability to perform each preventive maintenance task with no degradation of system performance. If degradation of system performance exists, the preventive test will result in a reject decision.

4.21.3 Technicians. The procuring activity reserves the right to provide and select the technicians to perform the maintainabilty demonstration.

4.21.4 Technical documentation. Technical documentation shall be limited to the technical manual and related maintenance documentation delivered with the equipment.

4.21.5 Rejection. Failure to conform to any of the maintainability 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
b. Upon approval of an accepted approach, the contractor shall repeat the demonstration until an accepted decision is reached.

4.21.6 Acceptance. The maintainabilty demonstration shall exhibit that the equipment conforms to the accepted criteria prior to delivery.

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

4.22.1 Rough handling test packaging. When rough handling test in accordance with MIL-P-116 is required by the contract (see 6.2.1), the electrical operation performance tests (see 4.18) shall be conducted to determine freedom from operational malfunction caused by rough handling.

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

in the prediction. The prediction shall also include mechanical parts

contract. Preparation for delivery requirements for products procured by contractors shall be specified in the indidividual 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 6.2.1).

6. NOTES

6.1 Intended use. The transceiver, covered by this specification, is intended for use as a point-to-point, net radio, or when connected to another transceiver, as a retransmission link under field operating conditions in the 30.000-MHz to 75.975-MHz frequency range. The transceiver is intended to be completely interoperable with SAVILLE equipments in the CT single-channel mode and interoperable with any FM voice equipments in the PT single-channel mode. It is intended to operate the transceiver in either backpack or vehicular applications. The vehicular adapter is intended to control vehicular antennas as well as provide the interfacing required between the transceiver and vehicular systems. The RF power amplifier is intended to amplify the low power output of the transceiver for medium or high power transmissions.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify:

a. Title, number, and date of this specification
b. Ancillary equipments required (see 1.1)
c. Marking and shipping of samples (see 3.5)
d. Environmental test requirements for ancillary equipments (see 3.10)
e. Number of first article samples to be submitted if other than specified in 4.3
f. Specify inspection requirements when conducting inspections covered by subsidiary documents (see 4.4)
g. When reinspected production control and environmental sample units may not be accepted (see 4.5.4)
h. When reinspected Group D sample units may not be accepted (see 4.5.5.2)
i. If a maintainability demonstration is required (see 4.21)
j. If the rough handling and functional tests are required (see 4.22.1)
k. Levels of preservation, packaging, packing, and marking required (see 5.1)

6.2.2 Data requirements. When this specification is used in an acquisition and data are required to be delivered, the data requirements identified below should be developed as specified by an approved Data Item Description (DID) (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List, incorporated into the contract. When the provisions of DoD Federal Acquisition Regulations Supplement, Part 27, Sub-Part 27.410-6

(DD Form 1423) are invoked and the DD Form 1423 is not used, the data specified below should be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification are cited in the following paragraphs:

Paragraph/ Section No.	Data requirement title	Applicable DID No.
4.	Test Procedure	UDI-T-22710B
4.	Test Report	DI-T-5247
4.2	Inspection and Test Report	DI-T-5329
4.3	First Article Qualification Test Plan	DI-T-5315A
4.5	Quality Status Report of Production	DI-T-5156C
4.5	Test Plan	DI-T-5204
4.6	Environmental Stress Screening Report	DI-RELI-80249
4.9	EMI Test Report	DI-EMCS-80201
4.9	EMI Test Plan	DI-EMCS-80200
4.11	TEMPEST Test Evaluation Report	DT-T-5108A
4.11	TEMPEST Test Facility Certification Report	DI-T-5181A
4.11	TEMPEST Detection System Certification Report	DI-T-5182A
4.11	TEMPEST Test Set Up Ambient Signal Control Certification Report	DI-T-5183A
4.11	TEMPEST Test Plan	DI-T-5140B
4.15	Reliability Test Procedures	DI-RELI-80251
4.15	Reliability Test Reports	DI-RELI-80252
4.15	Reliability Test Plan	DI-RELI-80250
4.15	Failed Item Analysis Report	DI-RELI-80253
4.15	Failure Summary and Analysis Report	DI-RELI-80255
4.15	Corrective Action Plan	DI-RELI-80254
4.21	Maintainability Demonstration Test Plan	DI-R-7112
4.21	Maintainability Demonstration Report	DI-R-7113

(DIDs related to this specification, and identified in Section 6 will be approved and listed as such in DoD 5000.19L., Vol. II, AMSDL. Copies of DIDs required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.3 First article. When a first article inspection is required, the items should be first production items. The first article should consist of a minimum of 25 units as specified in 4.3. 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 requirements 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 6.4.12.

6.4.1 Branching. Branching is a connected arrangement of hyphae formed by shoots or secondary stems growing from the main stem of filament hypha.

6.4.2 Growth colonization. Growth colonization is a mass of individual plants, generally of one species, living together; or a group of hyphae which is formed from one spore or cell and may be one individual plant. Colonization which completely covers the surface of the nutrient material constitutes abundant growth.

6.4.3 Microbial growth. Microbial growth is the growth of very minute organisms. Such organisms when present in large numbers may provide a colony visible to the naked eye.

6.4.4 Sporulation. Sporulation is the formation of minute unicellular reproductive or dormant bodies, called spores.

6.4.5 Tubular germination. Tubular germination is partial growth by the production of hyphae, which are tubular-shaped fungal filaments. Tubular germination constitutes restricted individual spore growth not proceeding to colonization.

6.4.6 Exfoliation. Exfoliation is corrosion along the grain boundaries of the metal resulting in the peeling or separating, or both, of successive layers of the metal. The appearance resembles loose book pages or onion skin peeling.

6.4.7 Memory battery. A battery is required to hold the fill and frequency information when the main batteries are removed in the backpack configuration or when vehicle power has been turned off. Provisions should be made to allow replacement of this battery without opening the equipment case. Information should not be lost if the memory battery is removed while the equipment is being powered by the main battery or vehicle power. Only batteries which have been assigned a National stock number should be used.

6.4.8 Main battery. The main battery can consist of up to two battery packs for the backpack configuration, one for the radio portion and one for the digital portion. Only batteries which have been assigned a National stock number should be used.

6.4.9 Equipment. Equipment shall be interpreted as a transceiver in the backpack configuration with battery box and a transceiver, vehicular adapter, power amplifier, and loudspeaker in a vehicular system configuration.

6.4.10 NDI. NDI is off-the-shelf commercially developed equipment which conforms to nearly all of the requirements of this specification and is being currently produced. NDI is also equipment that was previously developed at Government expense which conforms to nearly all of the requirements of this specification. In either case, the changes necessary to the equipment to be in compliance with this specification should be low risk and technically simple to achieve.

6.4.11 Vehicular system configuration. As used herein, vehicular system configuration is the transceiver, vehicular adapter, power amplifier, loudspeaker, mount, and associated cabling arranged to fit within the volume specified in 3.19.

6.4.12 Failure. A failure is defined as inability of the equipment to conform to any of the requirements of this specification.

6.5 Environmental inspection. Approval to ship may be withheld at the discretion of the Government, pending the decision from the contracting officer on the adequacy of corrective action (see 4.5.3.3).

6.6 Location of operational inspection and air-seal test. It is desirable that the operational test (see 4.18) and the air-seal test (see 4.7) be performed at a location that will minimize handling (which may cause damage to the equipment) after this inspection is completed. Any preparation for shipment which would require breaking of the equipment seal should be accomplished prior to the air-seal test so that the seal may remain intact thereafter. It is recommended that the entire lot (including all previously inspected sample units) be sampled and inspected immediately prior to packaging.

6.7 GFE and GFM. The contracting officer should arrange to furnish the GFE and GFM specified in 3.18.3.6 and 3.20.

6.8 Test parameters. The test parameters specified in Section 4 are for equipment designed to the specific criteria given in 6.8.1 through 6.8.9. Since the use of NDI equipments is encouraged in conformance to the requirements of this specification, and unless otherwise specified in the contract, the contractor may use alternate test parameters suitable for the proposed equipment. If the contractor elects to use alternate test parameters, it should provide amended test paragraphs as specified in 6.8.1 through 6.8.9 as part of the response to the Government solicitation.

6.8.1 First intermediate frequency (IF). The test in 4.16.1.4 specifies a first IF design of 11.5 MHz with an up-conversion technique for operating frequencies from 30.000 MHz to 52.975 MHz and a down-conversion technique from 53.000 MHz to 75.975 MHz. An alternate test for TABLE IX should cover the full operating frequency range for test frequencies from the first IF to 500.00 MHz. The operating frequencies tested should cover the skirts of the receiver bands for the harmonics of interest.

6.8.2 Receiver bands. The tests in 4.16.1.4, 4.16.1.5, 4.16.1.7, and 4.16.7 specify a receiver designed for passbands for the bandwidths specified in a through c:

a. 30.000 MHz to 40.975 MHz
b. 41.000 MHz to 55.975 MHz
c. 56.000 MHz to 75.975 MHz

An alternate test should cover the skirts of the receiver passbands for the indicated tests. It is recognized that overlap of passbands may exist; for this reason a contractor should test the skirts.

6.8.3 Transmitter bands. The test in 4.16.2.1 specifies a transmitter designed for passbands for the bandwidths specified in a through e:

a. 30.000 MHz to 33.975 MHz
b. 34.000 MHz to 39.975 MHz
c. 40.000 MHz to 47.975 MHz
d. 48.000 MHz to 58.975 MHz
e. 59.000 MHz to 75.975 MHz

An alternate test should cover the skirts of the transmitter passbands for the indicated tests as well as some mid band values. It is recognized that overlap of passbands may exist; for this reason a contractor should test the skirt.

6.8.4 Voltage limiting circuitry. The tests in 4.15.1i, 4.16.6.3, 4.18.2.1, and 4.18.2.2 specify a design that includes circuitry to turn off the unit when the input voltage drops below 20 VDC. The circuitry was included as a safety consideration when certain lithium batteries are used to provide main battery power. It is not mandatory to include the voltage limiting circuitry; however if not included, the contractor should test at 16 VDC in lieu of 20 VDC.

6.8.5 EMC parameters. The tests in 4.9 utilize test frequencies that are at the mid point of an operating frequency range of 30 MHz to 76 MHz and test frequencies based upon the skirts of the operating frequency range decreased (increased) by one fifth of the value of the first IF. If a contractor chooses either a different first IF or different operating frequency range, or both, it should provide alternate test parameters based upon the criteria specified herein.

6.8.6 Self-test. The test in 4.16.3.9 specifies a generic test of system self-test. The contractor should provide a listing of the unique self-test codes as part of the response to the Government solicitation.

6.8.7 Operating frequency range. The tests in 4.16.1.1, 4.16.1.4, 4.16.1.5, 4.16.1.6, 4.16.1.7, 4.16.1.9, 4.16.1.13, 4.16.2.1, 4.16.2.2, 4.16.2.3, 4.16.2.4, 4.16.2.5, 4.16.2.6, 4.16.2.7, 4.16.5.5, 4.16.6.1, 4.16.6.2, 4.16.6.3, and 4.16.7 specify testing for an operating frequency range of 30.000 MHz to 75.975 MHz. If the contractor elects to supply equipments with a greater operating frequency range it should provide test points in the extended frequency range to demonstrate compliance to the requirements specified herein.

6.8.8 Alert signals. The test in 4.16.3.3 specifies testing for alert signals that are 6 dB less than received audio with a fixed frequency for each alert and that are operative for the time periods specified in 3.18.3.3. If the contractor elects to supply equipment with different alert signal characteristics, it should specify the alert signal level, frequency, and duration. It is intended that an operator be alerted to the conditions specified in 3.18.3.3 using the current implementations in the NDI equipments.

6.8.9 Power output. The tests in 4.16.2.1, 4.16.4.1, 4.16.6.2, 4.16.6.3, and 4.18.2.1 specify a system with power level outputs of 2 W, 10 W, and 40 W. If the contractor elects to supply a system with different power level outputs, it should revise the paragraphs specified herein for the power levels it supplies.

6.9 Subject term (key word) listing.

AT-892( )/PRC, Tape Antenna
Battery Box, CY-7518( )/U
Cable, Special Purpose Electrical, CX-13016( )/U
CX-13016( )/U, Cable, Special Purpose Electrical
CY-7518( )/U, Battery Box
Handset, H-250( )/U
H-250( )/U, Handset
Intended use: point-to-point, net radio, or as a retransmission link under field operating conditions in the 30-MHz to 76-MHz frequency range
Tape Antenna, AT-892( )/PRC
Transceiver, Secure, And Ancillary Equipment

Preparing activity:
NAVY - EC

(Project No. 5820-N865(EC))