MILITARY SPECIFICATION

RADIO SET AN/ARC-94

This specification has been approved by the
Bureau of Naval Weapons, Department of the Navy

1. SCOPE

1.1 Scope:

The equipment covered by this specification shall provide facilities to effect two-way radio communications between aircraft and properly equipped surface stations or other aircraft. Transmission and reception shall be in the single sideband mode with or without carrier suppression and shall be accomplished on the same antenna. Simultaneous transmission and reception is not required. Power amplifier automatic tuning is required throughout the frequency range of the equipment.

1.2 Classification:

The equipment covered by this specification shall consist of the following items:

Item	Type Designation	Maximum Allowable Wt. Lbs	Appl. Paragraph
Receiver-Transmitter	RT-648/ARC-94	52	3.3.4.1
Control	C-3940/ARC-94	2	3.3.4.2
Mounting	MT-2641/ARC-94	5	3.3.4.3

2. APPLICABLE DOCUMENTS

2.1 General:

The following documents of the issue in effect on the date of invitation for bid form a part of this specification to the extent specified herein.

Specifications

Military
MIL-A-8625 Anodic Coatings, for Aluminum and Aluminum Alloys

MIL-R-23016(Wep)

2.1 (Continued)

MIL-B-5087	Bonding, Electrical, for Aircraft
MIL-C-25	Capacitors, Fixed, Paper Dielectric
MIL-C-172	Cases, Bases, Mountings, and Mounts: Vibration, for use with Electronic Equipment in Aircraft
MIL-C-5015	Connectors, Electrical
MIL-C-5541	Chemical Films for Aluminum and Aluminum Alloys
MIL-C-6781	Control Panel, Aircraft Equipment, Pack or Console Mounted
MIL-C-6796	Coatings, Protective for Wood
MIL-E-4682	Electronic Tubes and Transistors, Choice and Application of
MIL-F-14072	Finishes for Grounded Signal Equipment
MIL-I-6051	Interference Limits and Methods of Measurements, Electrical and Electronic Installations in Airborne Weapons Systems and Associated Equipment
MIL-J-641	Jacks, Telephone, General Specifications for
MIL-M-6	Voltmeters, DC, Panel Type Sealed and Unsealed, Flush Mounting, Round Flange
MIL-M-10304	Meters, Electrical, Indicating, Panel Type, Ruggedized
MIL-M-16034	Meters, Electrical, Indicating
MIL-N-18307	Nomenclature and Nameplates for Aeronautical Electronic and Associated Equipment
MIL-P-78	Plastic Material, Laminated, Thermosetting for Designation Plates
MIL-P-3115	Plastic Material, Laminated Thermosetting, Sheets, Paper-base, Phenolic-resin
MIL-R-105090	Resistors, Fixed, Film, High Stability
MIL-S-7742	Screw Threads; Standard
MIL-T-27	Transformers and Inductors, Audio, Power and Pulse
MIL-W-5088	Wiring, Aircraft, Installation of
MIL-T-9107	Test Reports, Preparation of
QQ-P-416	Plating, Cadmium, Electrodeposited
QQ-Z-325	Zinc Coating, Electrodeposited, Requirements for
QQ-S-571	Solder, Lead Alloy, Tin Lead Alloy and Tin Alloy, Flux Cored Ribbon, and Wire, and Solder Form
SAR-300	Material Changes and Material Bulletins, Reparation of

2.1 (Continued)

Standards

Military

MIL-STD-16	Electrical and Electronic Reference Designations
MIL-STD-122	Color Code for Chassis Wiring for Electronic Equipment
MIL-STD-130	Identification Markings of U.S. Military Property
MIL-STD-192	Alloy Designation System for Wrought Aluminum
MIL-STD-202	Test Methods for Electronic Components Parts
MIL-STD-280	Definitions of Terms for Equipment Division
MIL-STD-704	Electric Power, Aircraft, Characteristics and Utilization of

Federal

Federal STD-595	Colors, with Information Notice
Federal Test Method Standard No. 151, Metals, Test Methods	

Bulletin

ANA Bulletin No. 400 Aircraft Equipment; Aircraft and Guided Missiles

ANA Bulletin No. 157 Colors; List of Standard, Aircraft Camauflague

Standard

AN565 Set Screws - Hexogan and Fluted Socket, Headless

JAN-I-10	Insulating, Material, Ceramic, Radio Class L
JAN-S-28	Sockets, Electron Tube, and Accessories

2.2 Availability of Documents:

(1) When requesting specifications, standards, drawings, and publications, refer to both title and number. Copies of this specification and applicable specifications required by contractor in connection with specific procurement functions My be obtained upon application to the commanding officer, Naval Supply Depot, Code CDS, 5801 Tabor Avenue, Philadelphia 20, Pennsylvania.

MIL-R-23016(Wep)

3. REQUIREMENTS

3.1 Materials, Parts and Processes:

Materials, parts and processes shall conform to applicable specifications as specified in ANA Bulletin No. 400, except as specified herein. Materials and parts which are not covered by applicable specifications shall be of the best commmercial quality, of the lightest practicable weight, entirely suitable for the purpose, and readily available. However, only nonflammable materials shall be used in the construction of the equipment.

3.1.1 Definitions:

For definition of terms used in this specification, see 6.7.

3.1.1.1 Selection of Parts and Materials:

Parts and material as approved in the pre-production model shall be identical in all models delivered under a given contract unless deviation within models delivered are specifically authorized by the contracting officer.

ANA Bulletin No. 400 lists the specifications, standards, drawings, and publications to be used in the design and construction of the equipment. The use of some of the specifications and publication is clarified or modified in this specification; others are to be used as listed. Parts, materials, and processes covered by the specifications and publications listed in ANA Bulletin No. 400 shall be considered as standard parts and shall be used whenever they are suitable for the purpose. In determining whether or not they are suitable for the purpose, the following points shall be taken into consideration:

(a) The space and weight limitations placed upon the equipment.

(b) The interchangeability of the parts with those in a model or in the drawings furnished on the contract for interchangeability purposes.

(c) The parts, materials, or processes selected must be of sufficient quality to allow the equipment to meet the performance and environmental requirements.

3.1.1.2 Approval of Non-standard Parts and Materials:

Except for metals and non-electrical hardware items used for mechanical applications, but net excepting non-standard vibration or shockmounts and vibration isolators, any part which is not covered by a specification listed in ANA Bulletin No. 400 is considered non-standard.

Data for non-standard parts shall be submitted in accordance with the requirements of this specification. When properly submitted in accordance with this specification during the first production contract for this equipment, such submission shall constitute approval of use of said non-standard parts within the limitations of paragraph 3.1.1.1 herein. The government reserves the right to obtain clarification of any non-standard part data sheet, but such clarification shall not constitute disapproval of the part unless so stipulated by the contracting officer. Such automatic approval of non-standard parts does not apply to reordered equipment. Non-standard parts for reordered equipment must be approved prior to use.

For non-standard and non-preferred electron tubes, transistors, and diodes, the electron tube compliment report outlined in Specification MIL-E-4682 shall, when submitted, constitute the non-standard part data submission or request as appropriate. Examples of non-standard data which must be submitted include the following:

(a) Parts and materials not covered by a specification in ANA Bulletin No. 400.

(b) Parts and materials covered by specifications which require qualification in ANA Bulletin No. 400 for which no approved products are listed in Military Qualified Products Lists or ANA bulletins.

(c) Parts and materials used as substitutes for standard parts.

(d) Parts and materials which are considered to be “state of the art” improvements over standard parts.

3.1.1.2.1 Reordered Production Equipment:

In the event a model or drawings of an equipment are furnished on a contract for interchangeability purposes, and the requirements for part interchangeability of the new equipment with the model contradict the requirements of one or more specifications listed in ANA Bulletin No. 400, the requirements for interchangeability shall govern. In the event a standard part (as listed in ANA Bulletin No. 400) cannot be found which will replace a non-standard part used in the model or drawings furnished for interchangeability purposes, the original part, as used in the model or drawings, may be used without additional approval by the procuring activity.

3.1.1.2.1.1 Tubes utilized in reordered production equipment shall be identical to the tubes listed in the electron tube compliment report previously admitted in accordance with MIL-E-4682.

3.1.1.2.2 Time Schedule of Approval Requests:

The submission or request for approval of non-standard parts and materials as appropriate shall be made before delivery of items against the contract.

3.1.1.2.3 Data to be Submitted with Non-Standard Part and Material Requests:

The data to be submitted with non-standard parts and material requests shall be as outlined in Figures 1 and 2.

3.1.1.2.4 Samples Required for Past and Material Approvals:

Samples of non-standard parts may be required by the procuring activity. These samples shall be submitted in quantities and to the destination specified by the procuring activity for tests and examination. Sample quantities to be specified will not exceed 1 pound of any lubricant, 12 fuses, and 6 units of any other part. Sample parts and materials may be tested to destruction by the procuring activity and will not be returned to the contractor. When there is more than one supplier for a part, parts from each supplier shall be considered for separate submission.

3.1.1.3 Unauthorized Use of Government Designations:

Parts which require qualification approval but have not received such approval shall not be identified by MIL-type numbers or AN-part numbers.

3.1.1.4 Choice of Parts and Materials

Whenever an applicable electronic standard specification provides more than one characteristic or tolerance for an item, the equipment manufacturer shall select and use in the equipment items of broadest characteristics and of the greatest allowable electrical tolerances that will fulfill the performance requirements of the equipment. However, delays in the development or production of the equipment shall not be allowed to arise by the application of this requirement when acceptable items of higher than minimum quality are readily available, the utilization of which would lessen the obvious waste of materials and production facilities. When maximum physical dimensions of an item are indicated in the applicable specification for the item, all new equipment shall be designed to accommodate the maximum physical size specified, in order that all parts having the same type designation will be physically interchangeable in the equipment.

NON–STANDARD PART DATA SHEET

1. Part is used in _____ (Type designation of major assembly.)
2. Circuit reference symbol(s) _____ (List all applications.)
3. Prime contractor _____ 4. Contract No. _____
5. Description of part: (Same as on production list.)
6. Prime contractor's Drawing No. _____ 7. Part No. _____
8. Actual manufacturer _____ 9. Part or dwg. _____
10. Previously approved to _____ for use in _____ on contract _____
11. Comparison between non-standard part and standard part whose characteristics are nearest to those required for the application: (Include reasons for not using standard part.)
12. Test data and comments: (Test data sheets and comments may be attached as necessary.)

As the designated representative of the contractor I certify that to the best of my knowledge the above information and data are correct and the non-standard part for which approval is requested is suitable for its intended use.

13. Engineer's signature _____ 14. Date _____

These data are _____ acceptable to the Government.

Engineer's signature _____ Date _____

FIGURE 1. Sample Non-Standard Part Data Sheet

DATA TO BE SUBMITTED WITH APPROVAL REQUESTS

Type of Data	Description	Required by
Request letter:	In a single request the contractor may include from one part to the entire parts compliment. Each submission must be accompanied by a request letter which lists the parts by name and part number.	Department of the Air Force Bureau of Aeronautics
Contractor's requisition or fabrication drawings:*	Two copies of the drawing used by the contractor to procure or fabricates the part or material must accompany the request.	Department of Air Force Bureau of Aeronautics
Non-standard part data sheet (Figure 1):	Three copies of the form shown as Figure 1 must be completed and enclosed with the request. At the discretion of the procuring activity, this form will be signed by the procuring activity and returned as an indication that the Government agrees with the material contained thereon.	Department of the Air Force
Test data:	After receipt of the request for non-standard part or materials approval, the procuring activity will advise the contractor of those parts and materials for which test data must be supplied by the contractor or his vendor. The test data requested shall indicate that the part or material will perform electrically in the equipment in which it is to be used, and will perform in the environment in which it will be used in the equipment.	

* NOTE: Drawings or specifications used by contracts for the purchase of a part must include, where applicable, electrical, enviromental, dimensional, performance, reliability, and test requirements, and when possible, differences from similar standard parts. Extensive use of other Military specifications and standards such as Standard MIL-STD-202, as reference documents is recommended.

FIGURE 2. Required Data to be Submitted with Approval Requests

3.1.1.5 Replaceability by Electronic Standard Parts and Materials:

Whenever permission is granted by the procuring activity for a contractor to use items not in accordance with electronic standard specifications for which approved products exist, only because of non-availability of electronic standard items, and whenever the items used are replaceable by electronic standard items, the contractor shall arrange the equipment to permit replacement in the field of the non-standard by the standard items. Mounting space and mounting holes shall be provided when required, and such other provisions shall be made as may be necessary. Whom such provisions for replacement is being made, the contractor shall inform the procuring activity of the type designation, nominal electrical value, or rating and tolerance of the electronic standard item for which the non-standard item is being substituted.

3.1.1.6 Equipment Performance:

Final approval of non-standard parts, materials and processes shall be contingent on subsequent satisfactory performance during preproduction and acceptance tests end other required equipment tests.

3.1.1.7 Preliminary List of Electronic Parts:

Five copies of a preliminary list of electronic parts, and the complete schematic wiring diagram, shall be furnished directly to the procuring activity as soon as practicable but by all means in advance of the submission of service test or preproduction model, or as specified in the contract, in order that the procuring activity may review the list of parts to be used in the equipment. The parts shall be adequately identified and arranged in accordance with Figure 3. The list shall be sectionalized according to the individual major and minor assemblies.

RADIO SET AN/XYZ		PRELIMINARY LIST OF ELECTRONIC PARTS		
Item No.	Reference Designation	Description Technical Information	MIL-type No. or AN P/N	Mfgr. P/N
1	C-101 through C-105	Capacitor, fixed: mica	CM25D241J	
2	C291-A, -B	Capacitor, fixed: paper		
3	R-108	(3.5-A) Resistor, fixed: composition or	RC20AE222M	
	R-109	(3.5-B) Resistor, fixed: composition	RC21AE222M	
4	R-103 (used in 527-A only)	Resistor, fixed: composition	RC1BE103K	
5	V-101	Tube, electron: 28D7	JAN-28D7	

Contract or Order No. _____

FIGURE 3. Sample Preliminary List of Electronic Parts

.1.2 Aluminum Antiseize Compound:

Aluminum antiseize compound shall be used on all threaded aluminum-alloy assemblies, except those involving machine screws or self-tapping screws.

.1.3 Capacitor:

.1.3.1 Air Dielectric Capacitors:

Nominal spacing between opposing plates shall be not less than 0.012 inch and actual spacing not less than 0.008 inch, unless a smaller nominal spacing is specifically approved by the procuring activity. Where nominal spacing less than 0.012 inch has been approved, the capacitors shall be enlosed in a dustproof case. Plates of all air dielectric capacitors shall be free from grease, dust, dirt and metallic burrs. Grease and other foreign matter shall be removed from the plates by cleaning the assembled capacitor thoroughly with a non-corrosive solvent which will not impair the proper functioning of the equipment. Rotors shall make low-resistance contact with connectors. All capacitors, as installed in the equipment, shall be able to withstand without breakdown at least 500 volts rms, 60 cycles, between opposing plates. For variable capacitors, this shall hold for any relative positions of rotor and stator plates.

.1.3.2 Electrolytic Capacitors:

The use of electrolytic capacitors is governed by the non-standard-parts approval procedures given in 3.1.1.2.

.1.3.3 Fixed Paper Dielectric Capacitors:

Paper capacitors of characteristic D in accordance with specification MIL-C-25 shall not be used. Molded paper capacitors shall not be used.

.l.3.4 Spring Plate-Type Variable Capacitors:

Spring plate-type variable capacitors shall not be used.

3.1.3.5 Mounting of Fixed Capacitors:

Fixed capacitors shall be securely mounted. They shall not be mounted by means of wire leads unless other mechanical support is provided for the body of the capacitor, except that capacitors whose weight does not exceed 1/2 ounce may be secured by only their leads if the total length of both leads from a capacitor to the terminals to which the leads are secured does not exceed 1 inch. In no case shall the tire leads be less than 1/8 inch for capacitors with axial leads.

3.1.4 Castings:

In the design of castings, consideration shall be given to the intended application, the availability of molding and casting alloys, and to the choice of a suitable casting process. If required by 3.1.11, castings, whether impregnated or not, shall be given conditioning treatments, and shall be processed to withstand corrosion.

3.1.5 Connectors:

3.1.5.1 Connectors for Voltmeter or Millimeter Measurements:

Connectors for voltmeter or millimeter measurements shall accommodate a test prod having a diameter of 0.078 ± 0.002 inch and a maximum length of 7/16 inch.

3.1.5.2 Connector Wiring:

Pins shall be wired according to the following precedence:

(a) To reduce to satisfactory level, input to output coupling.

(b) To reduce to satisfactory level, noise coupling.

(c) To hold voltage gradient below service ratings of the applicable cable connector specification.

3.1.5.3 Extra Contacts In Connectors:

The following requirements are applicable to all articles of equipment, except those such as dynamotors, inverters, indicating

3.1.5.3 (Continued)

instruments (meters), encapsulated assemblies, and the like, in which it is extremely unlikely that additional circuits will be required:

(a) Extra unused connector contacts for external circuits of the total specified below shall be available for future use by the procuring activity.

(b) The minimum quantity of extra unused contacts shall be as follows. Approval of the procuring activity hall be obtained if this requirement necessitates an additional connector.

Total No. of Connector Pins in Major Assembly	Extra Contacts
Up to 25	2
26 to 100	4
101 or over	6

(c) Size of extra contacts shall be compatible with other sizes of contacts within the connector.

(d) Each unused contact of the quantity specified herein shall be rated at service A or higher voltage, as specified in Specification MIL-C-5015.

(e) Each connector shall provide sufficient pins for the grounding of shields.

3.1.5.4 Special Contacts and Connectors:

All connectors used in conjunction with thermocouples shall be markd by a securely fastened nameplate indicating the type of pin metal, i.e. for chromel-alumel temperature sensing, nameplate should read CR-AL. Each pin of the connector shall be designated as to the type of metal by suitable markings on the face of the connector.

3.1.5.5 Moisture and Fungus Resistant Treatment of Power and Miscellaneous Connectors:

3.1.5.5.1 Connectors, Wired In:

Plugs and receptacles furnished as integral wired-in parts of articles of equipment shall be processed as follows:

(8) Means shall be provided to lengthen creepage distances, to spread the area of flexure of connector wires, and to move the flexure away from the terminals, such as a piece of moisture- and fungus-resistant plastic, or glass braid tubing, or equal, placed over each wire. The tubing shall be long enough to cover completely the terminal and at least 1/2 inch of insulation of the wire which is attached to it. The tubing shall either fit tightly enough over the terminal or be tied securely enough that it will not slide off. If bare wire is used, the tubing shall be long enough to extend at least 1/4 inch beyond the terminal.

3.1.6 Controls:

Controls shall be readily accessible, suitably arranged, and of such size and construction to permit convenience and ease of operation under all service conditions even when gloves are worn by the operator. The controlled characteristics (such as sensitivity, volume, and voltage) shall increase with clockwise rotation of the control as seen from the operating position. The setting, position, or adjustment of the controls shall not be affected by vibration, shock, or other service conditions. All controls shall operate freely, smoothly, and easily without excessive binding play, or backlash. Controls shall be designed to permit lubrication where necessary. Switches, levers, and other controls which are manipulated during operation of the equipment shall be of such rugged design and construction that they will not be damaged when repeatedly operated by unskilled personnel under the specified service conditions. When stops are used, they shall be sufficiently rugged to prevent damage to the mechanism.

3.1.6.1 Knobs and Handles:

Knobs and handles shall have high-impact strength and shall be firmly attached to the shaft by 1 socket-head set screw bearing on the flatted surface or 2 socket-head set screws at right angles or 120° to each other. Plastic knobs hsall have metal inserts for the set screws.

3.1.6.2 Tuning Dials:

The divisions and lettering on tuning dials shall be suitably etched or printed with characters large enough to read under normal conditions or eyesight and lighting at a distance of 2 feet anywhere within a solid angle of 60° (any point 2 feet from the dial and within an angle of 30° from a line through the center of the dial and perpendicular to the panel on which the dial is mounted). Weighted tuning knobs shall be counterbalanced. The mechanism shall be such that the tuning knob will stay fixed in any position and for all angular positions of the dial and dial mechanism. All tuning controls shall be insulated from the high-voltage circuits.

3.1.6.3 Non-turning Devices:

All controls shall be equipped with a device to prevent their turning on the panel to which they are mounted.

3.1.6.4 Console Control Panels:

Console control panels shall meet the requirements of Specification MIL-C-6781, except as stated herein.

3.1.6.4.1 Outline Dimension and Control Configuration:

The outline and mounting dimensions and location of the panel controls shall conform to the requirements of Figure 4. The frequency control knobs shall increase frequency with clockwise rotation of each control.

3.1.6.4.2 Control Panel Wiring:

The pin assignment for the control panel connector plug shall conform to the requirements of Figure 5.

3.1.7 Corrosion Resistance:

Materials shall be of corrosion-resistant types, or shall be suitably processed to resist corrosion.

3.1.7.1 Gold, nickel, chromium, rhodium, corrosion-resistant steel (12 percent or more chromium), tin, lead-tin alloys or sufficiently thick platings of these metals are satisfactory without additional protection or treatment other than buffing or cleaning. Aluminum, magnesium, brass, iron, steel; cadmium, and zinc, in general, require additional protection in accordance with 3.1.11.

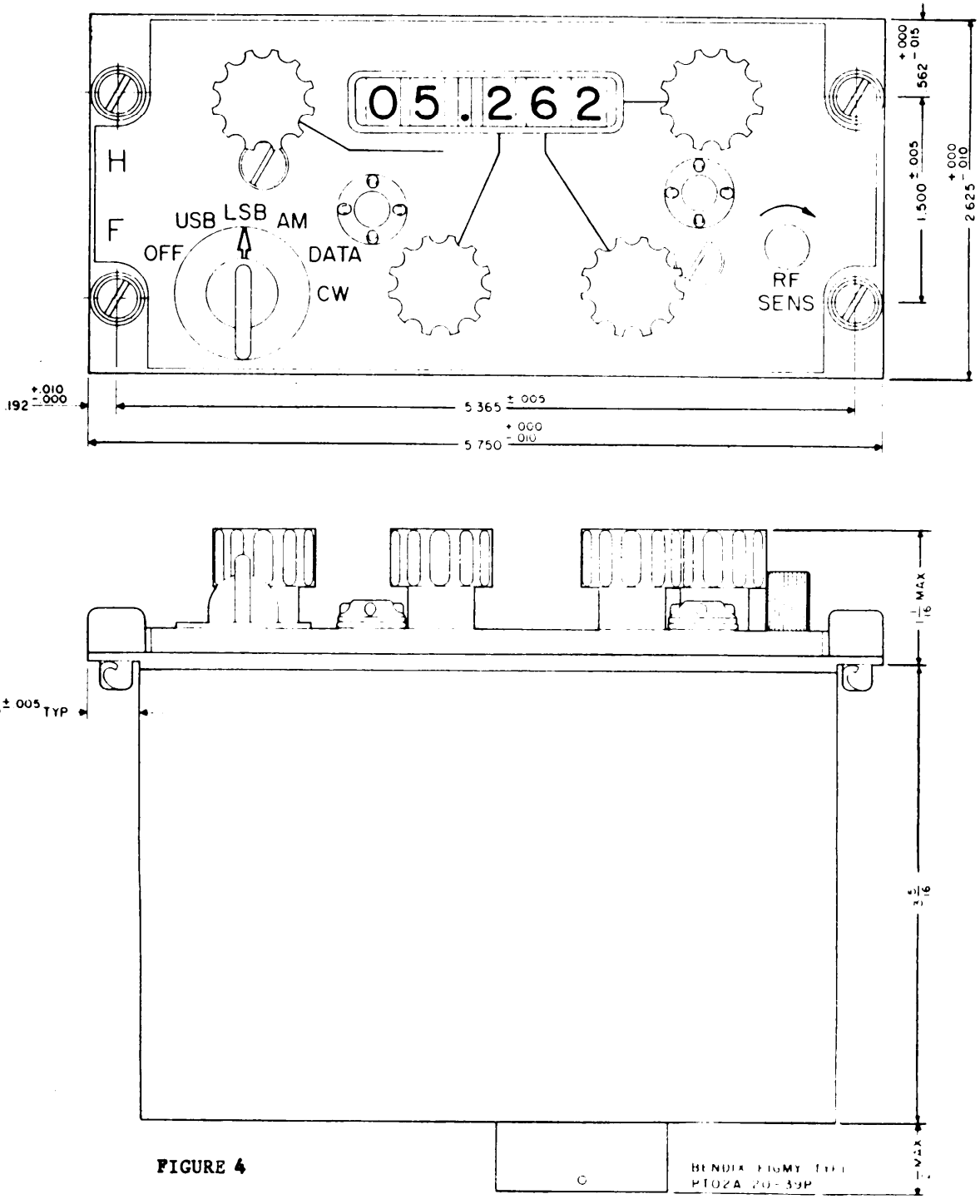


FIGURE 4

Function	Pin Letter	Function	Pin Letter
	J1		J1
GROUND	r		J
BAND INFO X	f	1 KC FREQUENCY CONTROL	H
BAND INFO Z	h		G
BAND INFO Y	g		F
	A	POWER ON - SSB	U
	B	RESERVED	a
MC FREQUENCY CONTROL	c	RESERVED	c
	D	RESERVED	b
	E	RF SENSITIVITY	Z
PANEL LIGHT SOURCE	d	SB SELECTOR/LINE B	i
PANEL LIGHT SOURCE	e	LINE A	j
	N	DATA ON	n
100 KC FREQUENCY CONTROL	M	AM RELAY	V
	L	AIRCRAFT KEY LINE	m
	K	UNIT CW KEY LINE	P
	T	AIRCRAFT CW KEY LINE	k
10 KC FREQUENCY CONTROL	S	UNIT KEY LINE	q
	R		
	P		
	W		
RESERVED	x		
	Y		

(BENDIX PIGMY TYPE PTO2A-20-39P0

PIN ASSIGNMENT OF CONTROL UNIT

FIGURE 5

3.1.8 Dissimilar Metals:

Dissimilar metals shall not be used in intimate contact unless suitably protected against electrolytic corrosion. When it is necessary that any combination of such dissimilar metals be assembled, an interposing material compatible to each shall be used. Dissimilar metals are defined in Table 1.

TABLE I

Grouping of Metals

GROUP I	GROUP II	GROUP III	GROUP IV
Magnesium alloys Most anodic	Aluminum Aluminum alloys Zinc Cadmium Tin Stainless Steel	Zinc Cadmium Steel Lead Tin Stainless Steel Nickel and its alloys	Copper and its alloys Nickel and its alloys Chromium Stainless Gold Silver Most cathodic

(a) Contact between a member of any one group and another member of the same group shall be considered as similar. Contact between a member of one group and a member of any other group shall be considered as dissimilar, except for zinc, tin, and cadmium, as listed in groups II and III, and for stainless steel as listed in groups II, III, and IV.

(b) Unless specifically approved by the procuring activity, all other metals shall be considered dissimilar with respect to each other and with respect to any of the materials listed in Table 1.

(c) The above grouping is intended to serve as a guide in selecting materials to be used in electronic equipment, and shall not be construed to waive requirements herein or in the detail specification pertaining to corrosion resistance of components and assemblies. In particular, care shall be exercised in using aluminum alloys against each other or against differing materials.

3.1.8 (Continued)

(d) Where reference is made to a metal in a particular group, the reference applies to the metal on the surface of the part; that is, zinc means zinc castings, as well as zinc electroplate, zinc hot dip, or zinc metal spray.

(e) Different metals in contact, even though similar, shall be employed in assemblies in such manner that the smaller part is cathodic or protected and the larger part is anodic or corroded, if any corrosion takes place.

(f) Certain qualified standard or approved non-standard parts and attaching hardware and tube sockets have tin or nickel-plate finish. These parts may be mounted on a chassis without additional protection from corrosion.

3.1.8.1 Protection Against Electrolytic Corrosion:

Where it is necessary that any combination of dissimilar metals be assembled the following methods or combinations of methods shall be employed for the alleviation of electrolytic corrosion, unless electrical considerations preclude the employment of such methods.

(a) Interposition of a material compatible to each to decrease electrolytic potential differences such as cadmium or zinc plate on steel in contact with aluminum.

(b) Interposition of an inert material between the dissimilar metals to act as a mechanical and insulating barrier, including potting or lubricating material.

(c) Application of organic coatings to the contact faces of each of the dissimilar metals, such as paint coats on steel and aluminum surfaces in contact.

(d) Application of corrosion inhibitors to the faces of the dissimilar metals, such as zinc-chromate paste on nickel-plated brass screws in contact with aluminum.

(e) Design of dissimilar metal or similar metal contacts, in order that the area of the cathodic metal is relatively smaller than the area of the anodic metal, such as screws of stainless steel or nickel-plated brass in contact with aluminum.

3.1.8.1 (Continued)

(f) Limitation of amount of aeration reaching the dissimilar metal faces, such as steel bolts in aluminum with all surfaces of contact sealed with zinc-chromate primer, vinyl films, sealing in dry gas or air, or equivalent.

(g) Any other systems of protection which are designed to alleviate electrolytic corrosion shall be subject to the approval of the procuring activity.

3.1.9 Electrical Tape:

Fabric or textile, pressure-sensitive (adhesive or friction) tape shall not be used, except as specified herein. Non-moisture-absorbing tape may be used for mechanical purposes or when included in hermetically sealed assemblies.

3.1.10 Fasteners, Snap Slides. and Studs:

Fasteners, snap slides, and studs shall be designed to fasten easily and hold firmly and positively the movable or separate part to its mounting or other supporting structure under all service conditions. The designs shall be such as to permit quick and easy fastening and unfastening without requiring the use of any spatial tools. If snap slides and studs are used, they shall conform to the requirements of Standard AN3195, AN3196, AN3197, AN3198, AN3199, or AND10082.

3.1.11 Finishes:

Parts, including hardware item of the equipment not covered by subsidiary specifications unless contained in hermetically sealed units, shall be resistant to corrosion and there shall be no destructive corrosion, after subjection to a 48-hour salt spray test in accordance with Federal Test Method Standard No. 151. Parts which are lubricated in equipment may be tested in a lubricated condition. Destructive corrosion shall be construed as being any type of corrosion which in any way interfere with mechanical or electrical performance. Lusterless finishes shall be used in all surfaces visible to operating personnel. Where cleaning operations on metal parts are not specified in detail, they shall be in accordance with commercial practices which will not cause subsequent destructive corrosion. It is not the intent that parts procured to the specifications listed in ANA Bulletin No. 400 must be refinished.

3.1.11.1 Aluminum Alloy:

3.1.11.1.1 Surface, General:

Parts fabricated from aluminum 1100, alloys 3003, 5052, 6053, 6061, 6063, 7072 (Standard MIL-STD-192) shall be cleaned with a cleaning solution such as caustic dip, and may be used with or without other surface treatment. Other aluminum alloys shall be anodized in accordance with Specification MIL-A-8625 or be given a chemical treatment in accordance with Specification MIL-C-5541.

3.1.11.1.2 Surfaces, Bonded and Grounded:

Where bonding or grounding is not necessary, aluminum 1100, alloys 3003, 5052, 6053, 6061, 6063, 7072, or equally corrosion-resistant alloys, shall be used. They may be used without other surface treatment.

3.1.11.1.3 Aluminum Surfaces, Extreme Wear Resistant:

Where bonding or grounding is not necessary, hard anodic finishes conforming to numbers E514, E515, or E516 of Specification MIL-F-14072 may be applied to obtain extreme wear resistant surfaces under type II exposure on desired areas of aluminum alloys not subject to repeated high tensile stresses.

3.1.11.2 Cadmium-Plated Parts:

Cadmium plating shall be in accordance with requirements in Specification QQ-P-416 for type II, class 2 plating, with the following exceptions:

(a) Bolts, studs, washers, nuts, and articles with portions extremely threaded: These parts shall have a minimum of class 3 thickness.

(b) Parts whose dimensional tolerances will not permit a class 2 thickness shall be given the maximum thickness of plating compatible with dimensional tolerances.

(c) Holes, recesses, internal threads, and other areas where a controlled deposit cannot be normally obtained shall not be subject to a thickness requirement.

3.1.11.2 (Continued)

(d) Corrosion-resistant, internal-threaded inserts or protective antiseize compounds on internal threads shall be used where necessary in cadmium-plated parts.

3.1.11.2.1 Color of Type II Treated Parts:

The use of clear or bleached chromates is prohibited. Unless otherwise specified, colored chromates as they normally occur in processing are desired. Olive drab or black is acceptable when specified.

3.1.11.3 Cases and Front Panels:

Equipment installed in the cockpit area shall be lusterless black, color number 27038 in accordance with Standard FED-STD-595, or black wrinkle finish. Equipment to be viewed in dark adaptation areas shall be lusterless black finish as above. Finish of all other equipment shall be color number 36231, in accordance with Standard FED-STD-595 (formerly specified as dark gull gray of ANA Bulletin No. 157).

3.1.11.4 Fasteners and Assembly Screws:

External fasteners and assembly screws which are manipulated, loosened, or removed in normal processes of installing and servicing the equipment shall be of such color as to provide strong contrast with the color of the surface upon which they appear. The contrasting colors may be applied at assembly as required. Other external fasteners and assembly screws shall be similar in color to the surface upon which they appear.

3.1.11.5 Ferrous Alloys:

Corrosion-resistant ferrous alloys shall be given a passivation treatment but need not receive any other protective plating or finish, unless such plating or finish is necessary or desirable for electrical or mechanical reasons. Straight chromium stainless steels shall not be required to receive passivation treatment if corrosion-resistant requirements are met. Ordinary iron and steel shall be plated or finished in accordance with the applicable specification listed in ANA Bulletin No. 400. The iron or steel laminations used in magnetic circuits need not be plated or given a protective finish if they are otherwise protected against corrosion.

3.1.11.6 Heat Dissipation:

When heat dissipation is a design factor, consideration shall be given to the use of finishes providing the best rates of heat transfer.

3.1.11.7 Internal Parts:

Black or gray paint, or ename1, or clear lacquer may be used on internal parts and interior surfaces or housings.

3.1.11.8 Magnesium and Magnesium Alloys:

Magnesium and magnesium alloys shall be finished in accordance with Specification MIL-M-3171.

3.1.11.9 Zinc and Zinc-Plated Parts:

Zinc parts and zinc-plated parts shall be given a dichromate treatment in accordance with Specification QQ-Z-325.

3.1.11.10 Other Standard Finishes:

Type I finishes in accordance with Specification MIL-F-14072 are approved as alternates to any differing requirements specified under the paragraphs on finishes, except that colors specified shall be used.

3.1.12 Fungus-Inert Materials:

Materials which are not nutrients for fungus shall be used to the greatest extent practicable.

3.1.12.1 The following types of materials shall not be used, except as specified herein:

Cotton	Leather
Linen	Paper and cardboard
Cellulose nitrate	Cork
Regenerated cellulose	Hair and felts
Wood	

3.1.12.1 (Continued)

This shall not preclude the use of the above materials in hermetically sealed assemblies, and other accepted proven and qualified products. If it is necessary to use these materials in other than heretically sealed assemblies, paper capacitors, treated transformers, and other approved products, they shall be treated in accordance with the applicable paragraphs of this specification, and their use shall be subject to the approval of the procuring activity.

3.1.12.2 The following types of materials are generally considered non-nutrients, and shall be used in preference to any of those listed in the preceding paragraph:

(a) Metals
(b) Ceramics
(c) Mica
(d) Glass
(e) Nylon
(f) Orion
(g) Saran
(h) Polyethylene
(i) Teflon
(j) Kel-F
(k) Natural rubber, compounded
(m) Synthetic rubbers:
  (1) Neoprene
  (2) Buna N
  (3) Buna S
  (4) Silicone
  (5) Butyl
  (6) Thiokol
(n) Plastics without fillers or laminates with glass, nylon, mica, or asbestos fillers:
  (1) Melamine-formaldehyde
  (2) Polymethyl methacrylate
  (3) Urea-formaldehyde
  (4) Phenol-formaldehyde
  (5) Silicone resin
(o) Chemically altered cotton:
  (1) 12.6 ± 0.4 percent acetylated cotton
(p) Polyvinyl chloride (fungus-resistant grades only)
(q) Epoxy resin (fungus-resistant grades only)

3.1.13 Fuse Posts (Panel-Mounting Type):

All panel-mounted fuse holders shall be of the extractor fuse-post type, and shall be finger operative under all conditions of service and test referenced herein. The insulating cap of the fuse post shall have a hole permitting the insertion of a test prod, 0.078 to 0.002 inch in diameter and having a maximum length of 7/16 inch for contact with the metallic frame holding one end of the fuse. Particular attention shall be given to the selection of a material which will not swell and bind under service and test condition. Connections to fuse posts shall be such that the metal structure which terminated the test prod hole in the cap is connected to the load side of the fuse.

3.1.14 Inductors (RF):

3.1.14.1 Flammable Material:

Flammable material shall not be used in the construction of r-f chokes, coils, and transformers.

3.1.14.2 Impregnation:

Impregnation of all multilayer windings is required and also of any single-layer windings on laminated phenolic forms or on forms of any other material not grooved to hold the wire. This impregnation shall be evenly applied.

3.1.14.3 Stability of "Q":

The design of a coil shall be such that the "Q" of the coil within the operating frequency range shall be that required by the equipment after immersion in a saturated solution of sodium chloride at 20°C for a period of 24 hours, followed by a rinse with tap water and drying for 1 hour in an atmosphere of 50°C and a relative humidity of 30 percent.

3.1.14.4 Dielectric Strength:

Inductors shall withstand a 1-minute application of a-c voltage between windings and between each winding and ground, all neighboring metal parts being grounded. The test voltage shall

3.1.14.4 (Continued)

have a frequency not greater than 100 cps and an rms value equal to 3 times the value of the maximum peak operating voltage between any two windings or between any winding and neighboring metal parts or ground. When the maximum peak operating voltage is greater than 700 volts, the rms value of the test voltage shall be 1,050 volts greater than 1.5 times the maximum peak operating voltage.

3.1.14.5 Variable Inductors:

When a roller or slider is used in contact with the conductor of variable inductors, suitable provision shall be made to limit the travel of the roller or slider to prevent its leaving the conductor.

3.1.15 Insulators, Insulating, and Dielectric Materials:

3.1.15.1 General:

When ceramic parts are used for electrical insulation, all surfaces shall be glazed, or if glazing is impracticable, the surfaces shall be sealed and moistureproofed. Ceramic parts shall not be treated with wax.

3.1.15.2 Terminal Strips and Boards:

Terminal strips and boards shall be fabricated from a satisfactory low-moisture-absorption, fungus-resistant material.

3.1.15.3 Impregnating and Potting Compounds:

A compound shall not, either in the state of its original application or as the result of aging, have any injurious effect upon the insulation which it is designed to protect, and shall net cause corrosion or deterioration of any adjacent parts. The compound shall not crack or flow in the temperature range of -65°C and +105°C, unless contained in such manner that the compound will not flow from the container.

3.1.15.3.1 A suitable impregnating material shall be a material which, when applied with applicable methods, does not cause any deterioration in the properties of the material being impregnated or of any adjacent parts, both initially and after aging.

3.1.15.3.2 A varnish is suitable for impregnating materials if the properties of the impregnated material meet the performance requirements of applicable specifications.

3.1.15.4 Laminated-Thermosetting-Plastic Materials:

3.1.15.4.1 When used for electrical insulation, parts fabricated from laminated-thermosetting-plastic sheets, plates, rods, and tubes (except transparent plastics) shall be impregnated with a suitable varnish and dried after all machining and punching operations have been completed. Materials having moisture absorption of 1.04 percent, or less, and those used in hermetically sealed assemblies shall not require impregnation.

3.1.15.4.2 Laminated-thermosetting-plastic materials for name, instruction, graphic chart, and designating plates shall be in accordance with Specification MIL-P-78.

3.1.15.5 Cast Thermosetting-Plastic Materials:

When used for electrical insulation, parts fabricated from cast thermosetting-plastic material shall be impregnated with a suitable varnish and dried after all machining and punching operations have been completed. Materials having moisture absorption of 1.04 percent, or less, and those used in hermetically sealed assemblies shall not require impregnation.

3.1.15.6 Molded-Thermosetting-Plastic Materials:

When used for electrical insulation, parts, fabricated from molded-thermosetting-plastic materials shall be impregnated with a suitable varnish and dried after all machining and punching operations have been completed. Materials having moisture absorption of 1.04 percent, or less, and those in hermetically sealed assemblies shall not require impregnation.

3.1.15.7 Cotton and Linen:

3.1.15.7.1 No insulated wire with cotton or linen in its construction shall be used in the equipment, except when the wire is used for coils or forms, and the, only provided the insulation on the wire is completely sealed off against the atmosphere.

3.1.15.7.2 Cotton or linen shall not be used as the base or filler for laminated or molded-plastic materials, unless the contractor definitely establishes to the satisfaction of the procuring activity that absorption of moisture will in no way cause degradation in performance of the equipment as a whole, or in any way adversely affect the particular put or any parts associated therewith or adjacent thereto. A cotton-based or linen-based laminated or molded-plastic material shall not be used for electrical insulation.

3.1.16 Jacks:

3.1.16.1 Headset Jacks:

Headset jacks shall be JJ-034 in accordance with Specification MIL-J-641.

3.1.16.2 Microphone Jacks:

Microphone jacks shall be JJ-033 in accordance with Specification MIL-J-641.

3.1.17 Locking Devices and Lock Washers:

All screw-head assemblies shall be made vibration proof. Lock washers shall be plated bronze or corrosion resistant, or cadmium- or zinc-plated steel. Lock washers shall be provided under all nuts, except those of the self-locking and castle types. Lock washers shall be provided under the heads of all screws not secured by a locked-nut arrangement, except as noted below. Screw and lock washer and nut or screw assembly, lock washer and flat washer assembly, and nut and lock washer assemblies are considered satisfactory for use, provided they are of such size and shape that they may be replaced by conventional screw, nut, and lock-washer combination in case of maintenance.

3.1.17 (Continued)

(a) Flat-head screws, the heads of which are adjacent to metals, may be staked by the usual center-punch method or by upsetting the adjacent metal into the ends of the slot.

(b) When screw heads of any type are adjacent to non-metal, with or without intervening washers, the facing surfaces shall be thoroughly covered with a suitable retaining compound.

(c) Self-locking nuts of specifically approved types, safety tiring, and castellated nuts with cotter pinning are acceptable.

(d) Locking devices are not required with screw assemblies involving instrument laws and other items which have been standardized without locking means.

3.1.17.1 Staking, and Retaining Compounds:

Staking by means of upsetting metal or by using a suitable retaining compound is acceptable. Neither shall be used when the assembly will be disassembled frequently.

3.1.17.2 Non-metals:

When screw threads engage tapped holes in non-metals, an approved retaining compound shall be applied to such threads.

3.1.18 Magnesium Alloys:

When magnesium-alloy parts are used in direct contact with dissimilar metals extreme caution shall be exercised in the selection of the proper alloy to guard against electrolytic corrosion. When possible, insulating coatings such as zinc-chromate primer shall be applied, or in cases where extreme exposure is contemplated, the use of gaskets is desirable. Such magnesium parts and all other parts of dissimilar metal normally attached thereto, when tested as an assembly, shall successfully withstand a 50-hour salt spray test in accordance with Federal Test Method Standard No. 151. At the completion of the 50-hour salt spray test, the sample shall exhibit no signs of destructive corrosion as defined In 3.1.11, and shall be capable of being easily disassembled.

3.1.19 Marking and Identification:

3.1.19.1 Marking:

Parts and assemblies shall be marked in accordance with Standard MIL-STD-130. Harking shall not adversely affect the leakage path between conductors or any other factor of performance.

3.1.19.2 Identification of Engineering Design Changes:

To identify properly deviations in articles of equipment resulting from engineering change proposals prepared by the contractor arid approved by the procuring activity, identification marking in one of the following categories shall be assigned for use on each major or minor assembly in which the change has been incorporated:

(a) A change in the type assignation of the article as included in a nameplate or other marking.

(b) The use of a modification symbol imprinted or affixed adjacent to but never on or to the right of the nameplate. A series of modification symbols shall be used for successive minor engineering changes not justifying a change in type designation.

3.1.19.3 Labels:

Labels showing wiring and schematic diagrams, lubricating and operating instructions, safety notices, list of tools, list of contents, and similar information shall be provided where space permits. Labels shall be legible and shall be designed to remain so for the service life of the equipment on which they are mounted.

3.1.19.4 Panel Markings:

The visible surface adjacent to panel facilities, such as controls, indicators, jacks, sockets, and fuse holders shall be marked with a suitable word, phrase, or abbreviation thereof, indicating the use or purpose of the part. These markings shall provide good legibility and shall be of contrasting color. Abbreviations shall be in accordance with ANA Bulletin No. 261.

3.1.19.4 (Continued)

Continuously variable operating controls shall be provided with markings which will permit the operator to set the control easily and correctly to a predetermined point. Controls which require the use of special test equipment and are not to be adjusted without such test equipment, do not require marking indicating the use or purpose of the part on the panel adjacent thereto.

3.1.19.5 Reference Designation for External Equipment Connectors:

All connectors mounted on a unit of equipment which accept or mate with connectors from external interconnecting-type wiring shall be assigned a "J" number. The contractor shall assign these "J" numbers numerically and consecutively, starting with J-1, for each unit of equipment. In addition, each "J" number shall be preceded by the unit number assigned the unit in accordance with Standard MIL-STD-16. (See Figure 6.) This "J" number shall appear on each side of the panel in a visible location. Connectors may be further identified, on that side of the panel to which the mating connector attaches, by a name denoting the function of the cable attached thereto.

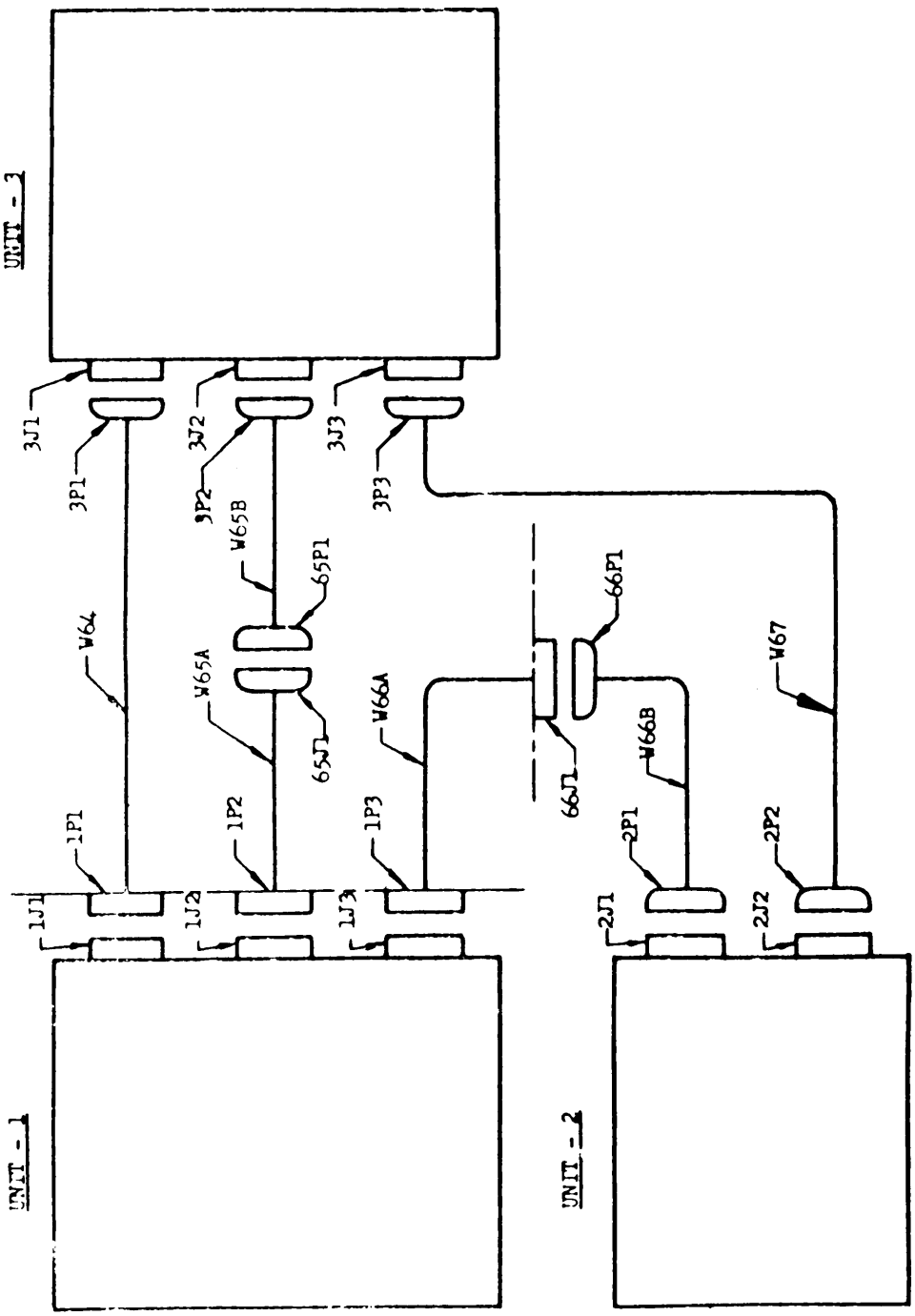
3.1.19.5.1 Marking of External Connectors:

Connectors that form a part of the external interconnecting wiring shall be identified by a "P" number corresponding to the "J" number of the mating unit connectors. When two cable connectors affixed to interconnecting cables are to be mated, the connector containing the coupling ring or active retention device (screw, clip, etc.) shall be assigned a "P" number and the mating connector shall be assigned a "J" number. (See Figure 6.)

3.1.19.6 External cables shall be assigned reference designations W-1, W-2, etc.; the numerical portion of the referenced designation shall be consecutive where practicable.

3.1.19.7 Reference Designations for Parts and Assemblies:

With the exception of external connectors and cables, reference designations shall be employed to identify each part for its particular circuit application in accordance with Standard MIL-STD-16. On subminiaturized assemblies, such as printed or etched boards or other forms of assembly where space is at a premium, the reference designation need not be marked. In lieu thereof, reference designation marking shall be shown by means of pictorial diagram, line drawings, photographs) Or other media to provide for circuit identification (by means of reference designations) in the appropriate handbooks for the equipment. The parts of non-repairable subassemblies shall not be marked with reference designations.



CONNECTORS ASSOCIATED WITH UNIT - 1 ARE RACK PANEL TYPE. ALL OTHER CONNECTORS SHOWN ARE NON-RACK PANEL TYPE.

FIGURE 6. Application of external connector designations

3.1.19.8 Tube Socket Identification:

A suitable location diagram shall be placed on the module cover, in a position such that is readily visible, showing the location and type of tubes used in that module.

3.1.19.9 Wire Coding:

Hook-up wires in the equipment shall be, insofar as practicable, distinctly color coded in accordance with Standard MIL-STD-122 or otherwise identified in order to facilitate testing and the location of faults. Wires used for external wiring between units shall be coded in accordance with Specification MIL-W-5088.

3.1.20 Meters (Electrical Indicating Instruments):

Meters shall be of a sealed type.

3.1.20.1 Conventional 2-1/2 and 3-1/2 inch diameter meters shall be type MR26 ( ) and type MR36 ( ), respectively conforming to Specification MIL-M-6.

3.1.20.2 Meters larger than 3-1/2 inch diameter shall be in accordance with Specification MIL-M-16034.

3.1.20.3 Ruggedized meters shall be in accordance with Specification MIL-M-16034.

3.1.20.4 No time totalizing meter shall be included in the equipment.

3.1.21 Relays:

The relays shall be hermetically sealed except the following:

USE	MFG.	P/N
Antenna Transfer	P & B	KR2703-2
Off/Oon	Aemco	45A-4273
Delayed Keying	RBM	28010-2
Keying	RBM	28010-2
Recycle	RBM	28010-2
Plate Contactor	Aemco	83-3618
Step-Start	Aemco	83-3615
Overload	Aemco	94-3749
Tune Power	Aemco	38-3242

3.1.22 Resistors:

The rating and placement of a resistor in a particular equipment shall be such that the permitted maximum temperature at any point on the surface of the resistor shall not be exceeded under the highest ambient temperature or altitude specified as a service condition for the complete equipment, with any type of operation provided by the equipment. Resistor type RN-10, RN-20, RN-25, and RN-30 under Specification MIL-R-10509 shall not be used except in hermetically sealed non-repairable assemblies.

3.1.22.1 External Voltmeter Resistors:

External voltmeter resistors shall be in accordance with the requirements of Specification MIL-R-10509D.

3.1.22.2 Tapped Resistors:

Fixed and variable resistors having fixed taps may be employed where required by overall design, but their use shall be held to a minimum.

3.1.22.3 Mounting of Resistors:

Resistors shall be securely mounted in such manner as to allow for expansion with temperature changes. They shall not be mounted by means of wire leads unlessu other mechanical support is provided for the body of the resistor, except that unit resistors whose weight does not exceed 1/2 ounce may be secured by only their leads if the total length of both leads from a resistor to the terminals to which the leads are secured does not exceed 1.0 inch. In no case shall wire leads be less than 1/8 inch.

3.1.23 Soldering:

Soldering shall be so executed that both a positive electrical and a strong mechanical connection is assured. No motion of lead wires shall be permitted to take place during the solidification of the solder.

3.1.23.1 Mechanical Assemblies:

Unless specifically approved by the procuring activity, no assembly shall depend solely on soft solder for mechanical strength, except for variable capacitor plates and sections and other relatively light parts that are of accepted commercial design and that have, by actual use, proved to be generally suitable for use in electronic equipment.

3.1.23.2 Electrical Connections:

Joints shall be mechanically secure before soldering. No connection shall depend on soft solder alone for mechanical strength, except in the case of small parts where mechanically secure connections are impractical, such as in eyelets, connector solder caps, etc. (see 3.1.35.2).

3.1.23.3 Solder:

Only compositions Ag 1.5, Ag 2.5, Sn-70, Sn-60, Sn-50, and Sb-5 solder conforming to Specification QQ-S-571 shall be used. Type AC flux shall not be used.

3.1.24 Springs:

3.1.24.1 Contact Springs:

Beryllium-copper, beryllium-cobalt-copper, chromium-coppers palladium-copper, silver-copper, platinum-iridium, phosphor-bronze, or nickel-silver, tempered and plated as necessary, shall be used for contact springs. Endurance limits and electrical conductivity of the springs shall not be adversely affected by corrosion, fatigue, high operating temperature, or other adverse phenomena resulting from service conditions enumerated herein.

3.1.24.2 Tempering:

Springs of beryllium-copper alloys shall be heat-treated to the proper spring temper after forming. Springs made from materials which are not heat-treatable shall have the direction of grain within 45° of the linear length of the spring.

3.1.25 Switches:

3.1.25.1 A-F Switches:

Plastic materials used in the construction of a-f switches shall conform to the requirements of 3.1.15.

3.1.25.2 RF switches:

The preferred switch for use in r-f circuits is one utilizing ceramic insulation. Plastic materials used in r-f switches be type PBE in accordance with Specification MIL-P-3115.

3.1.25.3 Rotary Switches:

3.1.25.3.1 Indexing Mechanism:

Rotary switches shall have a positive mechanical index, locating each contact position. The indexing mechanism shall be designed to minimize the possibility of the movable element coming to rest between contact positions. This requirement does not apply when the switch is positioned by means other than manual operation.

3.1.25.3.2 Materials:

Materials used in the construction of rotary switches shall be as follow:

(a) Laminated plastics shall be type PBE in accordance with Specification MIL-P-3115, or better.

(b) Molded plastics shall be type MFE, MME, or MAG in accordance with Specification MIL-M-14, or better.

(c) Ceramic parts shall be grade L-4, type A, or B in accordance with Specification JAN-I-10, or better. (Type A possesses greater resistance to thermal shock than type B.)

(d) Contacts and contractors shall be silver alloy or silver plated, and shall be self-cleaning.

(e) Shafts shall be aluminum or corrosion-resistant material.

(f) Metal parts other than contacts and shafts shall be made of corrosion-resistant material, except that bushing and bearing assemblies may be brass suitably treated to prevent corrosion.

3.1.25.3.3 Mounting:

Rotary switches shall be designed for mounting to a panel by means of a single bushing concentric with the shaft and threaded 3/8-32 MEF2A.

3.1.25.4 Toggle Switches:

The mounting of the toggle switches shall be such that the handle of the switch operates in the length (vertical) direction of the panel. Any "OFF" position shall be in the center or bottom position. When clarification of a control function or convenience of operation would result (for example, a "left-right" function control), toggle switches may be so mounted that the handle of the switch operates in the width direction of the control panel.

3.1.26 Terminals:

3.1.26.1 Terminals Attached to Parts:

Terminals attached to parts shall be mechanically strong and shall not break when soldering and unsoldering connections thereto. Terminals of potted parts shall be designed and fastened to a terminal insulating strip or plate (or the enclosure itself, if this complies with the insulation requirements) in such manner as not to cause any degradation in the moisture excluding property of the enclosure by normal soldering and resoldering of the external leads to the terminals. Terminals shall be so spaced as to assure a leakage resistance sufficiently high and to insure safe creepage distances for the particular application under specified conditions of high humidity and altitude. Insulating barrier covers or strips shall be provided over all exposed terminals contained within the equipment where possibility of contact with dangerous voltage exists.

3.1.26.2 Terminals Attached to Wires:

Terminals attached to wires shall be of a solder or solderless type.

3.1.26.3 Terminal Spacing:

Adequate terminal spacing or barriers shall be employed to prevent corona or breakdown or low-leakage resistance under high humidity, including condensation, and under high-altitude conditions.

3.1.27 Threaded Parts:

Threaded parts shall be of sufficient size to insure adequate strength for the intended use.

3.1.27.1 Screw Lengths:

The minimum length of the screws and bolts shall meet the requirements of Standard MS33588, except that for screws and bolts of 48 threads per inch and finer a minium of 1-1/2 threads shall be exposed. Maximum lengths shall be limited by the nearest larger standard screw length beyond the nut or joining components except when such projection will result in corona discharge or when design requirements cannot be met.

3.1.27.2 Threads:

Threads shall be in accordance with specification MIL-S-7742, and as amplified below.

(a) Threads for screws, bolts, nuts, and similar devices shall preferably be chosen from the recommended selection contained in paragraph titled “Recommended selection,” of Specification MIL-S-7742, unless used for adjustment, when they may be of fine or extra fine thread series.

(b) When MIL-JAN, AN, or other specifications for components, such as variable resistors and switches, are in conflict with the requirements of (a) the requirements of the specification for the component shall apply.

(c) Commercial threads in general use for mounting standard components that are not covered by specifications of the military establishment are acceptable.

(d) Aluminum and other soft materials shall not be threaded for use as parts that are frequently disassembled.

(e) Screws or bolts shall provide aluminum engagement length of one time their nominal diameter in tapped parts other than nuts when the assembly is frequently disassembled, except in those cases where maximum strength is not required, in which cases special prevision shall be made to insure compliance with required conditions.

3.1.27.3 Socket-Head Set Screws:

Set screws of size No. 6 and larger shall be of the hardened socket-head type conforming to Standard AN565. One set screw may be used on flatted shaft. Two set screws at 90° to 120° displacement shall be used when the shaft is not flatted. If practicable, all set screws of the same size used in the equipment shall have one type of head. Cone-point set screws shall not be used, except when the opposing metal has been properly countersunk to receive the cone point.

3.1.27.4 Self-tapping and Sheet-metal Screws:

Self-tapping and sheet-metal screws may be used only when no other suitable means exist.

3.1.27.5 Sheet Spring Nuts:

Sheet spring nuts shall be used only when specifically authorized by the procuring activity.

3.1.28 Tools (Special):

The design of the equipment shall be such that the need for special tools for timing, adjusting, and servicing shall be kept to a minimum. Special tools shall be designed to withstand the intended use throughout the life of the equipment and shall be subject to the approval of the procuring activity. Those required for operational adjustments shall be securely mounted within the equipment in a readily accessible location.

3.1.28.1 Set-Screw Wrenches:

One wrench for each size and type set-screw head employed for operational adjustments shall be securely mounted within the equipment in a readily accessible location.

3.1.29 Toxic and Corrosive Fumes:

The materials, as installed in the equipment under the service conditions specified herein, shall not liberate gases which combine with the atmosphere to form an acid or corrosive alkali, nor shall they liberate toxic or corrosive fumes which would be detrimental to the performance of the equipment or health of the occupants in the aircraft.

3.1.30 Transformers and Inductors (Audio and Power):

All audio and power transformers and inductors shall be in accordance with Specification MIL-T-27, grades 4 and 5. Grade 6 will be acceptable only for hermetically sealed applications where no repair or replacement is intended.

3.1.30.1 Corona:

Transformers and inductors shall be limited to working voltages such that windings are free from corona discharge under all specified service conditions, including surge voltages.

3.1.30.2 Rating:

Transformers and inductors shall be so designed that when installed, they shall reliably and safely handle the required power, peak voltage, and the like, without degradation in their own performance or that of the equipment in which they are employed throughout the life of the equipment under various service conditions.

3.1.30.3 Size and Weight:

The size and weight of transformers and inductors shall be held to a minimum consistent with required performance and life. Every effort shall be made to use materials of light weight and to employ methods of design and construction which effects minimum size and weight. High temperature rise is permitted when size and weight savings can be effected, provided dependability, performance, efficiency, and required life are obtained. The best available grades of core material shall be used to the maximum extent justifiable for the particular application.

3.1.31 Tubes (Electron):

Each component of equipment which employs electron tubes shall be furnished with a complete set of tubes properly installed therein. This shall also apply for crystal diodes and transistors.

3.1.31.1 Heat dissipating shields conforming to Specification JAN-S-28 shall not be used.

3.1.32 Washers for Ceramic and Vitreous Surfaces:

Buffer washers of suitable metallic or fibrous material shall be used between the otherwise facing surfaces of a ceramic or vitric insulator or vitreous enamel resistor and a metal part, whenever practicable. Buffer washers of soft copper or other suitable material shall be used whenever the heat resulting from soldering or like operations during assembly, or internal heat from normal operation of the equipment, is of such degree as to cause deterioration of fiber washers in any manner.

3.1.33 Welding:

The joining surfaces of all parts to be welded shall be thoroughly cleaned of foreign matter which will interfere with proper welding. All welds shall have good fusion and be of ample size to develop the full strength of the connected parts. Any weakening of the welded parts a short distance from the weld, owing to annealing as a result of the welding process, shall not reduce the strength below the design requirements. When harmful stresses may result from welding, the welded parts shall be annealed sufficiently to remove the stresses. All welds shall be cleaned of scale and oxidation products, and the excess flux shall be removed. Electrodes used in arc-welding shall be a type which will produce a weld having chemical and physical properties similar to those of the parent metal. When spot-welding is used to permanently secure parts, the number of welds shall be sufficient to provide adequate strength, with no less than two welds on each part.

3.1.34 Wire (Hookup):

Stranded conductors of suitable degrees of flexibility shall be used whenever practicable within the requirements of this specification. Hookup wire shall be of such cross section and temper as to provide ample and safe current carrying capacity and mechanical strength. In general, wire shall not be smaller than AWG No. 22. Wire directly associated with the primary power circuit shall be of a size consistent with the current requirement. of the circuit. When it can be demonstrated that the use of smaller hookup wire will result in no loss of performance and at the same time will produce benefits, such as a reduction in weight or improved accessibility, smaller wire may be used. This provision

3.1.34 (Continued)

is made specifically to permit the use of smaller wire in cables having a large number of wires and having adequate support against adverse effects of vibration. The size of wire leads supplied integral with parts shall be controlled by the specification for these parts.

3.1.34.1 Insulation on Conductors:

Insulation of the sleeve type may be used, provided its length is sufficient to prevent slippage along the conductor to such an extent as to expose a section of the conductor that should be insulated. Insulation shall provide adequate dielectric strength and adequate leakage resistance when the equipment is operated under the designated service conditions. The mechanical and electrical properties of the insulating materials and impregnating compounds shall not be permanently impaired as a result of being exposed to extremes of temperatures incurred in the equipment. Rubber without braid may be used only when the insulation is not depended upon to space or support the conductor, or when a number of conductors are assembled in the form of cordage and the assembly provided with a braid covering which has been suitably varnished or lacquered. All conductor insulation shall be of the non-combustible or slow-burning type; that is, with the insulated conductor held in a horizontal position in still air, self-sustained combustion of the insulation or lacquer shall not progress at a rate in excess of 1 inch in 1 minute.

3.1.35 Wiring (Internal):

3.1.35.1 Connections within the equipment shall be suitably supported in such manner as to prevent breakage and eliminate change in frequency or output owing to severe vibration and acceleration or shock encountered under the specified service conditions. The use of a flexible and a solid conductor in a continuous run without a support at their junction is not acceptable. Solid wire may be used in the equipment, provided such wire is so insulated or held in place that it does not fail or show excessive motion when the equipment is subjected to the vibration and shock encountered under the specified service conditions.

3.1.35.2 Before soldering, tires connecting to terminals shall be securely fastened to the terminals by crimping the terminals firmly upon the wire, or the wire upon the terminals, except in cases where the mechanical configuration of the wire or design of the terminal is such as to hold the wire securely in place without crimping, or where the small size of the terminal makes crimping impractical. For example, crimping is considered impracticable where a relatively large wire goes through a thin section terminal as on an electron tube socket, wafer switch, potentiometer, and the like, in which a wire hole is usually provided and crimping wrapping, or twisting is not feasible. The extent of the crimping or wrapping shall be just sufficient to hold the wire in place before soldering. In general, one-half to one turn of wire about a terminal will be sufficient for mechanical securing of the wire. In no case shall electrical connections be made by clamping wires smaller than AWG No. 14 between metal parts other than solderless terminals.

3.1.35.3 Whenever bolts, screws, nuts, studs, or rivets are used in a r-f circuit, all connections thereto shall be securely soldered, except that soldered connections are not considered practicable at studs of molded phenolic capacitors meter terminals, and other places where damage from overheating may result.

3.1.35.4 In no case shall electrical connections depend upon wires, lugs, terminals, and the like, clamped between a metallic member and an insulating material of other than a ceramic or vitric nature. Such connections shall be clamped between metal members, preferably such as an assembly of two nuts, two washers, and a machine screw. If such an assembly is not used, and maintenance of a tight connection depends upon the resistance of an insulating material of other than a ceramic or vitric nature to conpressive stress or shear, such connections shall be securely soldered.

3.1.35.5 Whenever wires are run through holes in metal partitions, shields, and the like, less than 1/8 inch in thickness, the holes shall be equipped with suitable grommets or punched and rolled for mechanical protection of insulation otherwise subject to abrasion. Panels 1/8 into, or more, in thickness either shall have grommets or shall have the hole edges rounded to a minimum radius of 1/16 inch. Care shall be exercised in the running of hookup wire to insure that it is not carried over or bent around any sharp corner or edge which might in time cut through the insulation. In order to prevent deterioration of the conductor by heat, care shall be taken to insure that wiring is not exposed to excessive temperatures and that it cannot come in direct contact with heated parts.

3.1.35.6 Conductors shall be bound into a cable whenever possible and securely hold by means of wrap-lock, cord, or other suitable means. Conductors intended to carry pulse or other radar-wave forms and which may undesirably couple such signals into other conductors shall not be bound into a cable. All lacing cord shall be fabricated of fungus-inert plastic, such as nylon or cellulose rayon.

3.1.35.7 Conductors using metallic shielding unprotected by an outer insulation shall be so secured as to prevent the shielding from coming into contact with exposed terminals or conductors. Shielding shall be terminated at suitable distance from the exposed conductor. The shield shall be suitably bonded to the chassis, unless part of an "above-ground" system.

3.1.36 Wiring (External):

Provisions shall be made for external wiring in accordance with Specification MIL-W-5088.

3.1.36.1 Cables, Wave Guides, and Cable Assemblies:

Electrical connections shall be so arranged and wired, if possible, that no "hot" leads are terminated in pins or other exposed contacts which might be accidentally shorted or touched. Except when specified in the detail specification, all inter-connecting cables carrying pulse of r-f signals shall make use of coaxial cable or wave guides, and shall preferably be ter-minated in the characteristic impedance of the transmitting media. All open-wire power and control cables shall be termi-nated in the lowest impedance practicable for the particular application.

3.1.36.2 Shielded Cables:

The shield of shielded cable shall be connected to the ground lead at least at one point in the circuit.

3.1.37 Wood:

The design of the equipment shall not involve the use of wed, except that wood suitably treated for protection against moisture and fungus in accordance with specification MIL-C-6796 may be employed for transformer, field, and armature wedges, and may be employed in other articles when specifically permitted or specified in the detail equipment specification.

3.1.38 Vibration Requirements for Detail Parts:

As a minimum requirement, detail parts shall operate satisfac-torily when subjected to continuous vibration over a frequency range of 5 to 55 cps and having a double amplitude of 0.06 inch.

3.1.39 Component Parts to Meet Reliability Requirements:

When the contract or equipment specification includes a reliability requirement that is based on a previous calculation and demonstration of the equipment reliability, the component parts used must be equal to or more reliable than those used in the demonstration equipment.

3.2 Desire and construction:

3.2.1 Mechanized Prediction (including Printed circuits):

When designing new equipment, contractors shall include, when possible, circuits that have been or can be reproduced by mechanized or semimechanized production facilities consistent with the state of the art. The procuring activity shall be kept informed of the type of circuits selected and the type of facility required to produce such circuits. The following factors applicable to this type of construction shall govern.

3.2.1.1 Subassemblies of high reliability or relatively inexpensive cost shall be constructed as nonrepairable.

3.2.1.2 The contractor shall inform the procuring activity of those circuits which he proposes to make up as nonrepairable subassemblies.

3.2.1.3 Larger assemblies and expensive repairable stages shall be constructed of MIL-JAN, or quality nonstandard replaceable parts or subassemblies as indicated above and shall be capable of replacement either by subassembly or detail part, as applicable.

3.2.1.4 In the construction of nonrepairable subassemblies, detail puts need not be submitted for approval. Approval must be obtained for the subassembly as a whole. The approval request shall describe the detail part construction (as a rule, the subassembly drawing will satisfy this requirement) and include data as specified in 3.1.1.2.3, with the subassembly considered as a nonstandard part.

3.2.1.5 In the selection and layout of circuits, the contractor shall attempt to use circuits, and methods of construction, which by permit use of the same subassemblies in other equipment having similar circuits and functions. Preferred circuits, such as may be published from time to time are recommended for consideration.

3.2.1.6 The following types of construction are considered to be classed in the mechanized or semimechanized category, and shall be considered:

(a) Subassemblies using printed circuits, upon which the parts are printed or mechanically placed and soldered.

(b) Construction in which several ceramic or filled plastic wafers are placed one above the other and components printed or mounted thereon.

(c) Three-dimensional, or folded-type construction, in which the parts are mechanically placed and soldered.

3.2.1.7 In order to permit flexibility in the arrangement or assembly of modules and subassemblies, interconnecting leads involving circuits considered susceptible of radiated interference or capable of radiating interference should be shielded and of low-impedance design. All other connections (such as power) should be well shielded or bypassed internally to prevent radiation or pickup of extraneous fields.

3.2.1.8 Quality connectors shall be used to connect the subassembly to the chassis or next order assembly. Pressure contacts shall not be used to connect detail parts to printed or other type wiring. The connectors to be used shall be submitted for approval as nonstandard parts.

3.2.2 General:

The detailed mechanical and electrical design of the equipment shall be accomplished by the contractor, subject to the requirements of this specification. The requirements of this specification are detailed only to the extent considered necessary to obtain the desired mechanical and electrical characteristics, performance, and permanence of the same. The design layout and assembly of the units and their component parts shall be such as to facilitate quantity production and to result in minimum size and weight.

3.2.2.1 Fabrication:

Boxes, cases, shields, and compartment walls shall be made by casting, drawing, or bending, and welding, except when ease of servicing of the equipment requires that a removable panel construction be used, or when the applied stresses dictate the use of a strong aluminum alloy which does not provide a good weld; for such parts, riveting or bolting may be used.

3.2.3 Cases and mounting bases:

Materials, bonding, shielding, and performance requirements of Specification MIL-C-172 shall apply to all cases and mounting bases, except that performance shall be met for the frequencies and amplitude shown in the specific curve of figure 31 for the applicable equipment. Mounts and vibration isolators shall be subject to the approval of the procuring activity.

3.2.4 Accessibility:

Each article of equipment and each major subassembly, forming a part thereof, shall provide easy and ready access to its interior parts, terminals, and wiring for adjustments, complete circuit checking, and the removal and replacement of component parts. As a general rule, it will not be acceptable to displace or remove wires, cables, parts, or assemblies in order to gain access to terminals, soldered connections, mounting screws, and the like. When it is not practicable to avoid such construction, those parts which must be displaced or removed shall be so designed, mounted, and otherwise arranged to facilitate their displacement or removal when necessary. If, in order to check or remove a given part, it is necessary to displace some other part, the latter part shall, whenever practicable, be so wired and mounted that it can be sufficiently moved without being disconnected from its circuit.

3.2.4.1 Connections to Parts:

Connections to parts inside a removable container shall be arranged to permit the removal of the container without threading connection leads through the sides or top of the container.

3.2.4.2 Parts which are identified as replaceable by spare parts for the equipment shall be easily removable.

3.2.5 Cooling:

Adequate means shall be employed to maintain parts within their maximum permissible operating temperature under all operating conditions. Air vents shall not be provided if adequate cooling can be obtained without such vents. If vents are necessary, internal parts, such as air-dielectric capacitors and relays, which might be affected by dust and insects shall be protected. Forced cooling shall not be

used unless all other practicable means are found insufficient to meet the requirements, or unless a significant reduction in overall size or weight can be realized. The use of thermal characteristics of finishes or induced draft and ventilation by means of baffles, internal vents, and louvers, etc, shall be investigated to the greatest extent practicable. Exhaust and recirculating fans, blowers and pumps shall be driven by brushless motors operating from the applicable a-c power supply. If a larger quantity of heat is required to be dissipated, which might involve the use of heat exchangers, liquid, air blast, or evaporative coolants, the particular design shall be negotiated with the procuring activity. Supplementary cooling means or devices may be employed for the equipment when operated for prolonged test or checkout purposes, which periods are not consistent with normal operating requirements.

3.2.6 Corona prevention:

The design of all pertinent puts of the equipment shall be such that when operating under any service conditions specified herein corona discharge effects shall be negligible. Particular attention to corona is required in unpressurized application involving peak voltage of the order of 1,000 volts and higher. (See 3.1.30.1)

3.2.7 Explosion-Proofing:

The equipment shall be made explosion-proof. Equipment or units thereof which do not cause ignition of an ambient explosive gaseous mixture with air, when thoroughly operated in such an atmosphere after having been in such an atmosphere for a period long enough to be permeated by such atmosphere, shall be considered explosion-proof. In general, this condition will be satisfied when components such as relays, switches, and motors with commutators, which in normal operation produce, or are likely to produce, sparking or arcing, and which are not contained within pressurized containers, are made explosion-proof.

3.2.8 Fungus treatment:

Equipments shall be fungus-proofed by selection of parts and materials that are nonnutrient for fungus, or the parts and materials shall be so treated prior to their use in the equipment that overall spraying of the equipment is not necessary.

3.2.9 Interference:

Interference control requirements shall be in accordance with the following.

3.2.9.1 Scope:

This requirement covers design requirements, interference test procedures, and limits for electrical and electronic aeronautical equipment to be installed in or closely associated with aircraft.

3.2.9.2 Classification:

The test procedures which are specified cover the following types of tests:

(a) Interference tests: Conducted and radiated tests which measure the magnitude of the interference signals emanating from the equipment under test.

(b) Susceptibility tests: Conducted, radiated, intermodulation and front-end rejection tests which determine whether an equipment will operate satisfactorily when exposed to external interference signals.

3.2.9.3 Interference Requirements:

3.2.9.3.1 Definitions:

For definitions of interference terms, see section 3.2.9.15.4.

3.2.9.3.2 General:

3.2.9.3.3 Operation:

Electrical and electronic equipment shall operate satisfactorily, not only independently but also in conjunction with other equipment which may be installed nearby. This requires that the operation of such equipment shall not be adversely affected by interference voltages and fields reaching it from external sources, and also requires that such equipment shall not, in itself, be a source of interference which might adversely affect the operation of other equipments. The limits specified herein are established to insure that the air vehicles will meet the requirements of Specification MIL-I-6051 or other applicable system specification.

3.2.9.3.4 Short Duration Interference:

Interference resulting from manual operation of switches but not including any electrical or electromechanical operations resulting from the manual switching, may deviate from the limits as indicated below. Ignition components used only during engine starting may deviate from the limits by 20 db. Other short duration interference may deviate from the limits as indicated below. Approval shall be obtained from the procuring activity before using these deviations.

Maximum duration	Maximum recurrence	Deviation permitted
1 sec.	Once in 3 minutes	20 db.
3 sec.	Twice per normal operational period.	no limitation

3.2.9.4 Design:

3.2.9.4.1 Interference-free Design

Interference control shall be considered in the basic design of all electronic and electrical equipment, components, assemblies, and systems. This design shall be such that, before interference control components are applied, the amount of interference internally generated and propagated is the minimum achievable. The application of interference control components that must be used, such as filtering, shielding, and bonding, shall conform to good engineering practice and, whenever possible, shall be an integral part of the system. Whenever additional interference control components are

3.2.9.4.1 (Continued)

necessary, the use of miniaturized components is preferred.

3.2.9.4.2 Susceptibility:

The equipment shall be designed to minimize susceptibility to interference from other sources. The enclosing case construction shall be designed not only to minimize interference propagation, but also to minimize interference pickup from external sources. Where conducted energy on the power leads or any external leads might cause interference, the leads shall be isolated from other leads to avoid coupling, and, where necessary shall have line filters at their entry into the enclosing case. Receiving antenna inputs, or any other low-level signal circuits shall be low impedance or of balanced design, so that coaxial or other shielded transmission lines can be used to insure an interference-free installation. Routing of receiving antenna input or any low-level signal circuit within the equipment shall be so designed and installed that interference is not picked up from power or control leads owing to coupling. Antenna or low-level signal circuit return paths or ground circuit paths shall be so arranged that interference will not occur owing to common conductive paths with other circuits, or with the enclosing case grounding path.

3.2.9.4.3 Case Shielding:

The number of mechanical discontinuities in the case (such as covers, inspection plates, and joints) shall be kept to a minimum. All necessary mechanical discontinuities in the case shall be electrically continuous across the interface of the discontinuity so as to provide low impedance current path. Multiple-point spring-loaded contacts will be used as needed to obtain low impedance continuity. Ventilation openings shall permit conformance to the radiated interference limits. Electrical bonding shall be provided where access doors or cover plates form apart of the shielding. Hinges, in themselves, shall not be considered satisfactory conductive paths.

3.2.9.4.4 Chassis, Case and Mounting Continuity:

The mating surface of the chassis, case, and mounting shall be free of all insulating finishes in order to provide a continuous electrical bond between these items and to enable the installing activity to accomplish bonding contact to the basic structure.

3.2.9.4.4 (Continued)

Such surfaces shall be covered with removable protective coating to prevent corrosion prior to assembly. This requirement shall take precedence over any conflicting requirements in specifications on finishes.

3.2.9.4.5 Component Placement:

Components shall be placed and circuitry arranged to obtain minimum undesired coupling and to require a minimum number of filter components.

3.2.9.4.6 Line Shielding:

It is preferred, that interference reduction be accomplished inside the equipment when such means give results equal to or better than the use of a shielded line. Any line shielding used shall be prescribed as an installation requirement.

3.2.9.4.6.1 Under no condition shall line shielding be used for primary power leads to equipment.

3.2.9.4.6.2 Equipment requiring antennas shall be designed to utilize shielded coaxial cable as lead-in. When it has been determined that a single braid shield is not adequate, a double or triple braid or a solid shield shall be used as required.

3.2.9.4.7 Interference Control Components:

When additional interference control components are required after careful design in accordance with the foregoing paragraphs, components shall be used that conform to the environmental requirements for the equipment. Heretically sealed interference control components shall be used even though the equipment is not hermetically sealed. Separately installed and external components shall not be used unless specifically authorized by the procuring activity.

3.2.9.5 The contractor shall use the latest engineering design procedures and techniques to assure that the equipment will comply with the requirements of this specification.

3.2.9.6 Interference Control Requirements:

All equipment tested for compliance with this specification shall conform to the interference control requirements. For the purposes of this specification, all unwanted signals shall be considered as continuous wave (CW), pulsed CW, or broadband impulsive interference.

3.2.9.7 Interference Measuring Equipment:

The interference measuring equipment listed in table 2 shall be used for determining conformance to the interference limits of this specification. Category B instruments which have been modified to meet category A requirements shall not be used as Category A instruments, unless a distinctive nonremovable label has been attached by the instrument manufacturer; any restrictions on the usage of the modified instrument, or associated accessories, shall be indicated on the label. Instruments listed in table 2 are of the following categories:

(a) Category A: Category A instruments are those interference measuring instruments which adequately measure the parameters of interference signals as required by this specification and which are approved by the procuring activity. Any combination of category A instruments can be used for the required measurement. Category A instruments can be used without prior approval of the procuring activity.

(b) Category B: Category B instruments are those existing instruments which are in use but which do not adequately measure the perimeters of interference signals as required by this specification.

(c) Category C-1: Category C-1 instruments are those which have recently been developed to meet category A requirements but have not yet been evaluated by the procuring activity. These instruments shall not be used without prior approval of the procuring activity.

(d) category C-2: Category C-2 Instruments are those which have been recently developed but do not meet Category A requirement, and which can presumably be modified by the manufacturer to

3.2.9.7 (Continued)

(d) - continued

attain a category A rating. These instruments shall not be used without prior approval of the procuring activity.

TABLE II Acceptable Interference Measuring Instruments

Category	Frequency Range	Commercial Model	Notes	Basic Military Nomenclature	Manufacturer
A	0.15 to 25 mc	NM-20A,B	None	AN/PRM-1	Stoddart
	0.15 to 30 mc	T-A/NF-105	(2)	None	Empire
	0.15 to 1,000 mc	None	None	AN/URM-85	USA Sig Corps.
	20 to 400 mc	None	None	AN/URM-7	USA Sig Corps.
	20 to 400 mc	NM-30A	(3)	AN/URM-47	Stoddart
	20 to 200 mc	T-1/NF-105	None	None	Empire
	200 to 400 mc	T-2/NF-105	None	None	Empire
	400 to 1,000 mc	T-3/NF-105	(4)	None	Empire
	375 to 1,000 mc	NM-50A	None	AN/URM-17	Stoddart
	1,000 to 10,000mc	FIM, A, B	None	AN/TRM-6	Polarad
B	0.15 to 30 mc	T-A/N-105	(5 6)	None	Empire
	20 to 400 mc	NM-30A	(6)	AN/URM-47	Stoddart
	400 to 1,000 mc	T-3/NF-105	(6 7)	None	Empire
	375 to 1,000 mc	NM-50A	(6)	AN/URM-17B	Stoddart
C-1	0.15 to 1,000 mc	NF-205	None	None	Empire
	375 to 1,000 mc	NM-52A	None	AN/URM-17B	Stoddart
C-2	None available at this time				

1 This table is subject to change upon reasonable notice to include new instruments having superior performance characteristics and to change the category of older instruments which have become obsolete
2 This category applies to tuning units purchased after 11 March 1957
3 This category applies when power supply 91226-1 is used with instruments numbered 191-1 and higher
4 This category applies to instruments purchased after 9 May 1956
5 This category applies to instruments purchased prior to 11 March 1957
6 These instruments can be modified to category A requirements by the manufacturer
7 This category applies to instruments purchased prior to 9 May 1956

3.2.9.7.1 Antenna System Correction:

All instrument readings of radiated interference levels shall be converted to antenna terminal open-circuit ("antenna induced") values, in accordance with correction factors furnished by the instrument manufacturer for the particular antenna type, frequency, and operating procedures used.

3.2.9.7.2 Substitute Measuring Instruments:

The use of substitute interference measuring instruments in the frequency range from 1 to 10 kilomegacycles will be considered by the procuring activity. The contractor shall submit, with the test plan, justification explaining why approved instrumentation cannot be used and shall proposed substitute instrumentation and test procedures that are capable of measuring the limits. Approval for the use of substitute equipment might not be granted if a commercial test laboratory can perform the required measurements with approved equipment within a reasonable period of time.

3.2.9.8 Extension of Frequency Range:

If the contractor believes that some, or all, of the applicable interference requirements should be extended beyond the required frequency range, the interference control plan and the test plan shall be used to give proposed limits, instrumentation, methods of measurements, other pertinent information, and an explanation of the need for the extended frequency range.

3.2.9.9 Testing:

All tests and test reports specified herein shall be accomplished by the contractor and shall be subject to approval and verification by the procuring activity. When the procuring activity waives verification, the tests and test reports shall be approved and verified by a qualified representative of the contractor's Quality Control Department. Evidence of quality control verification and approval, either Government or contractor, shall be contained in the test report. The Government further reserves the right to have a technical. representative of the procuring activity present during the testing.

3.2.9.9.1 Test Plan:

The contractor shall submit a detailed test plan to the procuring activity showing the means of implementation and the application of the test procedures in this specification to the equipment being procured. Included shall be the proposed method of testing and additional details such as:

(a) Nomenclature and serial numbrs of test equipment to be used.
(b) Methods of calibration to be used.
(c) Detector function to be used on measuring equipment.
(d) Methods of loading and triggering.
(e) Operation of test sample.
(f) Control settings on test sample.
(g) Frequencies at which interference might be expected, local oscillator, intermediate frequencies, multipliers, etc.
(h) Other details requiring approval by the procuring activity.

This test plan shall be submitted before any interference testing is started.

3.2.9.9.2 Test Report:

A test report shall be submitted, conforming to MIL-T-9107, to the procuring activity. The test report shall include such details of testing as:

(a) Nomenclature of interference measuring equipment.
(b) Serial number of interference measuring equipment.
(c) Date of last calibration of interference measuring equipment.
(d) Detector functions used on interference measuring equipment.
(e) Internal noise level of instrument used on detector function at each test frequency.
(f) Descriptions of procedures used (methods of loading and triggering, etc., operation of and control settings of test samples, etc.).
(g) Measured line voltages to test sample.
(h) Test frequencies.
(i) Method of selection of test frequencies.
(j) Type of interference measured.
(k) Measured level of interference at each test frequency.
(l) Specification limit at each test frequency.
(m) Graphs showing items (e), (h), (k), and (l).
(n) Photographs of the test setup and test sample.
(o) Sample calculations (showing how item (k) was obtained for all antennas used).
(p) Description and size of screened enclosure.
(q) Ground plane used if test is not performed in screened enclosures.
(r) Description of open space area, if used.

3.2.9.9.2 (Continued)

(s) Ambient interference levels.
(t) Measured Impedance of line stabilization network.
(u) Certification required in 3.2.9.9.6.

3.2.9.9.2.1 Examples of Sample Calculation:

(a) Interference measuring equipment	NF-105
Frequency of cw measurement	460 mc
Antenna actor (DM antenna)	+8 db
Cable loss correction factor at 460 mc	+3 db
Meter reading	+40 db

Interference level = meter reading + cable loss + antenna factor = 40 + 3 + 8 = 51 db

(b) Interference measuring equipment	NM-20B
Frequency of broadband radiated measurement	500 kc
Antenna factor	1
Cable loss correction factor	1
Meter reading	9 microvolt
Effective random bandwidth	3,400 cps

Impulse bandwidth = 1.4 x 3,400 = 4,760 cps = 4.760 kc

$$\text{Interference level} = \frac{(\text{meter reading})\ (\text{antenna factor})\ (\text{cable loss})}{(\text{impulse bandwidth})}$$

$$-\ \frac{9 \times 1 \times 1}{4.76} = \frac{\text{Antenna induced microvolt}}{\text{kc}}$$

= 65.75 db above 1 microvolt per mc (antenna induced)

3.2.9.9.2.2 Identification of Test Sample:

The test sample shall be completely identified in the test report with complete nomenclature, manufacturer, and serial number. All suppression work performed on the test sample during the interference tests shall be fully described in words as well as by the test data in the test report.

3.2.9.9.3 Operation of Measuring Instruments:

For both conducted and radiated interference measurements, the instruments used shall be calibrated and operated as indicated in their respective instruction manuals, unless otherwise permitted by this specification.

3.2.9.9.3.1 Calibration:

Interference measuring instrumentation shall be maintained in a known condition of accuracy. Periodic checks on the calibration accuracy shall be made with laboratory generators. Recalibration shall be accomplished when the standardized gain setting fail. to reflect a meter reading within ± 20 percent of the known input signal. Substitution type measurements can be used in lieu of the calibrated method.

3.2.9.9.3.2 Generator Accuracy:

Laboratory-type signal generators and impulse generators capable of an output voltage accuracy of at least 20 percent shall be used to calibrate interference measuring instruments and for substitution measurements.

3.2.9.9.3.3 Broadband Interference Measurement:

Broadband interference shall be measured by using an impulse generator with the substitution technique, or by calibrating the interference measuring instrument so that it reads directly in decibels above 1 microvolt per unit bandwidth. The peak detector function on the interference measuring instruments shall be used for broadband and pulse CW measurements.

3.2.9.9.3.4 CW Interference Measurements:

CW interference shall be measured by calibrating the interference measuring instrument so that it reads directly in decibels above 1 microvolt or by using a signal generator with a substitution technique.

3.2.9.9.3.5 Pulsed CW Interference Measurements:

Pulsed CW shall be measured in accordance with the procedures and

3.2.9.9.3.5 (Continued)

limits used for broadband interference.

3.2.9.9.4 Bonding Measuring Instrument:

Interference measuring instruments utilizing dipole antennas shall be bonded to the ground plane or shielded enclosure with the ground clip on the power cord. Instruments used for conducted measurements shall not be bonded to the ground plane except through the interconnecting coaxial cable.

3.2.9.9.4.1 The counterpoise on rod antennas shall be bonded to the ground plane with a strap of such length that the rod antenna can be positioned correctly. The strap should be as wide as the counterpoise. This applies to rod antennas utilizing the interference measuring instrument as a counterpoise, and to rod antennas mounted on a separate counterpoise.

3.2.9.9.4.2 The interference measuring instruments shall be physically grounded with only one connection. If the copper strap in used, neither the ground clip, the ground terminals, nor the power supply shall be connected to ground.

3.2.9.9.4.3 Test for Leakage:

At any test frequency, when tuned and calibrated for a measurement, the measuring instrument, when used with a shielded dummy antenna, shall show no change from the internal background when the equipment under test is turned “on” and “off.”

3.2.9.9.5 Monitoring:

The interference measuring instrument shall be monitored with a headset, loudspeaker, oscilloscope, or other indicating devices, during all measurements. Precaution shall be taken to insure that the monitoring does not influence the meter reading on the interference measuring equipment.

3.2.9.9.6 Test Frequencies:

The interference measuring instrument or signal generator for susceptibility tests shall be slowly tuned through each continuous tuning range and the frequencies at which maximum interference or

3.2.9.9.6 (Continued)

susceptibility is obtained shall be selected as test frequencies. Test frequencies shall not be selected prior to the interference test. The witnessing official or Government representative shall certify in the test report that the test frequencies were selected after each range was scanned. A minimum of three measurements shall be made in each continuous tuning range.

3.2.9.9.7 Tuning:

The interference measuring instrument shall be tuned to and measurements made at the fundamental frequency and all harmonics of equipment containing oscillator circuits. Additional checks shall be made by scanning for and measuring any signal or spurious response that can be anticipated. (The test item shall be adjusted for mode of operation and control settings, including frequency, which may be expected to result in a maximum of interference emanation.)

3.2.9.9.8 Powerline Stabilization Network:

The powerline stabilization network is shown in figure 7. One network shall be inserted in each ungrounded power supply lead supplying power to the test sample, and shall be used for the complete radio interference tests. The network enclosure shall be bonded to the ground plane for safety and radio frequency purposes.

3.2.9.9.8.1 Performance Characteristics:

The current carrying capacity of the network shown is 50 amperes dc to 800 cycles ac. The maximum voltage drop at 50 amperes is not over 2 percent of the supply voltage. The performance characteristics of this device will permit measurements of test items at the following maximum voltage ratings:

dc	600 volts
60 cycles	440 volts
400 cycles	230 volts
800 cycles	115 volts

3.2.9.10 Test Conditions:

3.2.9.10.1 Ambient Interference Level:

It is desirable that the ambient interference level during testing, measured with the test sample de-energized, be at least 6 db below the allowable specified interference limit. However, in the event that at the time of measurement the levels of ambient interference plus test item interference are not above the specified limit, the tested item shall be considered to have met the specified requirements. This requirement shall apply equally to both radiated and conducted ambient interference levels. A shielded enclosure may be used if necessary or desired. If a shielded enclosure is used, the minimum length shall be such that a 35-mc tuned dipole can be placed in the room with at least 12 inches clearance between the antenna extremities and the shielded enclosure.

3.2.9.10.2 Ground Plane:

A copper or brass ground plane, 0.01-inch thick minimum for copper, 0.025-inch thick minimum for brass, 12 square feet or more in area with a minimum width of 30 inches, shall be used. In a screen room, the ground plane shall be bonded to the shielded room at intervals no greater than 3 feet and at both ends of the ground plane. The ground plane and screen room walls may be considered equivalent to an aircraft fuselage for purposes of simulating a normal installation. For large equipment systems mounted on a metal test stand, the test stand may be considered, for testing purposes, to be a part of the ground plane and shall be bonded accordingly. When a shielded room is not used, the measuring equipment may be placed on a solid support for operation. The support may be solid earth, steel, or iron flooring, metal bedplate, metal-covered planking, or the like.

3.2.9.10.3 Bonding:

Only the previsions included in the design of the equipment and specified in the installation instructions shall be used to bond units, such as equipment case and mount, together or to the ground plane. Where bonding straps are required to complete the test setup, they shall have a length not greater than 5 times the

3.2.9.10.3 (Continued)

width, shall have a minimum thickness of 0.025 inch, and shall be copper or brass metal straps, not braid. Connections made with such bond straps shall have clean metal-to-metal contact.

3.2.9.10.3.1 Shock and Vibration Isolators:

Test samples shall be secured to mounting bases incorporating shock or vibration isolator, if such mounting bases are used in the installation. The bonding straps furnished with the mounting base shall be connected to the ground plane. Where mounting bases do not incorporate bonding straps, bonding straps shall not be used in the test setup.

3.2.9.10.3.2 External Ground Terminal:

When an external terminal or connector pin is available for a ground connection on the test sample, this terminal shall be connected to the ground plane if the terminal is normally grounded in the installation. If the installation conditions are unknown, the terminal shall not be grounded.

3.2.9.10.3.3 Portable Equipment:

Portable equipment shall be tested while it is bonded to the ground plane and also when it is not bonded to the ground plane. Portable equipments that are intended to be grounded through a power cord shall not be bonded to the ground plane by other means.

3.2.9.10.4 Power Supply Voltage:

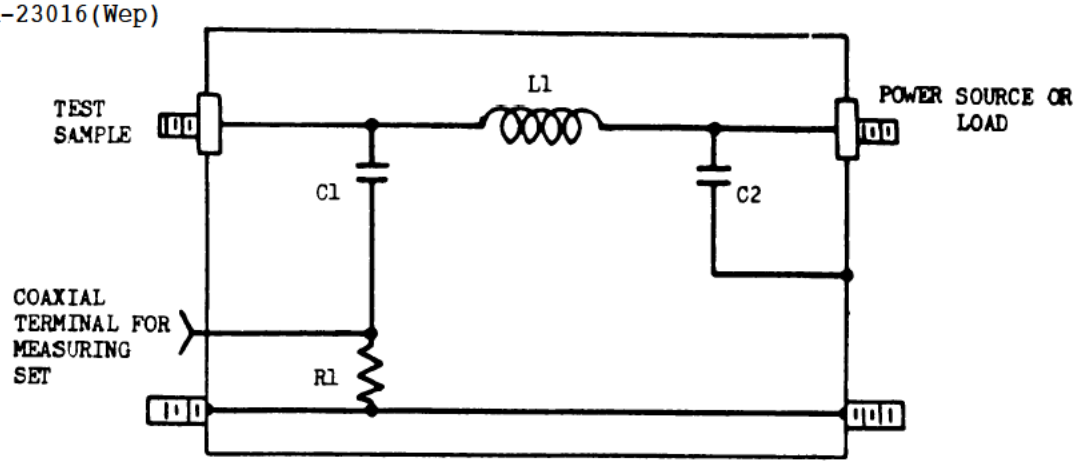
The power supply voltages shall be within the tolerance specified in the detail specification for the test sample. The voltages shall be measured at the test sample terminals on the line stabilization networks.

3.2.9.10.5 Arrangement and Operating Conditions:

The general arrangement of equipment, interconnecting cable assemblies, and supporting structures shall be such as to simulate actual installation and usage insofar as practicable. The front surface of each unit shall be located 4 inches ±½ inch from the

3.2.9.10.5 (Continued)

edge of the ground plane; interconnecting cables shall be routed between the units and the edge of the ground plane. In those cases where equipment size exceeds the ground plane dimensions, or where more than two line stabiliation networks are required, the above instructions shall be adhered to as closely as possible. The test item shall be adjusted for mode of operation and control settings, including frequency, which may be expected to result in a maximum of interference emanation or susceptibility. All receivers and transmitters shall be tested using a shielded dummy antenna.



ENCLOSURE DATA: 14 GAGE (B&S) ALUMINUM SUGGESTED SIZE 9-3/8 IN. BY 4 BY 4 IN.
FORM DATA: 5-1/4 IN. LENGTH, 3 IN. DIA (OD), .125 IN. WALL DRILL 3/8 IN. HOLE 7/16 IN. FROM EACH END.
WIRE DATA: AWG 6,600 VOLT, .310 IN. DIA (OD).
COIL DATA: L1 = 5 MICROHENRIES, 13 TURNS SINGLE LAYER, 4 IN. WINDING LENGTH.
CAPACITOR: C1 SHALL BE MOUNTED ON 1 IN. INSULATING BLOCK ABOVE GROUND.
CAPACITOR DATA: C1 = .1 UF, 600-VOLT DC, BATHTUB.
C2 = 1 UF, 600-VOLT DC, BATHTUB, SINGLE TERMINAL CASE MOUNTED ON GROUND.
RESISTOR DATA: R1 = 5,000-OHM, 5-WATT CARBON.

1. THE VALUES GIVEN FOR THE COMPONENT PARTS OF THE NETWORK ARE NOMINAL. REGARDLESS OF THE CONSTRUCTION OR DEVIATION FROM NOMINAL VALUES, THE NETWORK MUST HAVE AN IMPEDANCE WITHIN 20 PERCENT OF THAT GIVEN IN FIGURE 8.
2. CONNECTING LEADS TO CONDENSERS AND RESISTORS SHOULD BE AS NEARLY AS POSSIBLE TO ZERO LENGTH.
3. NETWORKS MAY ALSO BE CONSTRUCTED HAVING A 1-OHM SERIES RESISTOR BETWEEN THE LINE AND CAPACITOR C2. THIS 1-OHM RESISTOR SHALL BE MADE UP FROM TEN 10-OHM, 1-WATT COMPOSITION RESISTORS.
4. THE DATA GIVEN IN THIS FIGURE IS SUITABLE FOR THE CONSTRUCTION OF 50-AMPERE NETWORKS. LARGER CURRENT-CARRYING NETWORKS MAY BE CONSTRUCTED BY INCREASING THE WIRE SIZE GIVEN FOR THE COIL AND THE SIZE OF THE OVERALL ENCLOSURE.
5. THE 50-OHM TRANSMISSION LINE SHOULD BE EXTENDED WITHIN THE ENCLOSURE RIGHT UP TO THE LOCATION WHERE IT CONNECTS WITH CAPACTOR C1.
6. CAUTION: THE NETWORK SHALL BE PROMINENTLY AND PERMANENTLY MARKED "CAUTION - SHOCK HAZARD - CONNECT CASE TO EARTH GROUND BEFORE CONNECTING A-C POWER LINE."
7. NETWORKS PROCURED PRIOR TO THE DATE OF THIS SPECIFICATION, BUT MEETING THE IMPEDANCE REQUIREMENTS OF FIGURE 8, MAY STILL BE USED.
8. EACH NETWORK SHALL BE PERMANENTLY LABELED WITH THE FOLLOWING DATA: CURRENT RATING IN AMPERES AND VOLTAGE RATING IN VOLTS AT DIRECT CURRENT, 60, 400, AND 800 CPS.

FIGURE 7 *Powerline stabilization network schematic diagram.*

3.2.9.10.5.1 Dummy Antennas:

Any dummy antenna used shall have electrical characteristics which closely simulate those of the normal antenna, and should be shielded where possible. The dummy antenna shall be capable of handling the power required and shall contain any unusual components which are used in the normal antenna (such as filters, crystal diodes, etc). When the nominal antenna impedance is 50 ohms, a 50-ohm (±20 percent from 0.15-1,000 mc) dummy antenna shall be used.

3.2.9.10.5.1.1 Acceptance test of the transmitter may be with cable and dummy antenna of negligible leakage. A test of leakage shall be made with a 5-foot length of double shielded coaxial cable, used between a transmitter and its dummy antenna, to provide information on acceptable cables for actual installations.

3.2.9.10.5.2 Test Sample Leads:

The test sample leads to the powerline stabilization network shall be 24 inches ±1 inch in length and shall be so arranged that the distance between the leads and from each lead to ground or grounded enclosure is approximately 2 inches. In those cases where more than two impedance stabilization networks are required, the above instructions shall be adhered to as closely as possible.

3.2.9.10.5.2.1 Interconnecting Leads:

Whenever possible, interconnecting leads between boxes comprising a test sample shall be not less than 2 feet and not more than 5 feet long. However, if the interconnecting leads are furnished as a part of the equipment, they may be used instead.

3.2.9.10.6 Antenna Orientation and Positioning in Shielding Enclosure:

For each measuring instrument, the following procedure shall be used to determine the horizontal positioning of the antennas of the measuring instruments relative to the test sample.

3.2.9.10.6.1 Test Samples Generating only Broadband Interference (not intended to generate or receive: signals):

The following procedures shall be employed in testing for broadband interference:

(a) Set up antenna in accordance with figure 9, 10, 11, or 12, as applicable, opposite the center of the test sample, but without a bond from the instrument to the ground plane.

(b) Scan the full frequency range of the lowest tuning band of the test instrument in use for the frequency of maximum interference or susceptibility.

(c) Move the antenna horizontally to the position of maximum indication at that frequency, except that dipole antennas of dimension longer than the test sample shall be placed opposite its center.

(d) Bond instrument to ground plane when required and proceed with measurement.

3.2.9.10.6.2 Test Samples Intended to Generate or Receive Signals:

The following procedures shall be employed in testing samples intended to generate or receive signals:

(a) Set up antenna in accordance with figure 9, 10, 11, or 12, as applicable, opposite the center of the test sample, but without a bond from the instrument to the ground plane.

(b) Adjust sample for a mode of operation and control settings, including frequency, which may be expected to result in a maximum of interference or susceptibility.

(c) Scan the full frequency range of the test instrument in use for a maximum indication of interference or susceptibility.

(d) Move the antenna horizontally to the position of maximum indication of interference at that frequency.

(e) Bond instrument to ground plane when required and proceed with measurements.

3.2.9.10.7 Antenna Orientation and Positioning (Free Space):

Those interference measuring instruments which use a rod antenna shall be so placed that the rod antenna is in a vertical position. Those interference measuring instruments which use a dipole antenna shall be so placed that the antenna is parallel with the test sample and on the same level as the midpoint of the test sample. The antenna shall be at the distance from the test sample specified in 3.2.9.10.6. The antenna shall be located at a point around the perimeter of the test sample where maximum interference or susceptibility signal is received. All provisions of paragraph 3.2.9.10.6 and its subparagraphs not in conflict herewith shall apply.

3.2.9.10.8 Loads:

The equipment under test shall be loaded with the full mechanical and electrical load, or equivalent, for which it is designed. This requirement specifically includes electrical loading of the contacts of mechanisms which are designed to control electrical loads even though such loads are physically separate from the equipment under test. Operation of voltage regulators and other circuits which operate intermittently is required. The loads used shall simulate the resistance, inductance, and capacitance of the actual load.

3.2.9.11 Test Methods:

3.2.9.11.1 Conducted Interference:

Radio interference voltages, in the frequency range of 0.15 to 25 mc, except the fundamental signal in the key down condition, generated by the equipment or system in excess of the values indicated in figures 13, 14, 15, and 16 shall not appear on any conductor, external to the system, which could conduct interference to other equipment. Typical test setups for these measurements are shown in figures 17 and 18. Measurements may be omitted on leads deemed by the procuring activity to be incapable of conducting interference into other equipment.

3.2.9.11.1.1 Conducted Interference Using Stabilization Network, 50 Amperes and Under:

Conducted interference measurements on power leads, 50 amperes and under shall be made by connecting the interference measuring instrument to the noise meter terminal on the line stabilization network with a 50-ohm double-shield coaxial cable. The line stabilization network shall not be used on power frequencies over 800 cps since it will probably burn up. The current probe shall be used for this application.

3.2.9.11.1.2 Conducted Interference, Over 50 Amperes:

Conducted interference measurement on power leads over 50 amperes shall be made with a stabilization network, designed for high current (see Figure 7), or with the network shown in Figure 19, at the discretion of the contractor.

3.2.9.11.1.3 Interconnecting Leads:

Conducted interference on interconnecting and signal leads and power lines over 800 cps shall be measured by using a clamp-on interference measuring device (current probe Stoddart Aircraft Radio Co. type 91550-1, or equal).

3.2.9.11.1.3.1 Position of Probe:

The current probe shall be positioned at the point of maximum interference on the cable to be tested. A maximum movement of 5 feet along power lines is considered adequate. This maximum interference point shall be located at each test frequency. The location of the current probe shall be fully described in the test report.

3.2.9.12 Radiated Interference:

Radiated interference fields, except the fundamental signal in the key down condition, which shall not exceed 100 db above 1 μv, in excess of the values given in Figures 20, 21, 22 and 23, shall not radiate from any unit, cable (including control, pulse, IF, video, antenna transmission, and power cables), or interconnecting wiring over the frequency range of 0.15 to 10,000 mc for cw and pulsed cw interference,

and 0.15 to 400 mc for broadband impulse interference. This requirement includes fundamental oscillator radiations other spurious emanations, and broadband interference. This does not include radiation emanating from antennas. Test setups are illustrated in Figures 9, 10, 11, and 12.

3.2.9.13 Antenna-Conducted Spurious Emanations:

3.2.9.13.1 Transmitter Keyup or Receiver:

The r-f output of the transmitter keyup or receiver shall not exceed 43 db above 1 microvolt for cw or 60 db above 1 microvolt per mc for pulse cw interference at any frequency between 0.15 and 10,000 mc. Normally, measurements are required up to the 20 harmonic or 1,000 mc, whichever is higher, but in no event above 10,000 mc unless the contractor can show by scanning or other means that such measurements will not result in any significant data.

3.2.9.13.2 Transmitter Keydown:

The transmitter shall be operated into a dummy load. A suitable coupling device shall be used to sample the transmitter output and protect the measuring equipment. Bridge "T" rejection network, filter rejection network, or other adequate devices shall have the approval of the procuring activity. Attention should be given to oscillator frequency and harmonics, outputs from frequency multipliers and crystal saver circuits, beat frequency oscillator outputs, etc. External filters shall not be used unless approval is obtained from the procuring activity. Normally, measurements shall be made up to the 10th harmonic or 1,000 mc, whichever is higher, but in no event above 10,000 mc unless the contractor can show by scanning or other means that such measurements will not result in any significant data.

3.2.9.13.2.1 Spurious Emission Limits:

The peak power output shall be as follows:

(a) Second Harmonic: The peak power output of the second harmonic of the output fundamental frequency shall be at

least 35 db below that of the fundamental, or 10^{-8} watts (707 μv into 50 ohms)$_j$ whichever is greater, but in no event greater than 1 watt.

(b) Harmonics above the second, and other spurious emissions: The peak power output of any harmonic above the second, and of any non-harmonic emission, shall be at least 45 db below that of the fundamental, or 10^{-8} watts (707 μv into 50 ohms) whichever is greater, but in no event greater than 10^{-8} watts.

3.2.9.14 Susceptibility:

The r-f sensitivity control shall be set for maximum signal plus noise-to-noise ratio. The radio frequency signal shall be modulated 30 percent, 400 or 1,000 cps.

3.2.9.14.1 Conducted Susceptibility Powerline:

The voltage specified shall be those voltage which are calculated to exist across the output terminals of the signal source when no load, other than that necessary to meet the requirements as to source impedance is connected to the signal generator. A matching network suitable for use at required test frequencies and voltages shall be used to obtain the proper source impedance. Blocking capacitors having negligible impedance at the test frequency may be inserted in the leads from the signal source to the equipment under test if required for the protection of the signal source.

3.2.9.14.1.1 Radio Frequency Conducted:

No malfunction or reduction of specified sensitivity shall be produced in any equipment when an r-f signal of 1K microvolts, from a source having an impedance of 50 ohms is applied to the test sample as shown in Figure 24. Tests shall be made over the frequency range of 0.150 mc to 10,000 mc.

3.2.9.14.1.2 Audio Frequency Conducted:

No malfunction or reduction of specified sensitivity shall be produced in any equipment when a sine wave

audio frequency signal of 1 volt rms, open circuit, is applied as shown in Figure 25. Measurements shall be made over a frequency range of 50 to 15,000 cps.

3.2.9.14.2 Radio Frequency Radiated:

No malfunction or reduction of specified sensitivity shall be produced when the equipment is subjected to a radio frequency field. This field shall be established with a 50-ohm signal generator driving the antenna listed below. Care shall be taken to use matching networks when required. The test setup is shown in Figure 26 for the rod antenna and is similar to Figures 11 and 12 for the other antennas, with the signal source replacing the interference meter.

Frequency	Open-circuit Microvolts	Antenna
0.15 to 25 mc	100,000	41-inch rod
25 to 40 mc 10,000 (3,000 for	receiver bandpass)	35-mc dipole
40 to 1,000 mc	100,000	Tuned dipole
1,000 to 10,000 DC	100,000	Same as used for radiation test

3.2.9.14.3 Receiver Intermodulation:

The contractor shall test the intermodulation properties of receiving type equipment by either of the two tests following.

3.2.9.14.3.1 Two-Signal Intermodulation Test:

Receivers, preamplifiers, or antenna couplers shall not produce an output indication when two sine wave signals representing undesired signals are connected to the input terminals of the test sample. The two frequencies shall be chosen so that their sum or difference is equal to the test frequency and so that neither will give an output when applied alone. The magnitude of each shall be at least 70 db above 1 microvolt at the test sample terminal; one shall be modulated 30 percent with a 10,000-cycle signal, and other 30 percent with 1400-cycle signal. Impedance matching networks shall be used as required.

3.2.9.14.3.2 Broadband Intermodulation:

The test sample receiver shall be connected to the standard-impulse generator by means of 150-ohm coaxial cable terminated with a 10-db resistive pi or T pad with negligible frequency characteristics in the region of the frequency of test. The impulse generator shall be turned on and the output attenuator reading for minimum preceptible receiver output, or other evidence of normal function, shall be noted. The receiver local oscillator (or each oscillator in turn for multiple-conversion superheterodyne receivers) shall be disabled and, if feasible, a 60-cycle voltage (or current) equal to the oscillator signal shall be injected into the mixer. The output of the impulse generator is then raised until the minimum perceptible receiver output, or other evidence of normal function, is again evident. This generator setting in db, less the original setting in db, is the broadband intermodulation in db. The intermodulation of undesired signals introduced across the antenna terminals shall be at least 25 db.

3.2.9.14.3.2.1 Impulse Generators:

Impulse generators used for intermodulation testing of receivers shall be as shown in table III.

3.2.9.14.4 Receiver Front-end Rejection:

Front-end rejection of receivers shall be equal to or greater than the limit shown in figure 29 except that image frequencies above 25 mc. shall be 50 db. This test shall be performed with any signal generators equipped with an accurate attenuator and capable of a signal output at least 80 db greater than the minimum signal perceptible at the tuned frequency of the particular receiver being tested. If necessary, matching networks shall be used to obtain a 50-ohm output. All measurements shall be corrected to account for any changes in output voltages owing to addition of matching networks and shall be equal to the open-circuit voltage at the output terminals. With the signal generator and receiver connected with a 50-ohm coaxial cable and tuned to the same frequency, the generator setting which gives the minimum perceptible reading above the receiver background noise shall be noted. Modulation may be used in conjunction with an output meter if the receiver is not equipped to

give meter indications of CW signals. The frequency range between 150 kc and 10,000 mc shall then be scanned with the generator output preferably set at least 80 db above the output originally noted. Those frequencies at which output signals are obtained shall be investigated to obtain the generator reading which corresponds to the original receiver output signal. Since all signal generators emit a substantial amount of harmonics, care should be taken that the receiver is not erroneously rejected because of such spurious signal content.

TABLE III -- Impulse Generators

Receiver tuning range in mc	Impulse generator type	Manufacturer
Below 500	IG-102	Empire Devices Products Corp.
	IG-115	Empire Devices Products Corp.
	Impulse generator incorporated in NF-105 or NF-205.	Empire Devices Products Corp.
	91263-1	Stoddart Aircraft Radio Company
500-10,000	IG-118	Empire Devices Products Corp.

Front-end rejection is calculated with the following formula:

Front-end rejection = 20 log V_2/V_1

V_1 = Signal generator voltage required for minimum perceptible receiver output on channel or frequency under test.

V_2 = Signal generator voltage required for minimum perceptible receiver output at all other frequencies.

When this test cannot be accomplished owing to the possibility of crystal burnout or for other reasons, the test signals shall be injected into the test sample by using a suitable antenna fed from a signal generator. The test procedure to be used shall be included in the test plan.

3.2.9.15 Notes:

3.2.9.15.1 Intended Use:

The test procedure and limits specified herein are intended to insure that this equipment will operate properly in service use when subjected to certain radio and audio interference voltages, and will not cause the malfunction of other equipments by generation of interference voltages.

3.2.9.15.2 Bonding:

The requirements of Specification MIL-B-5087 are recommended for study as a guide toward design for compliance with the bonding requirements of this specification.

3.2.9.15.3 Additional information.

The information contained in the handbook “Design techniques for Interference-Free Operation of Airborne Electronic Equipment,” is recommended as a guide towards design for compliance with this specification. Organizations with a military contract can obtain the handbook, at no cost, from ASTIA, Publication No. ATI-159699. Organizations without a military contract can order the handbook as Report No. P. B. 111051 from the Department of Commerce, Office of Technical Services, Washington 25, D.C. A check for $11.50, payable to the Treasurer of the United States, must accompany the order.

3.2.9.15.4 Definitions:

3.2.9.15.4.1 Interference:

Interference is defined as any electrical or electromagnetic

disturbance, phenomenon, signal or emission, man-made or natural, which causes or can cause undesired response, malfunctioning or degradation of performance of electrical and electronic equipment, or premature and undesired location, detection, or discovery by enemy forces, except deliberately generated interference (electronic countermeasures).

3.2.9.15.4.2 Susceptibility:

As used herein, susceptibility is defined as that characteristic which causes an equipment to malfunction or exhibit an undesirable response when its case or any external lead or circuit, excepting antennas, is subjected to the specified radio or audio frequency voltage or field.

3.2.9.15.4.2.1 Undesirable Response:

Undesirable response is defined as a change in the normal output which causes no malfunctioning but is not required for the proper operation of the equipment.

3.2.9.15.4.2.2 Threshold Susceptibility:

Threshold susceptibility is defined as an undesirable response which is barely recognizable from the normal output.

3.2.9.15.4.2.3 Malfunctioning:

Malfunctioning is defined as a change in the normal output which effectively destroys the proper operation of the equipment.

3.2.9.15.4.3 Ambient Interference:

Ambient interference, for the purpose of this specification, is the interference level emanating from sources other than the test sample, including the internal background noise of the interference measuring equipment.

3.2.9.15.4.4 Internal Background:

Internal background is the indication on the measuring instrument obtained when a shielded dummy antenna is connected at its

input. A correct indication is obtained only if the ambient interference does not affect the instrument and the test for leakage.

3.2.9.15.4.5 Antenna Induced Microvolts:

Antenna induced microvolts is that voltage which exists across the open-circuited antenna terminals.

3.2.9.15.4.6 Impulsive Interference:

For the purposes of this specification, all broadband noise, including random noise and pulsed CW is considered to be impulsive interference.

3.2.9.15.4.7 Octave:

An octave is a frequency ratio of 1 to 2, i.e., from 1 to 2 mc, to 2 to 4 mc, 500 to 1,000 mc, etc.

3.2.9.15.4.8 Microvolt per mc:

The nearest approach to a standard unit of measurement of broadband radio interference is in terms of microvolt per megacycle. Interference intensity in microvolt per megacycle is equal to the number of root mean square sine wave microvolt (unmodulated) applied to the input of the measuring circuit at its center frequency that will result in detector peak response in the circuit equal to that resulting from the interference pulse being measured, divided by the impulse bandwidth of the circuit in megacycles.

3.2.9.15.4.9 Impulse Bandwidth:

The impulse noise bandwidth of the interference measuring instrument should be used in calculation involving broadband noise. Effective (random) bandwidth should not be used. The impulse noise bandwidth of a receiver can be readily obtained by use of an impulse generator of known output in microvolts/kc. The peak response indication of the instrument in input microvolt divided by the output of the impulse generator in microvolts/kc

is the impulse noise bandwidth of the instrument in kc.

3.2.9.15.4.10 Radio Receiver Front-end Rejection:

Front-end rejection is the measured capability of a receiver, expressed in decibels, in rejecting signals at the antenna terminals that are outside the channel, or frequency, to which the receiver is tuned.

3.2.9.15.4.11 Open Space:

The term "open space," as used in this specification, is intended to designate an ideal site for radiated interference measurements. This ideal site should be open, flat terrain at a considerable distance (100 feet or more) from buildings, electric powerlines, fences, trees, underground cables, and pipe lines. This site should have a sufficiently low ambient level of radiated interference to permit testing to the governing radiated interference limit at any test frequency selected.

3.2.9.15.5 Standard Antennas:

Because of the nonuniformity of the electromagnetic field which usually exists close to a test sample, it is imperative that tests for radiated interference be conducted with antennas identical to those specified. Attempts to correlate results obtained with other antennas by reducing the results to microvolt per meter, based upon plane wave calculations and antenna effective height, may be erroneous and will not be accepted as indicating compliance with this specification.

3.2.9.15.6 Operator and Observer Positions:

In those cases where the operator's or observer's location seems to vary a measurement reading, a minimum distance of 3 feet should be maintained between his body and the antenna; the operator should change position slightly until a maximum reading is obtained. In all cases, as few observers as possible should be present in the screen room during the radiated measurements.

3.2.9.15.7 Impulse Generators:

Satisfactory impulse generators can be obtained from Empire

Devices Products Corp., Amsterdam, N. Y., and from Stoddart Aircraft Radio Co., 6644 Santa Monica Boulevard, Hollywood 38, Calif.

3.2.9.15.8 Loop Probe MX-936/URM:

Loop probe MX-936/URM is commercially available from White Industries, Inc., 421 West 54th Street, New York, N.Y., or from National Co., Inc., 16 Sherman Street, Malden, Mass. (Part No. R8061-1.)

3.2.9.15.9 Coaxial Switches:

Coaxial switches can be used to advantage for measurements where many manipulations of coaxial cables are required during tests.

3.2.9.15.10 RF Radiation Hazard:

A tri-service limit for exposure to RF radiation has been established at .01 watts/cm^2 at any frequency. It is possible to encounter even higher power densities than the established safe maximum limit during the course of tests required by this specification; however, these exceedingly high densities are usually localized. The human eye is highly vulnerable to RF radiation. Adequate safety precautions are recommended.

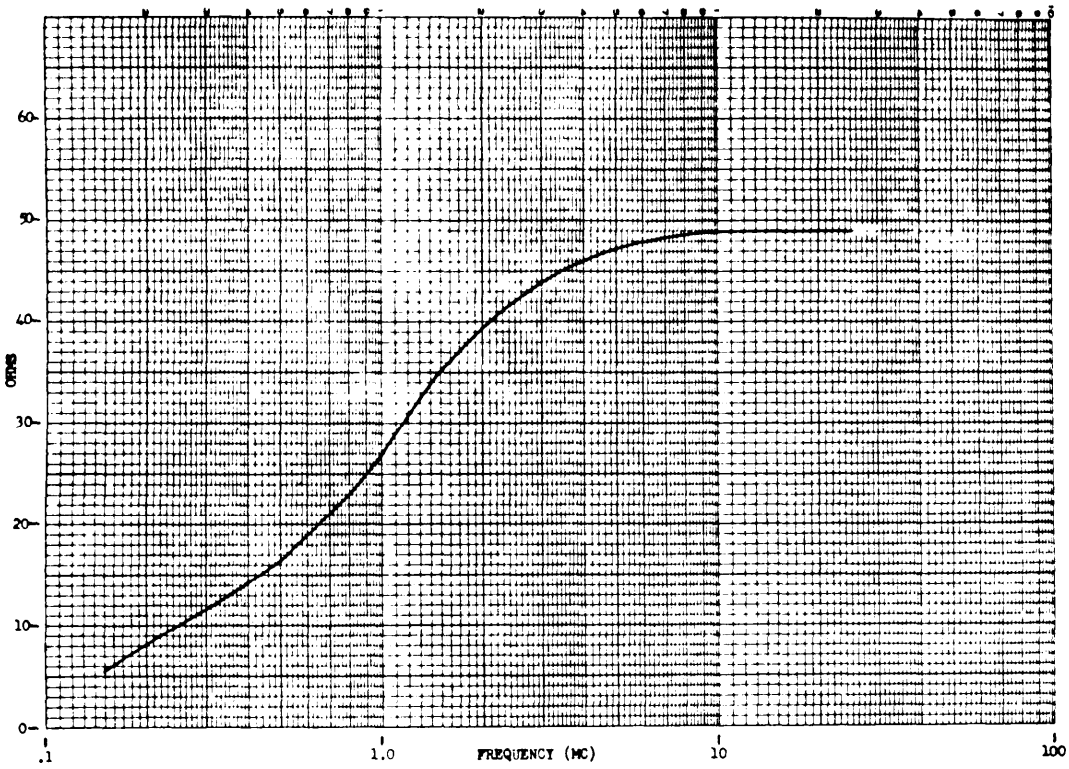


FIGURE 8 *Input impedance at test sample terminal of stabilization network with coaxial connector terminated in 50 ohms, power terminal open.*

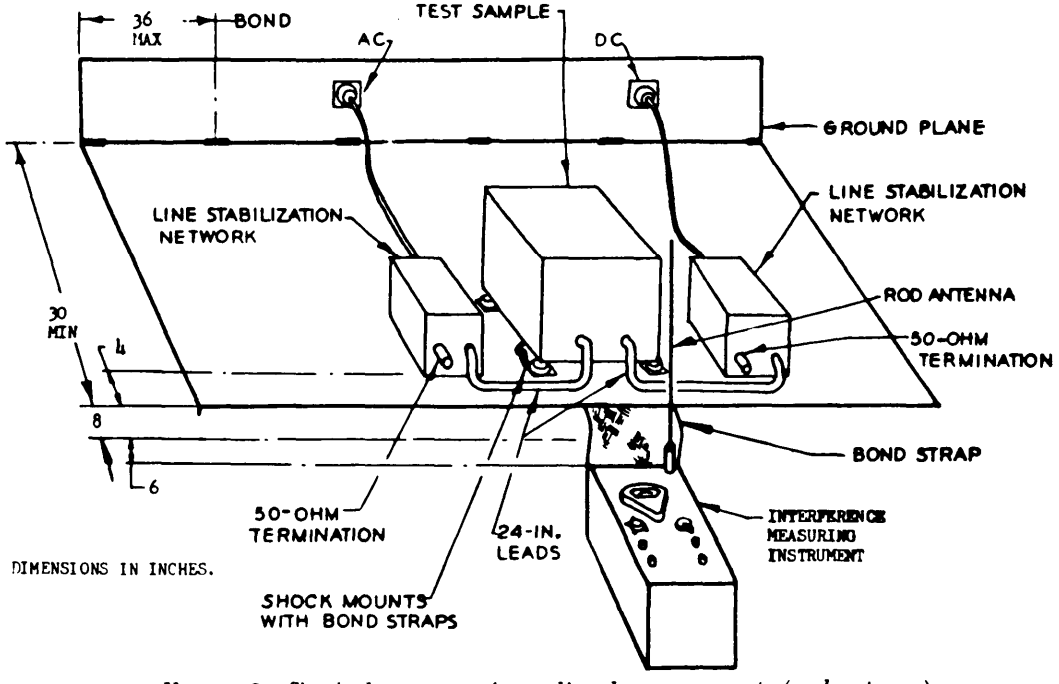


FIGURE 9 *Typical test setup for radiated measurements (rod antenna).*

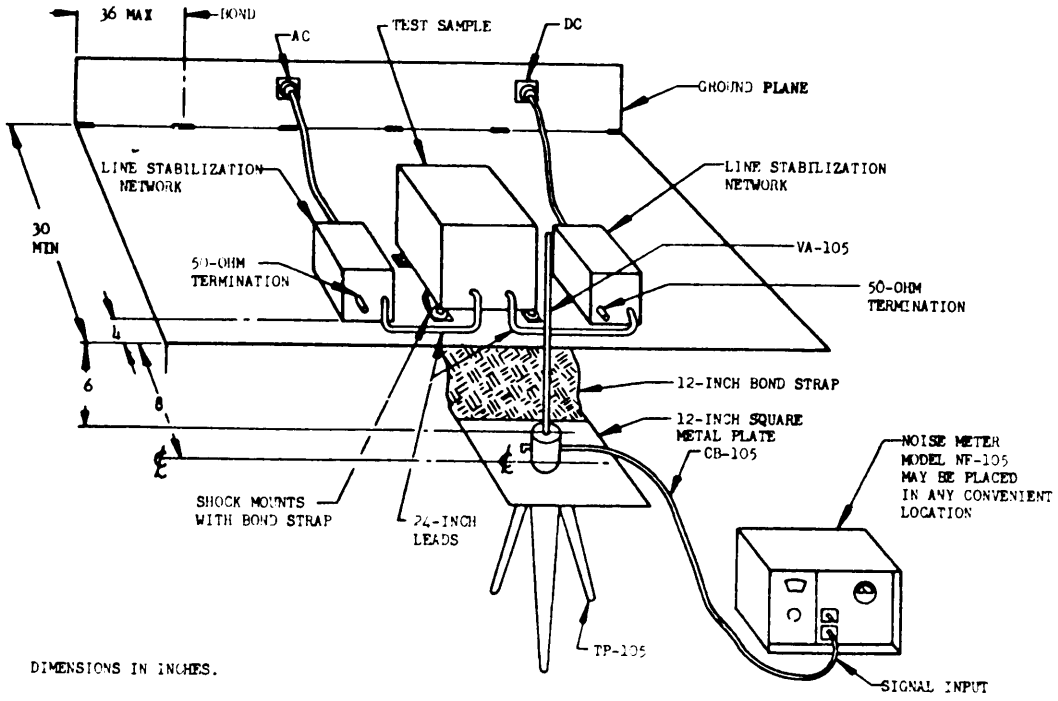


FIGURE **10** *Test setup for radiated measurements (rod antenna).*

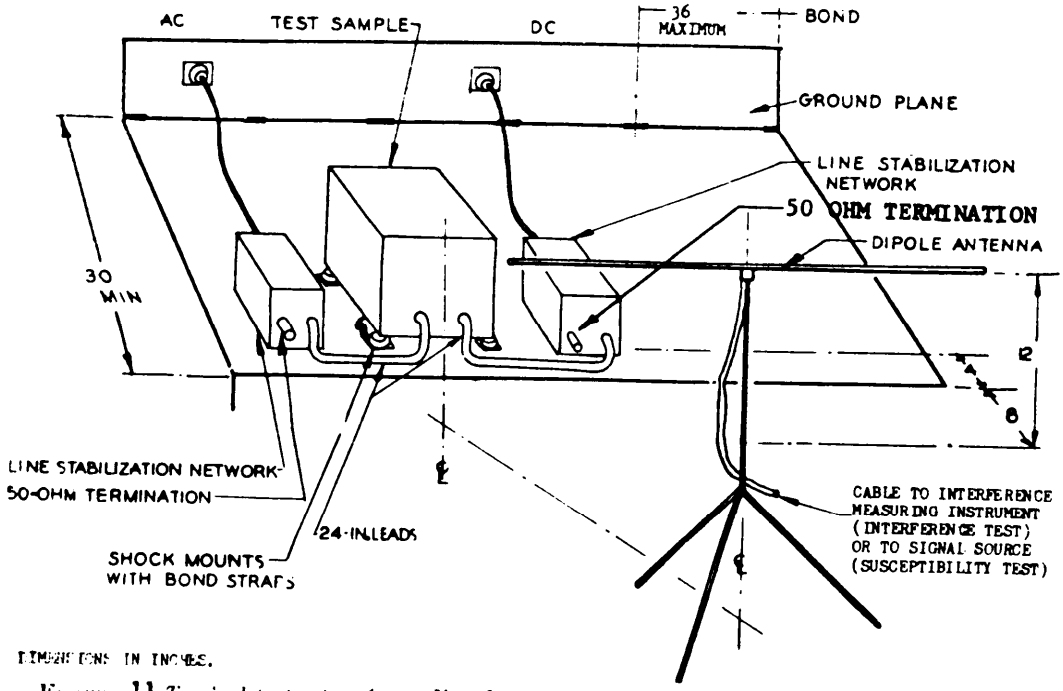


FIGURE **11** *Typical test setup for radiated and susceptibility measurements (dipole antenna).*

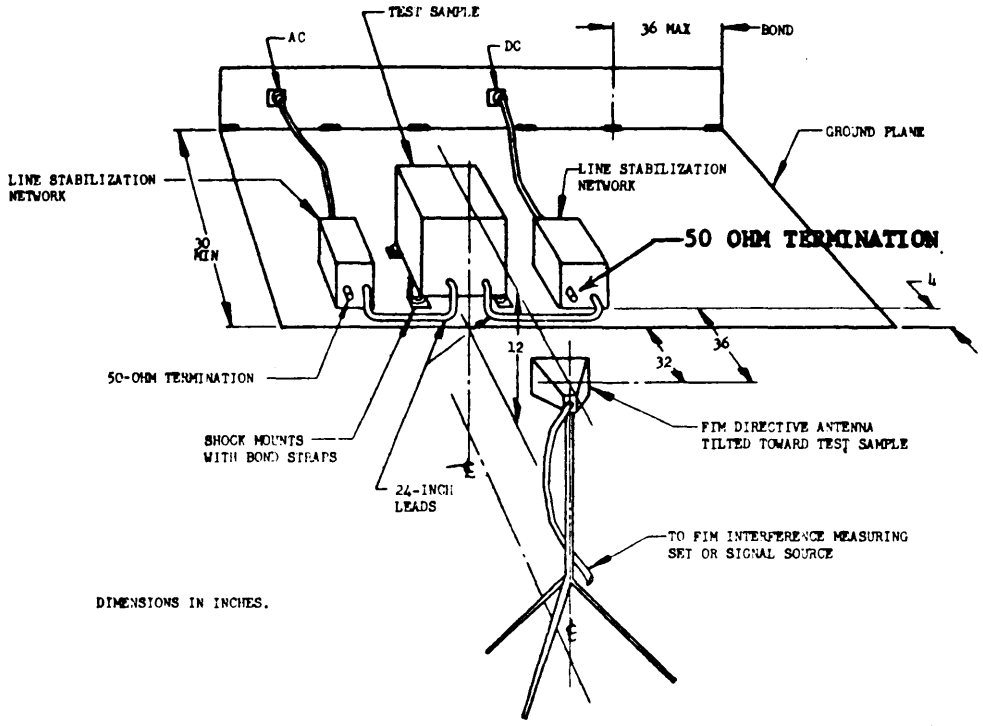


FIGURE 12 *Typical test setup for radiated and susceptibility measurements (microwave-directive antenna).*

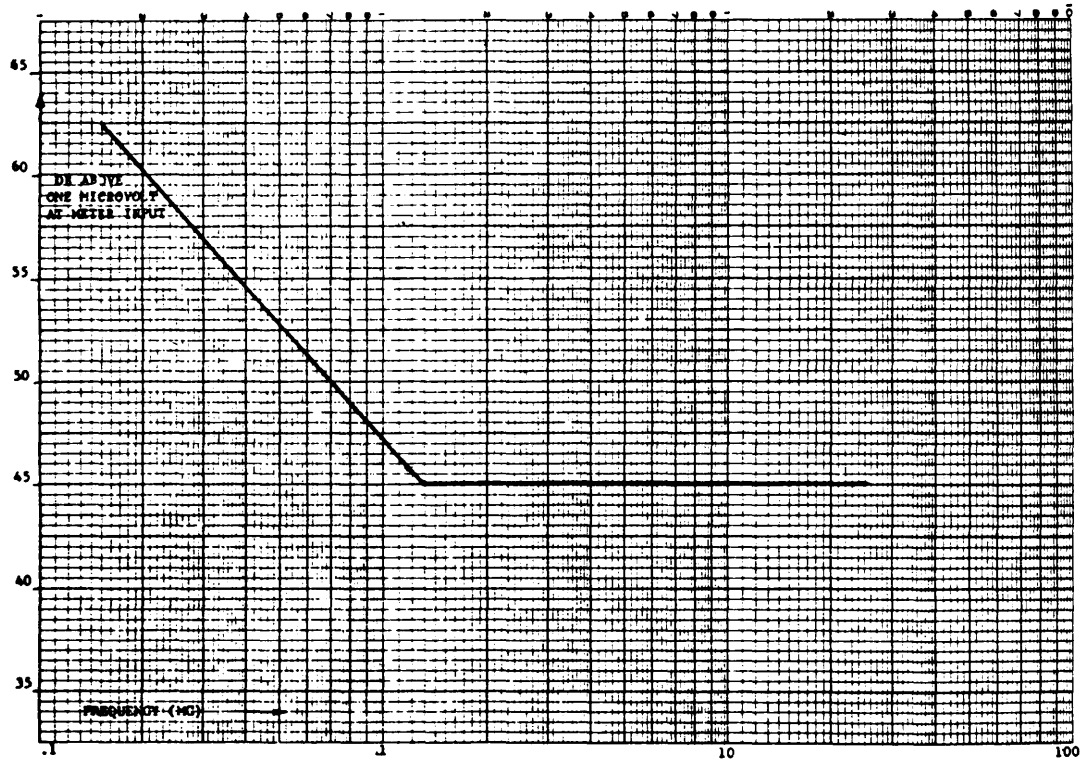


Figure 13 **Narrow band (CW) conducted interference limits using stabilization network.**

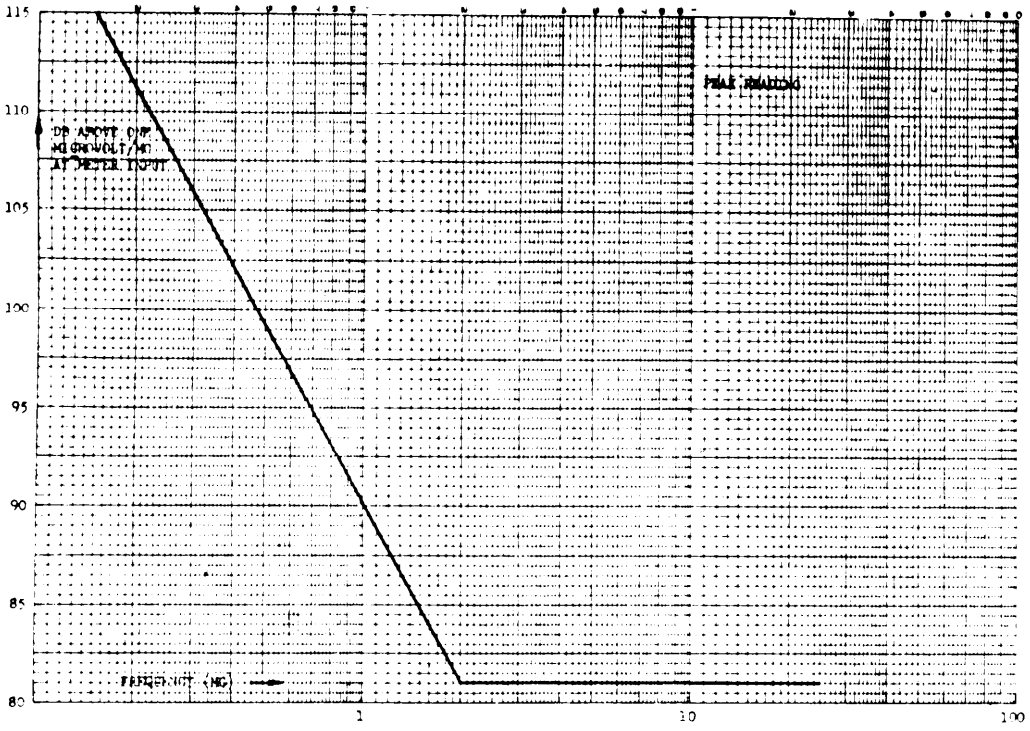


FIGURE 14 *Broadband and pulsed CW conducted interference limits using stabilization network.*

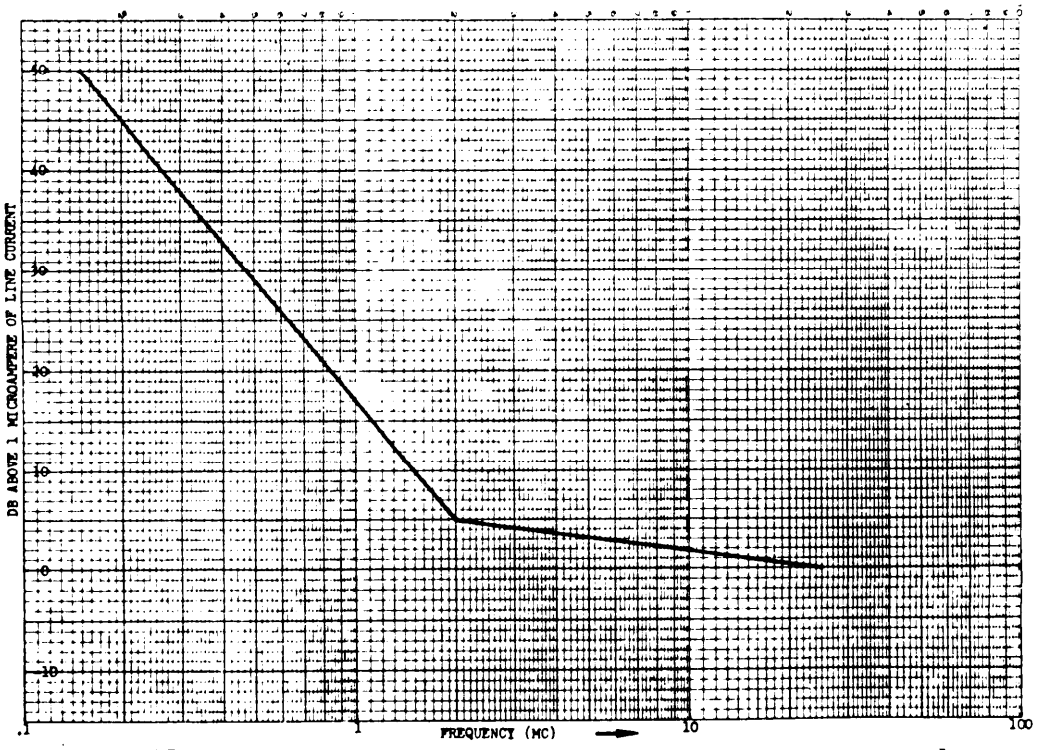


FIGURE 15 *Narrow band (CW) conducted interference limits using current probe.*

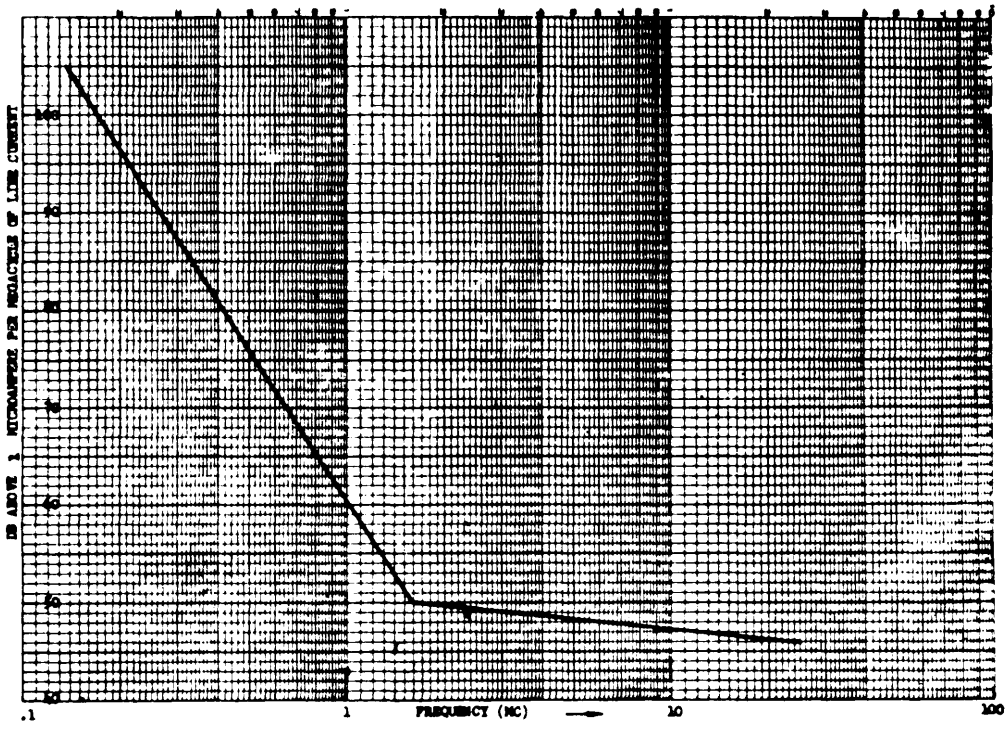


FIGURE 16 *Broadband and pulsed CW conducted interference limits using current probe.*

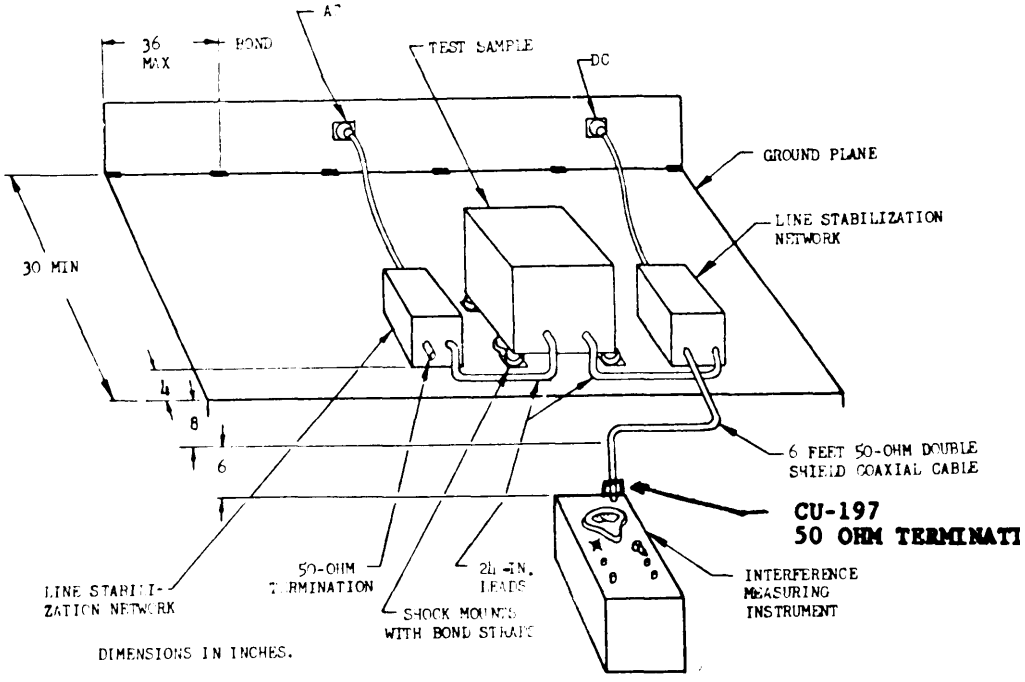


FIGURE 17 *Typical test setup for conducted interference measurements.*

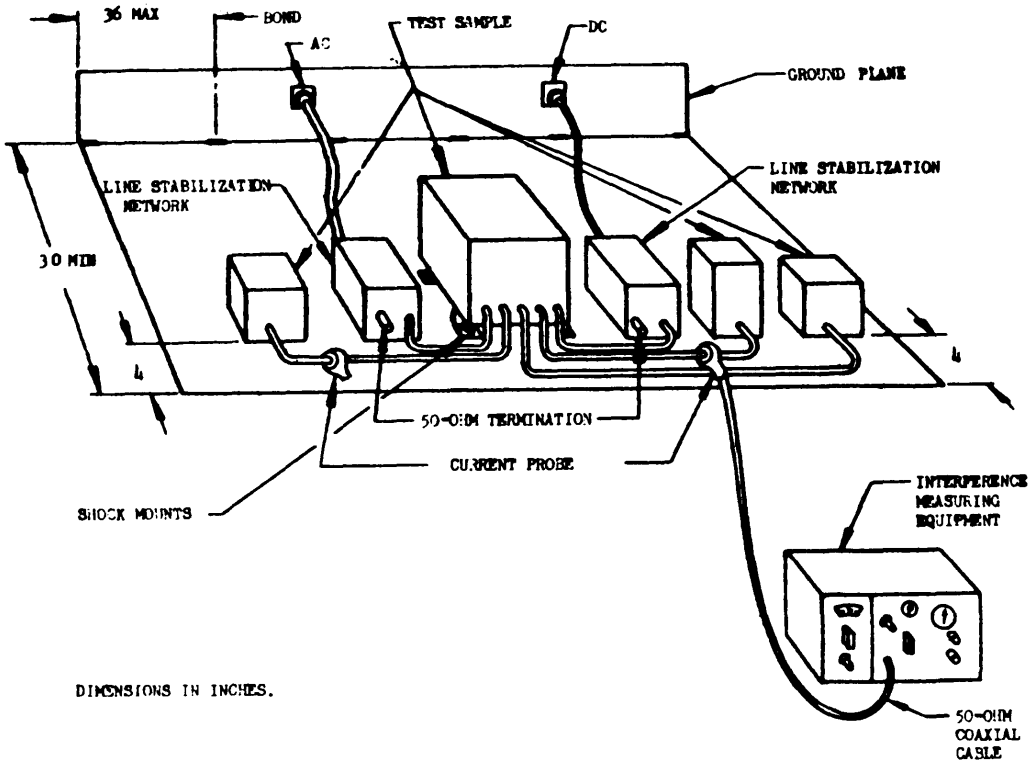
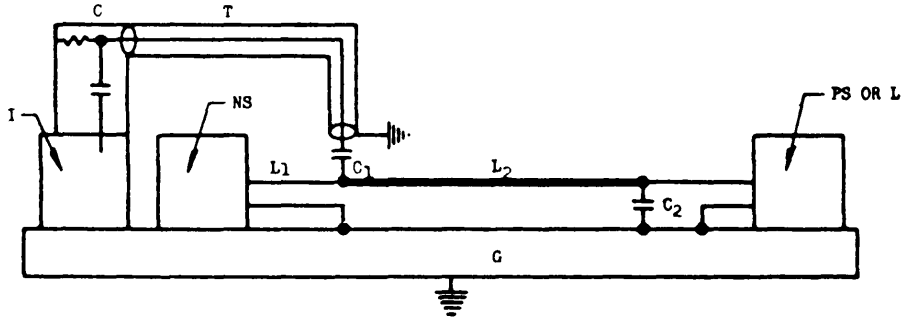


FIGURE 18 *Typical test setup for conducted interference measurements on interconnecting leads using current probe.*



I = AN/PRM-1 METER . G = GROUND COPPER TABLE.

C = CU-197/PRM-1 COUPLER (50-OHM AND 10-MMFD. DUMMY).

T = TRANSMISSION LINE CABLE, 50-OHM, RG-8/U.

C_1 = 0.1 MFD. C_2 = 1.0 MFD.

NS = NOISE SOURCE, TEST SAMPLE.

L_1 = TEST SAMPLE LEADS, 24 INCHES LONG, 2 INCHES APART, 2 INCHES ABOVE GROUND, UNSHIELDED.

L_2 = 10-FOOT LINE, UNSHIELDED, INSULATED, PLACED FLAT ON GROUND.

PS OR L = POWER SUPPLY OR LOAD.

L_1 AND L_2 OF PROPER SIZE TO CARRY LINE CURRENT.

L_2 MAY BE ZIGZAGGED IF DESIRED WHEN TABLE G IS NOT OF SUFFICIENT LENGTH.

FIGURE 19 *Network for conducted interference measurements, line current above 50 amps.*

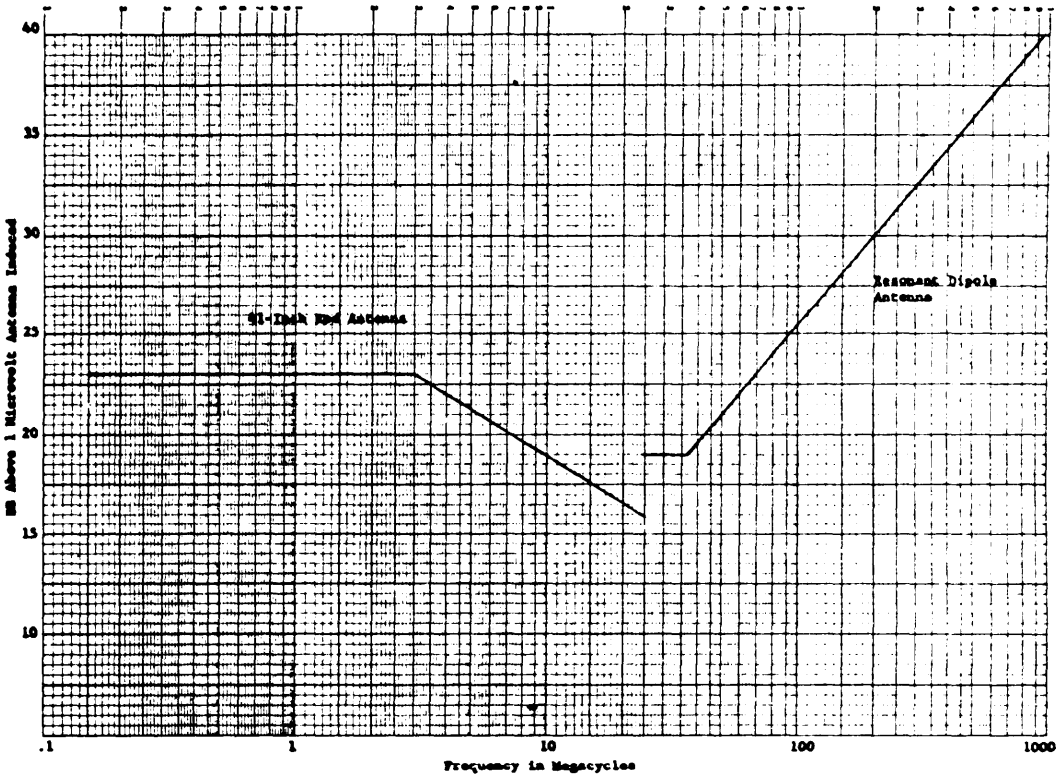


FIGURE 20 *Narrow band (CW) radiated interference limits.*

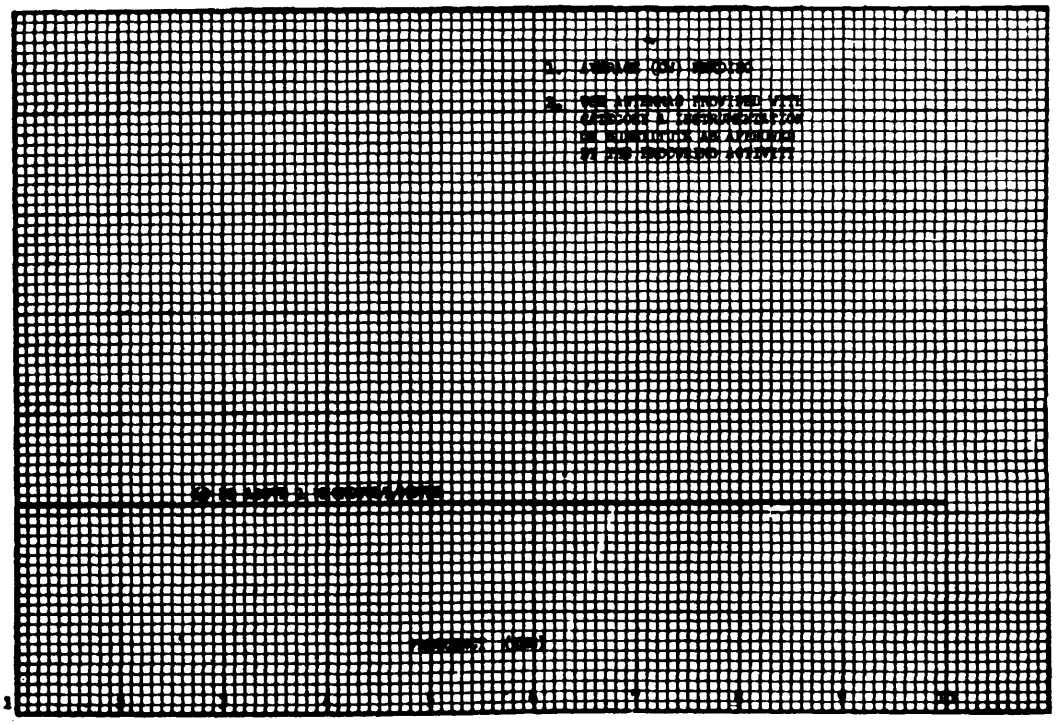


FIGURE 21 *Narrow band (CW) radiated limits.*

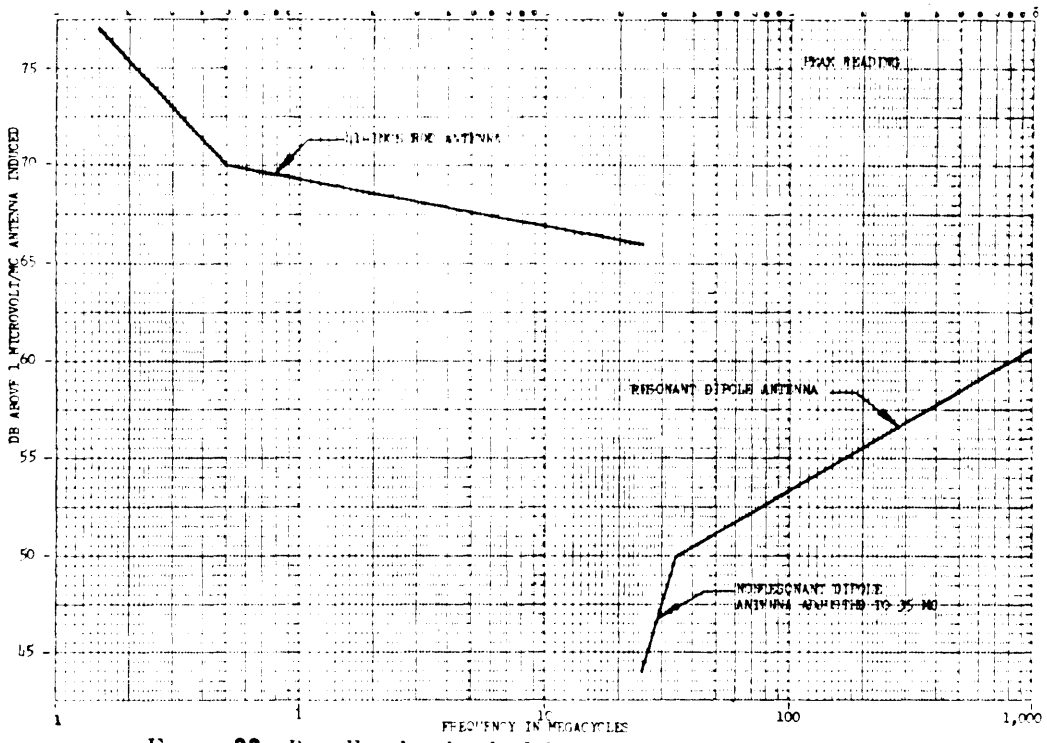


FIGURE 22 *Broadband and pulsed CW radiated interference limits.*

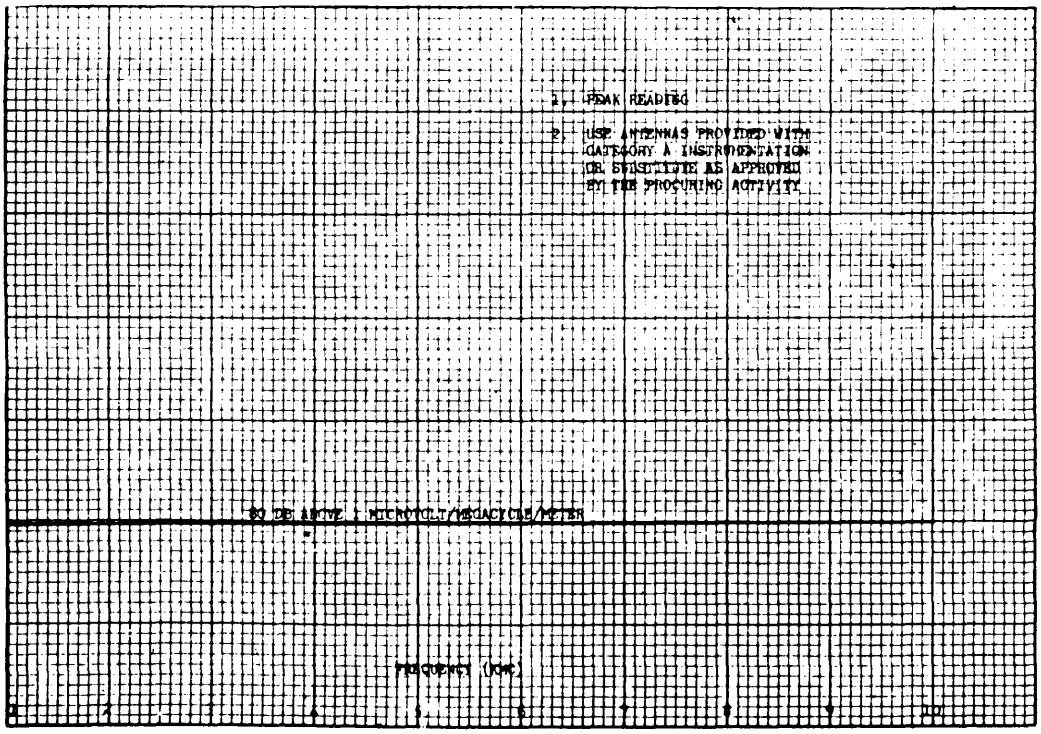


FIGURE 23 *Pulsed CW radiated limits.*

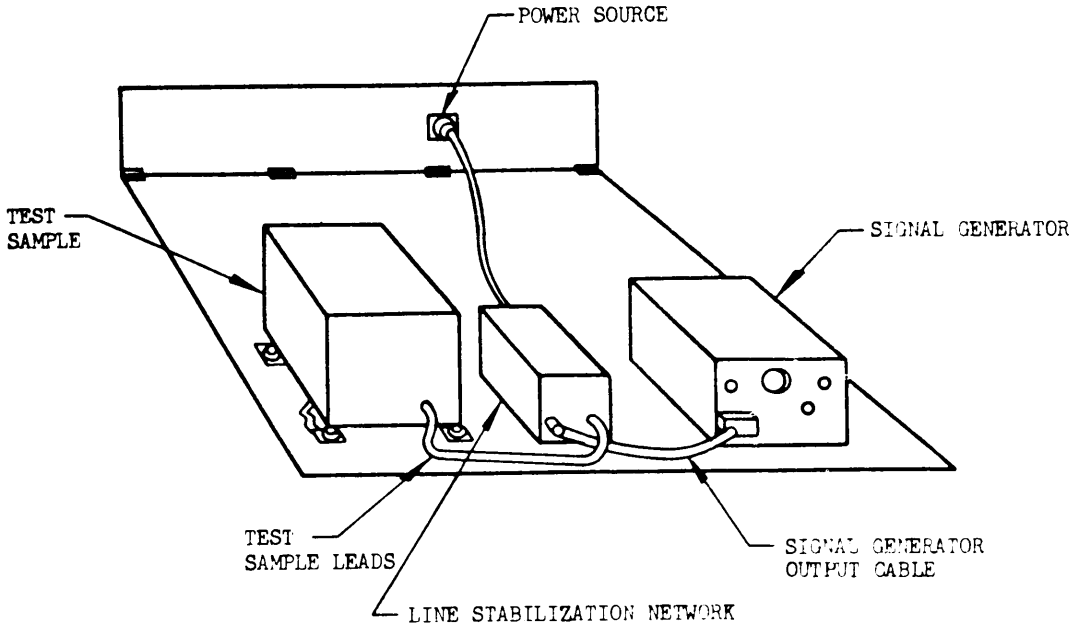
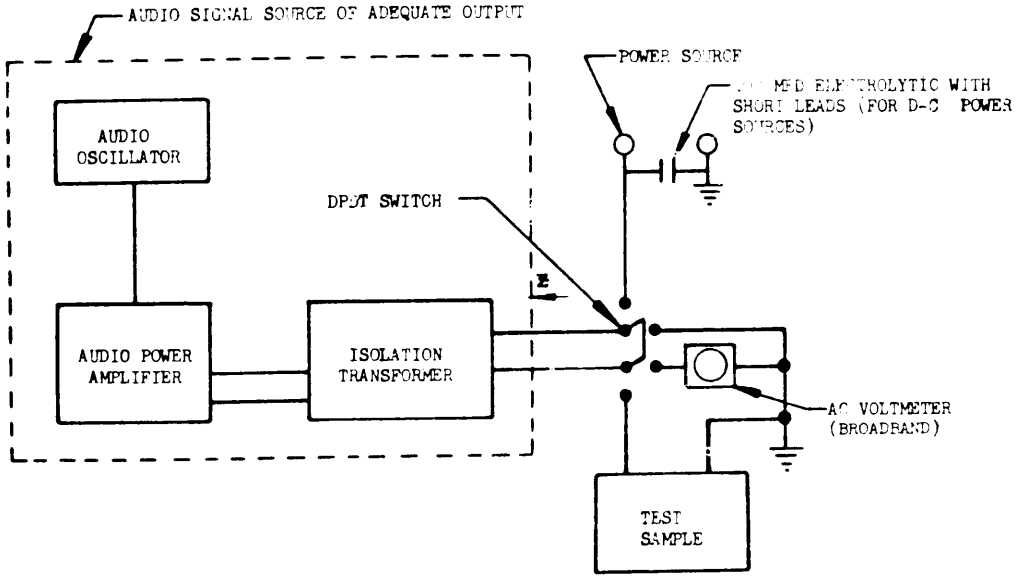


FIGURE 24 *RF susceptibility test setup (conducted).*



1. AUDIO SIGNAL SOURCE SHALL HAVE A SOURCE IMPEDANCE NOT EXCEEDING 0.6 OHM.
2. THE VOLTMETER SHALL READ AN OPEN-CIRCUIT VOLTAGE (TEST SAMPLE DISCONNECTED) OF 3V RMS.
3. ISOLATION TRANSFORMER SHALL CARRY ALL CURRENTS WITHOUT SATURATION.
4. SERIES CONDENSER ON AC VOLTMETER SHALL HAVE REACTANCE NOT GREATER THAN 1/10 METER IMPEDANCE.
5. A VARIABLE AUTOTRANSFORMER CAN BE USED BETWEEN THE ISOLATION TRANSFORMER AND THE AMPLIFIER TO ADJUST FOR THE REQUIRED IMPEDANCE.
6. THE ABOVE VARIABLE AUTOTRANSFORMER MAY ALSO BE USED TO PREVENT HIGH AC LINE VOLTAGES FROM FEEDING INTO THE AMPLIFIER.

FIGURE 25 *AF susceptibility test setup.*

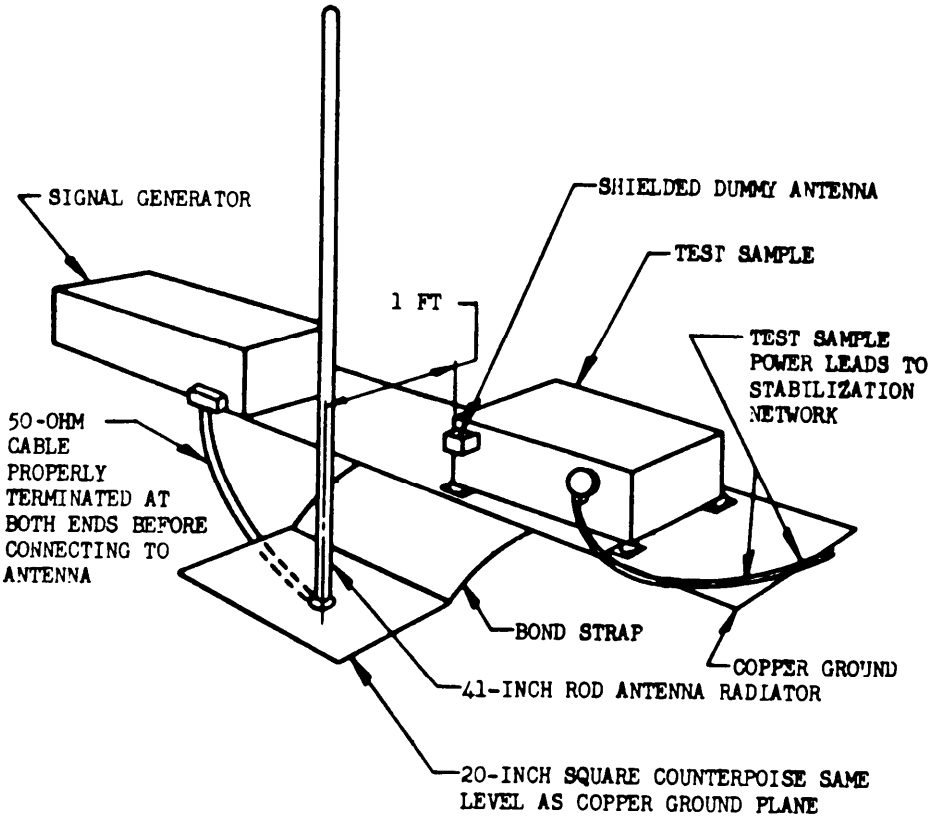


FIGURE 26 *Susceptibility radiated test setup (rod antenna).*

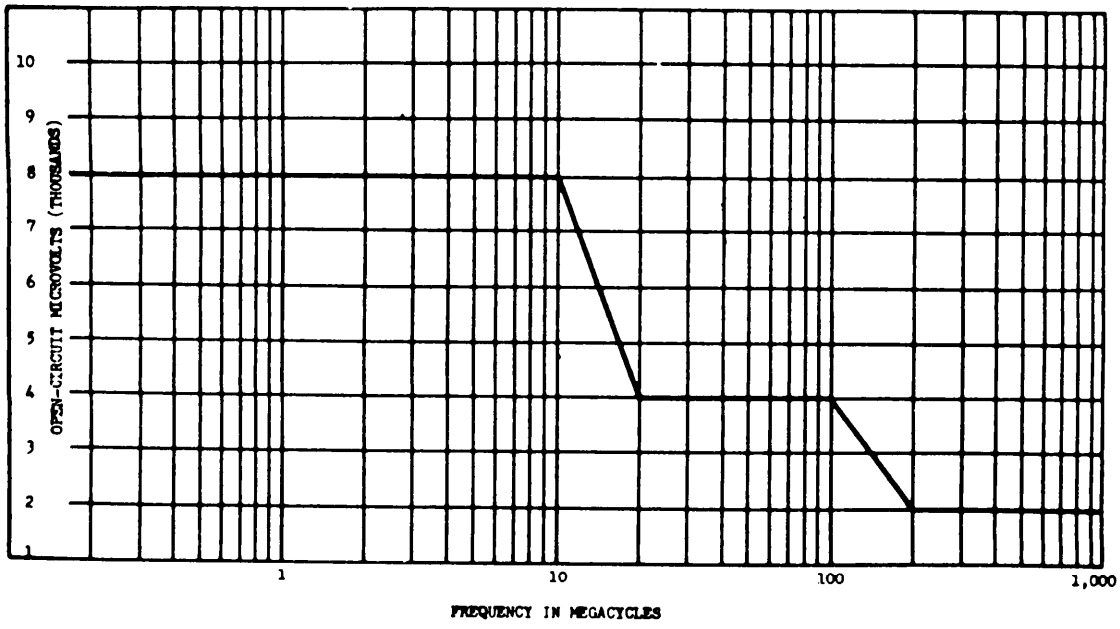


FIGURE 27 *Proposed limits for radiated RF susceptibility tests (equipments using shielded antenna lead-ins).*

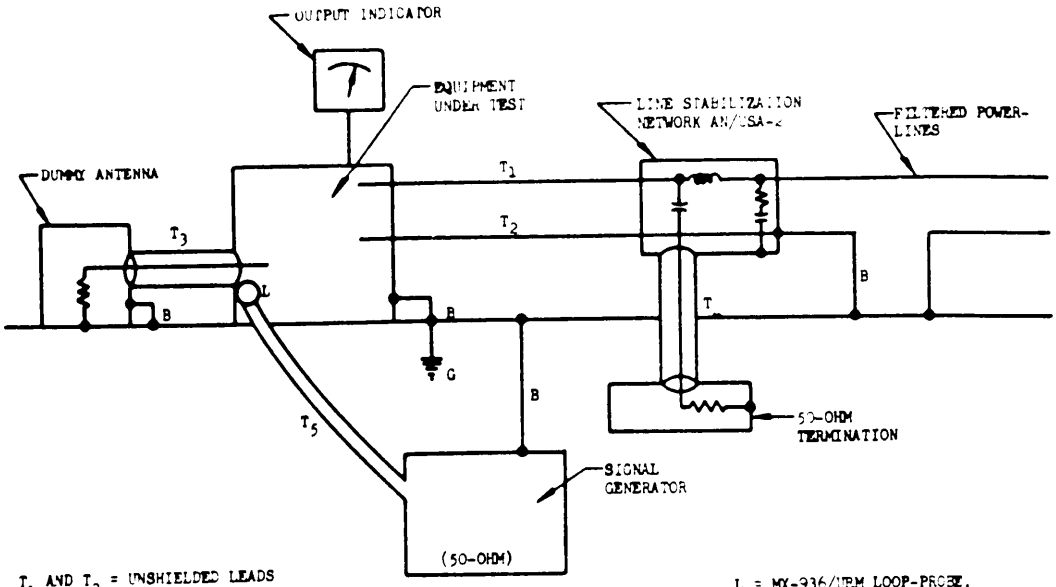


FIGURE **28** *Setup for radiated RF susceptibility tests.*

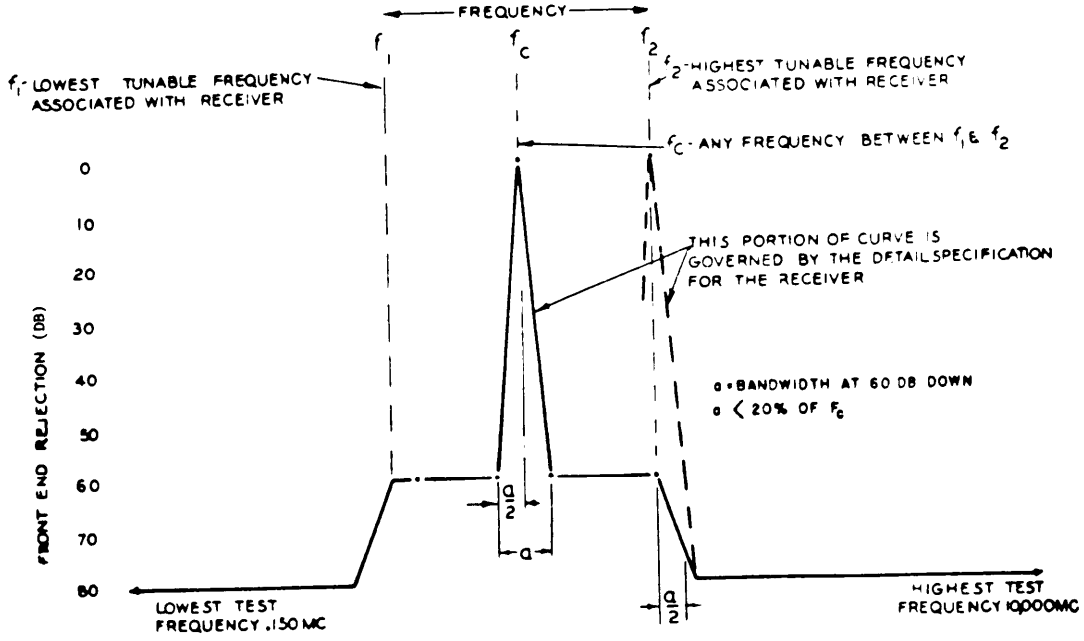


FIGURE **29** *Required receiver front-end rejection.*

3.2.10 Antijamming:

The electronic system or equipment shall be designed to obtain the maximum inherent protection against possible interfering signals caused by enemy jamming, inadvertent radio interference, and atmospherics.

3.2.11 Reliability and longevity:

The reliability and longevity requirements shall be as specified in paragraph 3.3.

3.2.12 Maintenance provisions:

3.2.12.1 Operational checkout provisions:

The equipment shall be designed to provide for connections for such test equipment as may be required for operational checkout tests. The equipment shall be designed in such manner as to permit use of items of standard service test equipment where possible. If special test equipment is required, the procuring activity shall be supplied with recommendations therefor.

3.2.12.2 Chassis test points:

Circuit test facilities shall be provided on the chassis of the equipment. These test facilities shall consist of suitable test-point terminals mounted on the chassis and electrically connected to selected positions of the circuit. The location of the test points shall be determined by the component layout and circuit involved. Sufficient test points shall be made accessible to facilitate the location of most probably circuit malfunctions which may reasonably be expected to occur within the equipment.

3.2.13 Microphonics:

Microphonics effects shall be kept to an absolute minimum or below the point where they are detrimental.

3.2.14 Moisture Pockets:

Pockets, wells, traps, and the like, in which water and condensed moisture can collect shall be eliminated or properly drained.

3.2.15 Application of (Detail) Parts:

A part shall not be subjected to any ambient or hotspot temperature, voltage, current, or power dissipation exceeding that for which the part is designed (including derating curves).

3.2.16 Orientation:

Normal installation position or range of positions shall be as specified in Figure 30, but any such normal installation shall be subject to temporary complete inversion during flight while the equipment is operating.

3.2.17 Overload Protection:

Overload protection for the equipment shall be provided in the form of a circuit breaker which is automatically reset when the operator releases the transmitter keyline.

3.2.18 Safety:

The design shall be such as to provide maximum convenience and safety to personnel in installing, operating, and interchanging a complete equipment assembly or component part thereof in aircraft. Satisfactory provision shall be made to prevent personnel from accidentally coming into contact with voltages in excess of 40 volts. When cases and seals are removed for maintenance, protection shall be provided from voltages in excess of 500 volts. The design shall be such as to prevent reversed assembly or installation of connectors, fasteners, parts, and units where possible malfunction or personnel hazards might occur.

3.2.18.1 High Voltage Protection:

When the operation or maintenance of an equipment employing potentials in excess of 1,000 volts could require that these voltages be measured, the equipment shall be provided with test points such that all these high voltages may be measured at potential levels less than 1,000 volts relative to ground. This may be accomplished through the application of voltage dividers or other techniques such as the use of safety-type panel meters and multipliers. Full details shall be given as to the method used in the test equipment to obtain the voltages at the test points. The voltages specified herein shall be construed as applying to direct current (d-c), alternating current (a-c), or d-c plus a-c voltages.

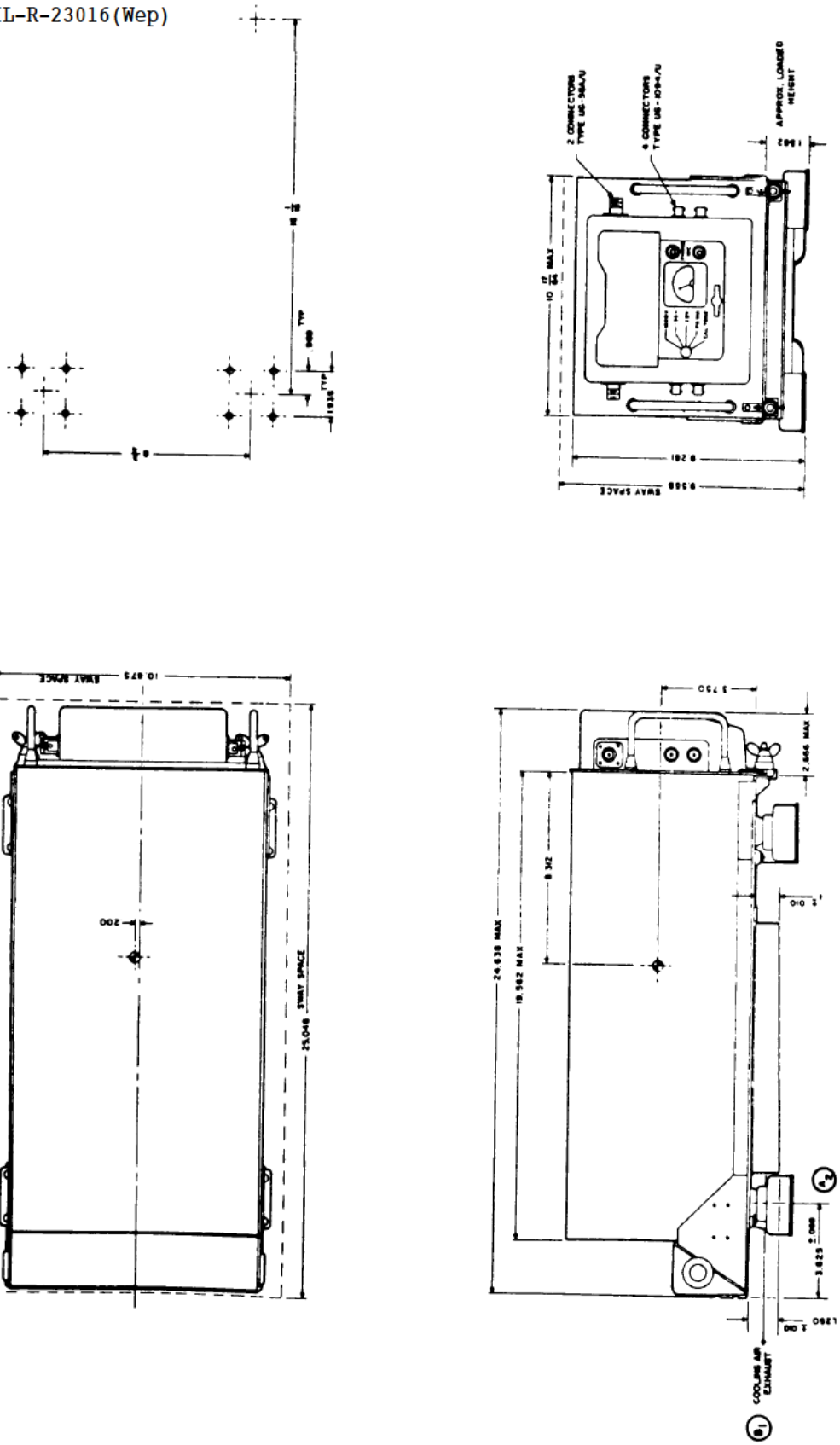


FIGURE 30

3.2.19 Interchangeability:

Mechanical and electrical interchangeability shall exist between all like assemblies, subassemblies, and replaceable parts regardless of the manufacturer or supplier. Interchangeability for the purpose of this paragraph does not mean identity, but requires that a substitution of such like assemblies, subassemblies, and replaceable parts be easily effected without physical or electrical modifications to any part of the equipment of assemblies, including cabling, wiring, and mounting, and without resorting to selection; however, adjustment of variable resistors and trimmer capacitors may be made. In the design of the equipment, provisions shall be made for design tolerances sufficient to accommodate various sizes and characteristics of any one type of article, such as tubes, resistors, and ether components having the limiting dimensions and characteristics set forth in the specification for the particular component involved, without departure from the specified performance.

3.2.19.1 Interchangeability of Reordered Units:

Reordered units of an equipment shall be interchangeable with units of a designated model of any previously manufactured equipment supplied by the procuring activity. Such interchangeability shall be measured against the designated model, manufacturing drawings or other technical information provided for the purpose. In the event the contract or order does not stipulate whether the model, drawings, or other information shall govern, the designated model shall be used. In the event that the requirements of this specification conflict with the requirements for interchangeability, the interchangeability requirements shall govern.

3.2.20 Service Conditions (Electrical):

The equipment shall be designed to operate from power sources with characteristics conforming to paragraph 3.3.3.1.5. The design shall be such as to prevent reversed assembly or installation of connectors, fasteners, parts, and units where possible malfunction or personnel hazards might occur.

3.2.20.1 Input Power Connations:

Internal connections to the main power control of airborne electronic equipment shall be in accordance with standard MS25245.

3.2.29.2 Warm-up Time:

The time required for the equipment to warm up prior to operations shall be kept to a minimum and shall not exceed 10 minutes under standard conditions and 15 minutes at extreme service condition.

3.2.21 Service Conditions (Environmental):

The equipment shall be so designed and constructed that no fixed part or assembly shall become loose, no moving or movable part or assembly become undesirably free or sluggish in operation, no movable part or control be shifted in setting, position, or adjustment, and no degradation be caused in the performance below that specified in the individual specification during operation or after storage in ambient conditions as follows.

3.2.21.1 Temperature:

The equipment shall be exposed to the temperature conditions listed below. The ambient temperature within the specified temperature ranges may remain constant for long periods and may vary at a rate as high as 1°C per second.

3.2.21.1.1 Operating:

The equipment shall operate at maximum duty cycle with rated performance between -40°C to +55°C; and 30 minute emergency operation at +70°C at sea level.

3.2.21.1.2 Non-operating:

The equipment in a non-operating condition shall withstand long periods of e xposure to the temperature extreme of -62°C to +85°C.

3.2.21.2 Altitude:

The equipment shall operate to an altitude of 40,000 feet without flashover during a 10 minute period at 50 percent duty cycle at +25°C or below.

3.2.21.3 Temperature-Altitude Combination:

The equipment shall operate under the applicable temperature-altitude combinations shown in Figure 32.

3.2.21.4 Humidity:

The equipment shall operate with rated performance after a 40 hour soak at 50°C with relative humidity of 95%.

3.2.21.5 Vibration:

3.2.21.5.1 Equipment Normally Mounted:

When normally mounted (with vibration isolators in place), the equipment shall operate satisfactorily when subjected to vibration within the frequency range and amplitude as shown in Curve I of Figure 31.

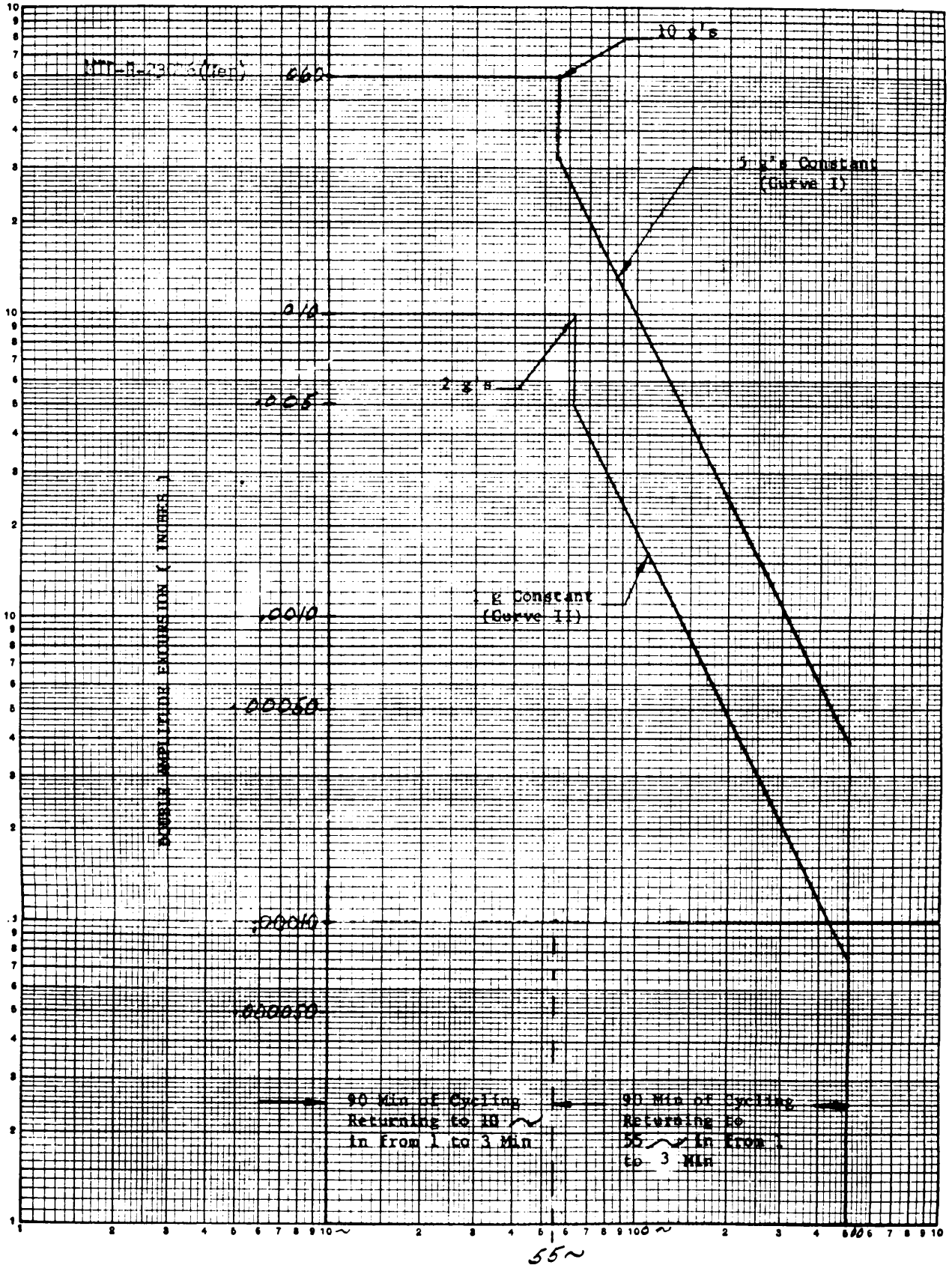
3.2.21.5.2 Equipment with Isolators Removed:

Equipment normally mounted on isolators shall operate satisfactorily with isolators removed when subjected to vibration within the frequency range and anplitude as shown on Curve II of Figure 31.

3.2.21.6 Shock:

3.2.21.6.1 Equipment:

Equipment (with vibration isolators in place), shall not suffer damage or subsequently fail to provide the performance specified when subjected to 18 impact shocks of 15g, consisting of 3 shocks in opposite directions along each of 3 mjtually perpendicular axes, each shock impulse having a time duration of 11 ±1 milliseconds. The “g” value shall be within ±10 percent when measured with a 0.2 to 250 cps filter, and the maximum “g” shall occur at approximately 5-1/2 milliseconds.



Frequency (CPS)
Vibration Envelope
Fig. 31

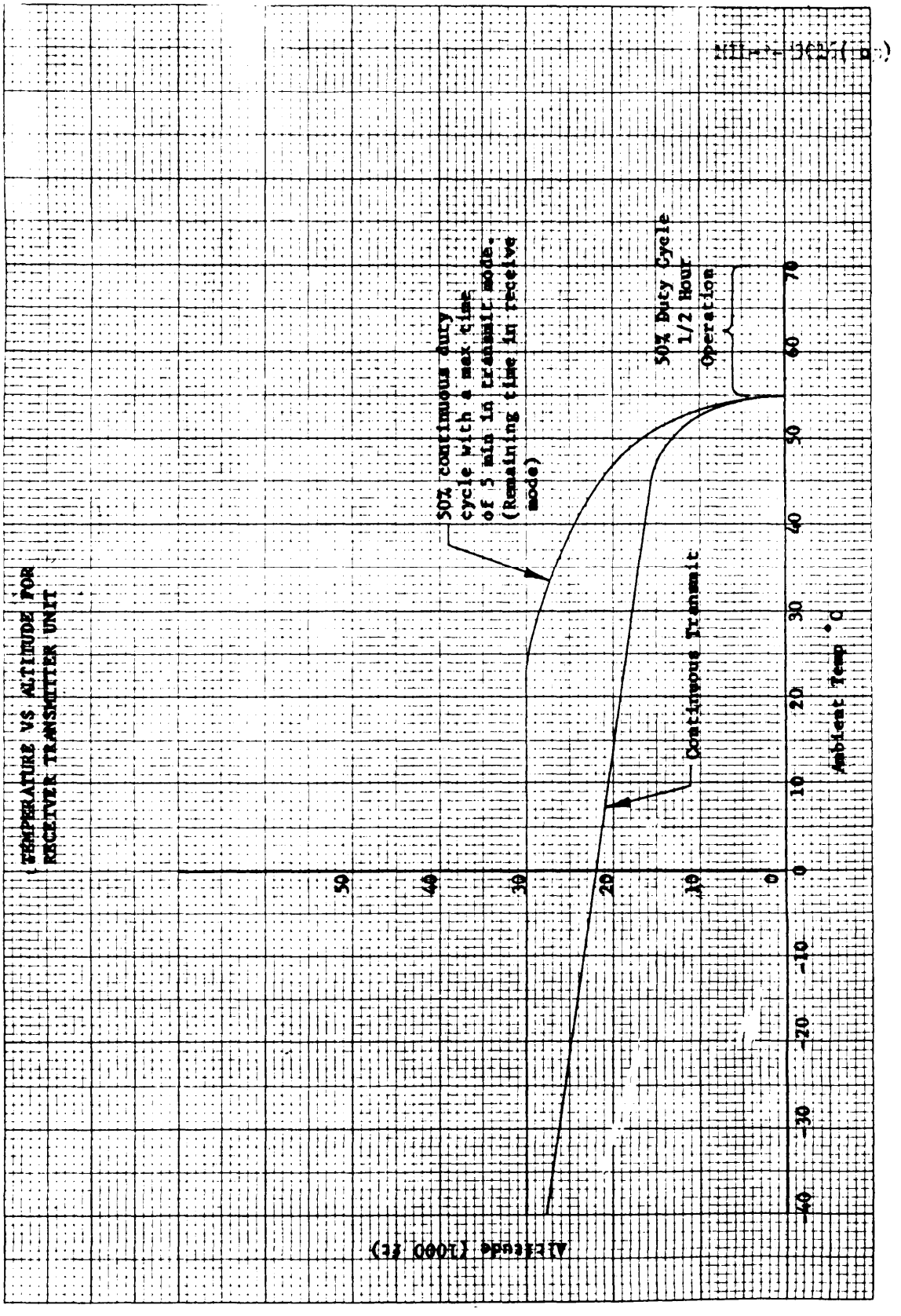


Fig 32

3.2.21 .6.2 Mounting Base (Crash Safety):

With excursion stops or bumpers in place and with maximum rated load applied in a normal manner, the mounting base, individual isolators, or other attaching devices shall withstand at least 12 impact shocks of 30g, consisting of 2 shocks in opposite directions along each of 3 mutually perpendicular axes. Each shock impulse shall have a time duration of 11 ±1 milliseconds. The "g" value shall be within ±10 percent when measured with a 0.2 to 250 cps filter, and maximum "g" value shall occur at approximately 5½ milliseconds. Bending and distortion shall be permitted, however, there shall be no failure of the attaching joints and the equipment or dummy load shall remain in place.

3.2.21.7 Fungus:

The equipment shall withstand, in both an operating and non-operating condition, exposure to fungus growth as encountered in tropical climates.

3.2.21.8 Explosive conditions:

The equipment shall not cause ignition of an ambient-explosive-gaseous mixture with air when operating in such an atmosphere.

3.3 Performance:

3.3.1 General:

3.3.1.1 Total Weight:

The total weight of the equipment, excluding cables, shall be a minimum consistent with good design and shall not exceed 59 pounds.

3.3.1.2 Operating Life:

3.3.1.2.1 Operational Stability:

The equipment shall operate with optimum performance for 200 hours, continuously or intermittently, without the necessity for readjustment of any controls which are inaccessible during flight.

3.3.1 .2.2 Total Operating Life:

The equipment shall have a minimum total operating life of 2000 hours with reasonable servicing and replacement of parts.

3.3.1.2.3 Mean Operating Time Between Failures:

The equipment shall have a calculated minimum of 300 hours of mean operating time between failures. A failure shall be defined as any malfunctioning which causes the equipment to fail to meet the minimum performance requirements specified for the equipment.

3.3.1.3 Maintenance and Field Testing:

The equipment shall be modularized to aid in maintenance and repair. Modules shall be supplied with test point facilities to allow for the greatest ease of maintenance.

3.3.1.4 Standard Conditions:

The following conditions shall be used to establish normal performance characteristics under standard conditions and for making laboratory bench tests.

Temperature	Room Ambient (30° ± 10°C)
Altitude	Normal Ground
Vibration	None
Humidity	Room Ambient up to 90% Relative Humidity
Input Power Voltage	115 ± 1.0 V 400 cps AC and/or 27.5 ± 0.5 V DC

3.3.1.5 Duty Cycle:

The equipment shall be rated to two duty cycle requirements. One shall be a 50% duty cycle consisting of a maximum of 5 minutes in the transmit mode followed by a minimum of 5 minutes in the receive mode. The other shall be a continuous transmitting rating. The equipment shall meet the appropriate temperature-altitude curve for each of these ratings as required by Figure 32. The duty cycle ratings apply to all services of operation.

3.3.1.6 Input Power Requirements:

The power required shall not exceed the specified amounts under service conditions. The equipment shall not be damaged when subjected to the power transient limits of MIL-STD-704.

(1)	AC Power (Single-Phase)	115 v
	Operating Voltage Limits	103.5 - 126.5 volts
	Operating Frequency Limits	380 - 420 cps
	Power (1 0)	175 V.A.
(2)	AC Power (Three-Phase)	
	Operating Voltage Limits	103.5 to 126.5 volts line to neutral
	Operating Frequency Limits	380 to 420 cps
	Power (3 0)	900 V.A.
(3)	DC Power -28 Volt System	
	Operating Voltage Limits	24.75 to 30.25 volts
	Current	4 amps.

3.3.1.6.1 Undervoltage Protection:

The equipment shall not be damaged by voltages below the minimum specified herein and shall automatically resume normal operation when the voltage returns within limits.

3.3.1.7 Terminations:

3.3.1.7.1 RF Terminations:

The RF input to the receiver shall be through a 51.5-ohm resistive only) dummy antenna and the value of 51.5 ohms shall include the internal impedance of the signal generator. The RF output of the transmitter shall be into a 51.5-ohm resistive load.

3.3.1.7.2 Audio Terminations:

The audio output (headset) of the receiver shall be terminated in a 300-ohm non-inductive load which shall include means for measuring the audio frequency power output. The audio (microphone) input circuit of the transmitter shall be connected to an audio frequency generator with a dummy microphone having characteristics as listed below.

Resistance	82 ohms
Impedance (mainly resistive)	82 ohms
Frequency Range	150 to 5,000 cps
Total Harmonic Distortion	Less than 5%
Open Circuit Output Potential	0.01 to 3.5 volts rms
Meter, AC	0-3.5 Volts RMS (to indicate voltage on the microphone line).
Meter, DC	0-100 ma.

3.3.2 Receiver Performance:

3.3.2.1 3 General:

Unless otherwise specified, values set forth to establish the requirements for satisfactory performance apply to performance under both standard and extreme service conditions. When reduced performance under the extreme conditions is acceptable, tolerances or values setting forth acceptable variations from the performance under the standard conditions will be specified.

All receiver tests are specified using “hard” microvolt.

3.3.2.2 Frequency Characteristics:

It shall be possible to receive on any carrier frequency in the range of 2 to 29.999 mc. Voice reception with suppressed carrier or continuous carrier shall be available on all such frequencies. Carrier frequencies shall be located at increments of 1000 cps throughout the frequency range commencing with 2.000 mc. Revisions shall be made for direct carrier frequency readout of 28,000 channels. The equipment shall be calibrated in terms of carrier frequency. Provision for teletype operation utilizing two audio tones shall be incorporated in the data mode. In CW mode the control unit selected frequency shall be 1000 cps below the desired “carrier” frequency and in the data mode the selected frequency will normally be 2000 cps below the desired “carrier” frequency.

3.3.2.3 Sensitivity

AM - The sensitivity of the receiver in the AM mode over the

specified frequency range shall be such that an r-f input signal of not more than 3 "hard" microvolt, modulated 30% at 1000 cycles, shall produce a signal-plus-noise-to-noise ratio of 6 db. This sensitivity shall be measured with the signal generator connected to the antenna terminals of the receiver using a generator with an effective source impedance of 51.5 ohms.

For input level of 100 μv, 30% modulation, 1000 cycles, the S + N to N ratio shall exceed 30 db.

SSB - The sensitivity of the receiver in the SSB mode over the specified frequency range shall be such that an r-f input signal of not more than 1 "hard" microvolt shall produce a signal-plus-noise-to-noise ratio of 10 db. This sensitivity shall be measured with the signal generator connected to the antenna terminals of the receiver using a generator with an effective source impedance of 51.5 ohms.

The sensitivity under service conditions shall not be degraded by more than 10 db from those specified above.

3.3.2.4 Selectivity and Response:

The following requirements for overall selectivity of the receiver shall apply:

MODE	ATTENUATION BELOW MAXIMUM RESPONSE (DB)	TOTAL BANDWIDTH (KC PER SECOND)
SSB	5 db	2.7 min.
	60 db	6 max.
AM	5 db	6.0 min.
	60 db	14 max.

The peak-to-valley ratio shall not be more than 5 db from 300 to 3,000 cps in AM or SSB.

3.3.2.5 Internal Signals:

Spurious signal outputs due to heterodyning between the various frequency conversion oscillators in the absence of a desired signal shall be less than 0.5 μv equivalent on the receiver antenna except the VFO fundamental crossovers and an internal signal produced by the two h-f oscillators at 2.500 mc. These shall be less than 2 μv equivalent at the receiver antenna. The receiver sensitivity requirement shall be reduced accordingly by these signals.

3.3.2.6 IF Rejection:

The receiver shall provide an attenuation of not less than 80 db below the desired signal response to signals on the frequencies of the intermediate frequency amplifiers.

3.3.2.7 AGC Characteristics:

The AGC characteristic shall be such that the audio output will not vary more than 6 db with input signals from 10 to 100,000 microvolt. No blocking shall occur on signals between 100,000 microvolt and 500,000 microvolt. A maximum attack time of 50 ma and minimum release time of 800 ms shall be used.

3.3.2.8 Audio Characteristics:

The audio characteristics of the receiver shall be as follows.

3.3.2.8.1 Capability:

Under standard conditions, the receiver shall be capable of delivering an audio output of 200 mw with a 50 microvolt input signal. At 1000 microvolt, 300 mw shall be delivered. Under service conditions, audio output obtained shall not be less than 60 percent of that output obtained under standard conditions.

3.3.2.8.1.1 Over-all Fidelity:

The overall response shall not vary more than 5 db for modulation frequencies in the range of 300 to 3,000 cps.

The total harmonic content of the receiver output shall not exceed 10% with an input signal of 1,000 μv modulated 80% with a 1000 cps tone.

3.3.2.9 Frequency Stability:

The error between indicated and actual carrier frequencies shall not exceed 0.8 part per million at any selected carrier frequency within the prescribed range of the equipment after warmup in accordance with paragraph 3.2.20.2.

3.3.2.10 RF Gain Control:

Control of the receiver gain shall be by an RF gain control. The gain control voltage shall be gated into the AGC system such that the threshold of AGC control is delayed. Proper adjustment of the gain control shall provide “quieting” of receiver noise without subsequent loss of signals above the ambient noise level. The gain control shall be capable of attenuating received signals from the threshold of sensitivity to one-half volt.

3.3.2.11 CW Requirements:

CW reception shall be accomplished by offsetting the control unit frequency one kilocycle below the assigned CW frequency.

3.3.2.12 FSK Requirements:

The receiver, when suitably interconnected with a separate keying unit, shall operate a standard teletype printer when receiving a standard FSK signal (±425 cps relative to even 1 kc Increments) at keying rates up to 75 cps. When the receiver is so operated, the output to auxiliary teletype equipment shall be in the form of two audio signals (1575 and 2425 cps). The control unit selected receiver frequency shall be set 2 kc below center frequency of the received signal.

3.3.2.13 Tuning and Adjustment:

With the equipment operating properly, no test equipment, tools, or other means or devices external to the equipment shall be required for its proper tuning and adjustment to any assigned frequency within the specified frequency range.

3.3.2.14 Audio Muting:

The audio output of the receiver shall be muted during the period of channeling or frequency selection.

3.3.2.15 Automatic Tubing:

With the control box energized to select any frequency within the range of the equipment, all circuits requiring tuning shall be automatically tuned to resonance.

3.3.2.16 Regeneration:

The interstage and overall regeneration of the receiver shall be so minimized that no evidence of oscillator, instability or excessive regeneration shall occur at maximum r-f gain, minimum squelch, maximum audio output, and maximum primary input voltages.

3.3.3 Transmitter Performance:

3.3.3.1 Frequency Characteristics:

It shall be possible to transmit on any carrier frequency in the range of 2 to 29.999 mc. Voice transmission with suppressed carrier, or continuous carrier, shall be available on all such frequencies. Carrier frequencies shall be located at increments of 1000 cps throughout the frequency range commencing with 2.000 mc. Provisions shall be made for direct frequency readout of 28,000 channels. The equipment shall be calibrated in terms of carrier frequency.

3.3.3.2 Sideband Selection:

Transmission and reception of either upper of lower sideband shall be provided.

3.3.3.3 Frequency Stability:

The errors between indicated and actual carrier frequencies shall not exceed 0.8 part per million at any selected carrier frequency within the prescribed range of the equipment after warm-up in accordance with paragraph 3.2.20.2.

3.3.3.4 Automatic Tuning:

With the transmitter terminated by the required load, all circuits requiring tuning shall be automatically tuned to resonance and/or automatically coupled to optimum for operation at the carrier frequency which has been selected at the associated radio set control unit. Automatic tuning shall be delayed until after the operating frequency has been selected and an independent enabling switch has been actuated.

3.3.3.5 Tuning Time:

The tuning time required between selection of a new frequency of operation, and completion of tuning of all transmitter and receiver circuits shall not exceed 8 seconds under standard conditions nor 12 seconds under service conditions. The tuning time of the associated antenna coupler shall be considered as an independent requirement peculiar to the coupler unit and shall not affect the maximum limitation governing the receiver and transmitter circuits.

3.3.3.6 Power Amplifier Loading:

The transmitter shall provide specified power output with normal power amplifier loading when terminated into a 51.5 ohm load with a standing wave ratio not to exceed 1.3/1. The equipmnt shall operate with VSWR up to 1.7:1 with the requirements as specified under service conditions.

3.3.3.7 RF Power Output:

Peak envelope power output from the transmitter into a 51.5 ohm resistive load shall be 400 watts -1 db +2 db. The carrier power in CW/FSK/AME shall be 125 watts ±1 db. Under service conditions the PEP or carrier power output shall not vary more than ±2 db from the nominal values stipulated above (i.e. 4OO watts PEP and 125 Watts carrier).

3.3.3.8 Carrier Suppression:

In SSB operation the carrier shall be suppressed at least 40 db below one of two equal test tones that are adjusted to deliver rated PEP by overriding the transmitter gain control circuit under standard conditions and not less than 25 db below under service conditions

3.3.3.8.1 Transmitter Gain Control:

Automatic transmittal gain control shall be provided which limits the average power amplifier plate current to a value which allows an average RF output of 99 to 157 watts into a properly terminated load. The time constants of this circuit shall be such as to allow full PEP output with voice modulation, while at the same time keeping the average power to the 99 to 157 watt level. This circuit shall protect the power amplifier and associated power supplies during tuning cycles and normal operation, and shall provide the proper carrier level for AM operation.

3.3.3.9 Intermodulation Products:

Odd order intermodulation products of the form 2f1 - f2 or 2f2 - f1 occurring outside the desired passband shall each be at least 30 db below the RF output level corresponding to one of two equal test tone. during suppressed carrier operation. The frequencies of the test tones shall be 900 and 2800 cps and their amplitudes shall be equal and sufficient to modulate the transmitter to its peak envelope power rating, when manually overriding the transmitter gain control circuit.

3.3.3.10 Sidetone:

Monitoring of the transmitter output shall be effected via the receiver audio output channel. The audio signals delivered to the receiver output while the transmission is in effect shall be actuated by detecting a small portion of the r-f output. Under standard conditions the minimum sidetone output from the receiver shall be 100 w. Under service conditions the sidetone output shall not be less than 50 mw. The sidetone frequency response shall not exceed receiving frequency response limits. Adjustment of the sidetone output from maximum to zero shall be provided and shall be separate and independent of the adjustment governing the receiver output during reception.

3.3.3.11 AME Modulation:

3.3.3.11.1 Capability:

With an audio input of less than 0.25 volts rms closed circuit applied to the microphone input terminals, the equipment shall be capable of 85% modulation. Audio clipping shall be provided with the threshold not more than 2 db above 0.25 volts rms at the microphone terminals.

3.3.3.11.2 Fidelity:

The overall frequency response of the transmitter from its audio frequency input to its radio frequency output shall not be more than 5 db variation from 300 to 3,000 cps. The total harmonic distortion at 85% modulation shall not exceed 20 percent.

The noise modulation on the AME carrier shall be at least 40 db below PEP power.

3.3.3.12 SSB/FSK Modulation:

3.3.3.12.1 Capability:

When a single tone of 0.25 v rms at 1000 cps is applied to the audio input terminals, the equipment shall produce rated carrier power output. With two equal (0.1 volts rems each) tones applied in SSB, the equipment shall produce rated PEP in accordance with 3.3.3.7 when manually over-riding the transmitter gain control.

3.3.3.12.2 Fidelity:

The variation in overall response of the equipment shall be less than 5 db from 300 to 3,000 cps. The total harmonic content of the transmitter audio shall not exceed 20 percent.

3.3.3.12.3 Automatic Level Control:

An automatic level control shall be provided to maintain rated peak power as specified in paragraph 3.3.3.7 and to maintain the linearity and spurious output requirements of paragraph 3.3.3.9.

3.3.3.13 Microphone Input:

The equipment shall supply 25 ma for a 82 ohm carbon microphone input.

3.3.3.14 CW Keying:

The equipment shall be capable of a break-in type of operation up to 20 words per minute while utilizing an antenna which is common to the receiver. The transfer time from receiver condition to transmitter condition shall be less than 150 milli-seconds. Once in the transmitter condition, the equipment shall

hold in this condition for at least 350 milliseconds before returning to operation as a receiver when operating in the cw mode. The cw signal shall be generated by applying a one-kilocycle tone in the USB channel. The control unit selected frequency shall be one kilocycle below the desired frequency of transmission.

3.3.4 Detail Requirements:

3.3.4.1 Receiver-Transmitter Unit:

The receiver-transmitter, RT-648/ARC-94 unit shall meet the following requirements.

3.3.4.1.1 Function:

The receiver portion of the equipment shall receive the r-f energy from the accessory antenna coupler or direct from the antenna, amplify it, and convert it to aural intelligence. The transmitter portion of the equipment shall generate r-f power as specified herein and transmit it to the specified load.

3.3.4.1.2 Form Factor and Mounting:

The receiver-transmitter unit shall be contained in a single unit conforming to case size MS 91403-BID2 of Specification MIL-C-172 and capable of being mounted in an aircraft by means of Mounting MT-2641/ARC-94. The Mounting MT-2641/ARC-94 shall conform to MX 91405-BID2 with exception of connector location end fully extended position of spring loaded pin, and shall be suitable for attachment to a plane surface in an aircraft.

	Height	Width	Length
Overall dimensions of the receiver-transmitter and base.	9.281	10.265	24.638
Overall dimensions including sway space (See Figure 30).	9.558	10.675	25.048

3.3.4.1.3 Contents of Unit:

This unit shall contain the complete transmitter, receiver,

frequency determination circuits, and all other parts to make the equipment function as a unit with the exception of the antenna coupler and those circuits necessary to control channel selection, emission and primary power to the equipment. It shall be possible to open the case and remove the assembly therefrom, using only ordinary hand tools and without breaking any electrical connections. After the assembly has been removed from the case, it shall be possible to remove all modular sub-assemblies from the frame using only hand tools and without unsoldering any connection. The construction of both the receiver-transmitter and the mounting base shall be such as to minimize the vacant or lost space and facilitate removal from the aircraft, location of trouble, disassembly, repair and reassembly.

3.3.4.1.4 Weight with Mountings:

The weight of the receiver-transmitter unit, including its mounting MT-2641/ARC-94, shall not exceed 57 pounds.

3.3.4.1.5 Connections:

The following connection facilities shall be provided on the front panel of the unit:

(a) A coaxial connection, Type N, for connecting the transmitter output to the associated antenna tuning unit.

(b) A coaxial connector, Type N, for auxiliary connation of the receiver input circuits to an antenna.

(c) A type JK-34 or approved equivalent, jack for headset connection.

(d) A type JK-33 or approved equivalent, jack for microphone connection.

(e) Type BNC coaxial connections are provided for the 500 kc IF Input and 500 kc RF translator-output.

(f) Type BNC coaxiel connections are provided for the 500 kc standard output end the 500 kc reference input.

All power and control wiring connections between this unit and associated units shall be made through connectors in the rear.

3.3.4.1.6 Controls:

The following shall apply to controls.

3.3.4.1.6.1 Internal, Main Chassis:

All adjustable devices provided for tracking, alignment, gain, etc., requiring periodic adjustment shall be readily accessible when the equipment is removed from its case. Other adjustments shall be readily accessible with the aid of module extenders.

3.3.4.1.6.2 Internal, Front Panel:

The following semi-fixed, adjustable controls shall be accessible from the front panel. A conventional, straight-lipped screwdriver may be used to adjust these controls.

(a) Audio output gain.
(b) Phone sidetone level.

3.3.4.1.6.3 Panel Mounted:

A meter switch and meter shall be mounted on the front panel with the following positions to indicate proper operation of the equipment.

PA Plate Voltage	(1500 V)
Plate Voltage	(130 V)
DC Power	(28 V)
PA Plate Current	

3.3.4.2 Radio Set Control:

The radio set control unit C-3940/ARC-94 shall fulfill the following requirements.

3.3.4.2.1 Function:

This unit shall provide prime control of the Radio Set and its associated antenna coupler, and shall include all controls for remote operation and frequency selection. Selection and direct frequency readout of any one of the 28,000 available operating frequencies of the receiver-transmitter shall be provided in increments of one KC.

3.3.4.2.2 Form Factor:

The Radio Control Set shall have the outline dimensions which are shown in figure 4.

3.3.4.2.3 Contents of the Unit:

This unit shall contain all circuits necessary to perform frequency selection, emission selection, RF sensitivity control and primary input power control.

3.3.4.2.4 Weight:

The weight of the radio control unit shall not exceed 2.0 pounds.

3.3.4.2.5 Connections:

All connections to this unit shall be made through one plug mounted on the rear of the unit and extending through the dust cover.

3.3.4.2.6 Controls, Internal:

There shall be no internal, adjustable controls.

3.3.4.2.7 Controls, Panel Mounted:

The following controls shall be provided in the panel of the console control box:

(a) A “Service Selector Switch” shall be located on the lower left side of the control panel to provide for control of the primary power input and the selection of the mode of operation, e.g. AM, USB, LSB, CW and DATA.

(b) Four rotary witches and indicators calibrated in frequency to permit frequency control and to indicate the carrier frequency of any channel selected. All switch positions on each switch shall be detented to enable frequency selection with accuracy.

(c) A control for adjusting the r-f sensitivity of the receiver.

3.3.4.3 Mounting: (MT-2641/ARC-94)

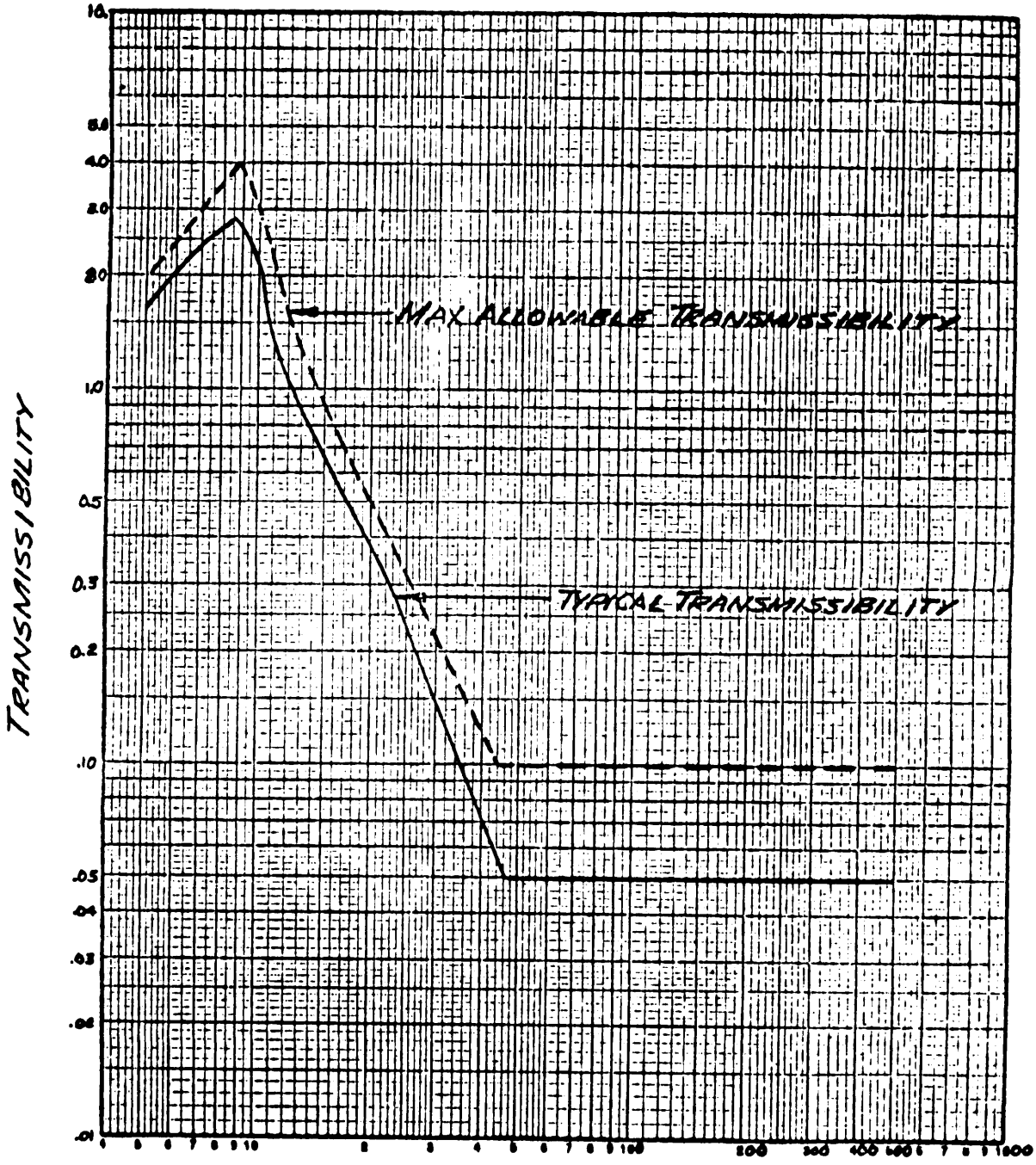
The equipment mounting shall meet the following requirements.

3.3.4.3.1 Function:

The Mounting MX-2641/ARC-94 shall have the transmissibility shown in Figure 33 to allow the equipment to perform under the specified environmental requirements.

3.3.4.3.2 Weight:

The hunting MT-2641/ARC-94 shall weigh less than 5 pounds.



TRANSMISSIBILITY VS. FREQUENCY

FIG. 33

3.4 Identification of Product:

3.4.1 Nameplate:

The equipment shall be marked for identification in accordance with Standard MIL-N-18307.

3.4.2 Patent Information:

Patent numbers, patent license notices, or any reference to either shall not appear on a nameplate. If the contractor considers it necessary to apply such a patent notice initially to the equipment because of some contractual obligation to a licenser, or because of the contractor's interpretation of the patent statutes, the notice may be applied only under the following conditions for secret and confidential articles of equipment:

(a) The notice shall be supplied as part of a tag, label, or sticker which may be easily removed or torn off by the Government inspector.

(b) The appearance and location of the tag or sticker shall be such as to render unlikely the overlooking of its removal by the Government inspector at time of acceptance inspection.

(c) The contractor shall institute a checkup as part of the procedure of packing for shipment to assure that the notice has been removed, and shall point out to the Government inspector any articles from which the notice has not been removed.

(d) The tag, label, or sticker shall not bear the Government type designation of the article of equipment to which it applies.

3.5 Workmanship:

3.5.1 General:

The equipment, including all parts and accessories, shall be constructed and finished in a thoroughly workmanlike manner. Particular attention shall be paid to neatness and thoroughness of soldering, wiring, impregnation of coils, marking of parts and assemblies, plating, painting, riveting, machine-screw assemblage, welding and brazing, and freedom of parts from burrs and sharp edges.

3.5.2 Dimensions:

Dimensions and tolerances not specified shall be as close as is consistent with best shop practices. When dimensions and tolerances affect the interchangeability, operation, or performance of the equipment, they shall be held or limited accordingly.

3.5.3 Fabrication:

Machining, drilling, and forming shall be done with the use of accurate templates, jigs, or gages.

3.5.4 Screw assemblies:

Assembly screws shall be tight. The word “tight” means that the screws cannot be appreciably tightened without damage or injury to the screw threads.

3.5.5 Riveting:

Riveting operations shall be carefully performed in order to insure that the rivets are tight. Rivet heads shall be full size and concentric with the body. Dimensions of the rivets shall be such that the holes will be filled. Loose, cracked, or badly formed, including protruding countersunk rivet heads, shall be replaced before acceptance of the material. Excess metal shall be removed from countersunk rivet heads as a customary operation. This does not cover eyelets or hollow tubular rivets.

3.5.6 Gears:

Gear assemblies shall be properly alined and meshed and shall be operable without interference, tight spots, loose spots, or other irregularities. When required for accurate adjustment, gear assemblies shall be free from detrimental backlash.

3.5.7 Cleanup:

Units shall be thoroughly cleaned of loose, spattered or excess solder, metal chips, and other foreign material after final assembly. Burrs and sharp edges as well as rosin flash which might crumble shall be removed.

3.5.8 Wire stripping:

Wire stripping shall be done without nicking or otherwise damaging the wire.

4. QUALITY ASSURANCE PROVISIONS

4.1 General:

Items covered by this specification shall be subjected to the following tests to determine compliance with all applicable requirements:

(1) Preproduction Tests

(2) Production Sample Tests

(3) Acceptance Tests

(4) Life Tests

4.2 Reproduction Tests:

Reproduction tests shall be made on an equipment representative of the production equipments to be supplied under the contract. Reproduction tests shall consist of the following:

(1) Contractor's Demonstration Tests

(2) Service Approval Tests

4.2.1 Contractor's Demonstration Tests:

Contractor's demonstration tests shall be accomplished under the responsibility of the contractor end shall be conducted in accordance with the approved test procedure of 4.6. The government inspector and the procuring activity shall be advised when tests are to be conducted so that a representative may be designated to witness or supervise the tests when so desired. Contractors not having adequate facilities to conduct all required tests shall obtain the services of a commercial testing laboratory.

4.2.1.1 The contractor shall submit all data collected in conducting these tests to the procuring agency for review and approval. This data shall include a list of all electrical and electronic parts giving their specified voltage, current and temperature rating and the applied circuit voltage, current and ambient and surface temperatures. The ambient and surface temperature shall be obtained under the extreme high temperature operating condition. Such data on parts may be included as part of the preliminary parts list.

4.2.2 Service Approval Tests:

At the completion of the contractor's demonstration tests and when requested by the procuring activity, the equipment shall be delivered to a specified government laboratory for additional testing. This additional testing may consist of duplicating tests previously conducted and such other tests as are deemed necessary to determine compliance with all applicable design and performance requirements.

4.2.2.1 Accessory Material:

In addition to the complete equipment submitted for service approval tests, the contractor shall also submit the following accessory material and design data:

(a) Complete set of interconnecting cables.

(b) One set of spare parts peculiar to the equipment. (Standard parts such as resistors, capacitors, and tubes in common use are not required.)

4.2.2.1.1 Design Data:

The following design data shall be supplied:

(a) Three copies of a cabling diagram of the complete equipment.

(b) Three copies of outline dimensional sketches of all major and minor assemblies of any detail parts not internal therein showing projections.

(c) Three copies of a practical wiring diagram of each major assembly or of each nonstructural unit thereof, whichever is practical, showing the physical location and connections of detail parts and subassemblies with reference symbols and terminal numbers indicated.

(d) Three copies of brief operating instructions.

(e) Three copies of a complete schematic diagram reduced to its simplest form, showing the circuits of all major and minor assemblies and of detail parts not internal therein individually in schematic form with electrical interconnection indicated.

(f) Three copies of an overall functional block diagram.

(g) Prior to submission of the preproduction sample equipment, three copies of a report by the contractor of his tests on the equipment. Included with this shall be an analysis of all failures which occurred, and suggestions for improvements in design which might be incorporated in later productions.

4.2.3 Scope of Tests:

Reproduction tests shall include all tests deemed necessary to determine that the equipment meets all the requirements of this specification and the contract.

4.2.4 Preproduction Approval:

Approval of the preproduction model shall be by the procuring activity upon satisfactory completion of all tests. No production equipments shall be delivered prior to the approval of the preproduction model. Prefabrication of production equipment prior to the approval of the preproduction model is at the contractor's own risk. The approved preproduction model will be returned to the contractor for his use in the fabrication and testing of equipment to be submitted for acceptance. The preproduction model shall not be considered as one of the equipments under the contract; however, it may be reworked by the contractor and submitted for acceptance as a production equipment.

4.2.5 Equipments supplied under the contract shall in all respects, including design, construction, workmanship, performance and quality, be equivalent to the approved preproduction sample. Each equipment shall be capable of successfully passing the same tests imposed on the preproduction sample. Evidence of non-compliance with the above shall constitute cause for rejection and for equipment already accepted by this government it shall be the obligation of the contractor to make necessary corrections as approved by the procuring activity.

4.3 Production Sample Tests:

When requested by the procuring activity, one equipment shall be selected from the first 10 production equipments submitted for acceptance and sent to a designated government laboratory for tests. The equipment shall be selected by the government inspector after the equipment has successfully passed all individual tests.

4.3.1 Scope of Tests:

This equipment may be subjected to any and all tests the procuring activity deems necessary to assure that the production equipment is equivalent to the previously approved preproduction sample in design, construction, workmanship, performance, and quality and that it meets all applicable requirements.

4.3.2 Production Sample Approval:

Approval of the production sample shall be by the procuring activity upon satisfactory completion of all tests. Any design, material or performance defect made evident during this test shall be corrected by the contractor to the satisfaction of the procuring activity. Failure of the production sample to pass any of the tests shall be cause for deliveries of equipment under the contract to cease until proper corrective action is approved and accomplished. Corrective action shall also be accomplished on equipment previously accepted when requested by the procuring activity.

4.3.3 Reconditioning of Reduction Test Sample:

On completion of the production sample test the equipment shall be reworked by the contractor by replacing all wear or damaged items. After reworking the contractor shall resubmit the equipment for acceptance.

4.4 Acceptance Tests:

The contractor shall furnish all samples and shall be responsible for accomplishing the acceptance tests. All inspection and testing shall be under the supervision of the government inspector. Contractors not having testing facilities satisfactory to the procuring activity shall engage the service of a commercial testing laboratory acceptable to the procuring activity. The contractor shall furnish test reports showing quantitative results for all acceptance tests. Such reports shall be signed by an authorized representative of the contractor or laboratory, as applicable. Acceptance or approval of material during the course of manufacture shall not be construed as a guarantee of the acceptance of the finished product. Acceptance tests shall consist of the following:

(1) Individual Tests

(2) Sampling Tests

(3) Special Tests

4.4.1 Individual Tests:

Each equipment submitted for acceptance shall be subjected to the individual tests. These tests shall be adequate to determine compliance with the requirements of material, workkmanship, operational adequacy and reliability. As a minimum, each equipment accepted shall have passed the following tests:

(1) Examination of Product

(2) Operational Test

(3) Manufacturing Reliability Test

4.4.1.1 Examination of Product:

Each equipment shall be examined carefully to determine that the material and workmanship requirements have been met.

4.4.1.2 Operational Test:

Each equipment shall be operated long enough to permit the equipment temperature to stabilize and to check sufficient characteristics and record adequate data to assure satisfactory equipment operation.

4.4.1.3 Manufacturing Reliability Test:

Each equipment shall be operated under the conditions specified herein for a period of 6 hours without failure. A failure shall be defined as anything which causes malfunctioning of the equipment. Only those adjustments will be permitted which can be made by using such controls and adjustments that are accessible to the operator during the normal use of the equipment.

Temperature	Ambient room
Humidity	Ambient room
Vibration	Any selected frequency within the range of 20 to 30 cps (excluding resonant points) and a minimum amplitude of ± 3g's

The equipment shall be vibrated (without vibration isolators) for a period of 10 minutes prior to the beginning of the 6-hour period of operation. Where feasible, the equipment shall be operated during this vibration period for the purpose of detecting flaws and imperfect workmanship. Operation within the specified limits of satisfactory performance is not necessarily required during the vibration period. The direction of vibration should be vertical to the normal mounting plane for 5 minutes and lateral to that plane for 5 minutes. Where it is not feasible to vibrate the equipment in 2 directions the vertical direction shall be used. During the 6-hour period of operation following the 10-minute vibration period, the equipment shall be mechanically cycled periodically through its various phases of operation. Should a failure occur, it should be repaired and the test started over, except that the 10-minute vibration period need not be repeated when it is certain the failure was not a result of the vibration. Should repetitive failures occur, corrective action shall be taken to eliminate this defect from future equipment. A record shall be kept of all failures. The 6-hour period specified above may be composed of two 3-hour periods to conform with standard working hours.

4.4.2 Sampling Tests:

Sampling tests shall be conducted on equipments which have successfully passed the individual tests. Equipments shall be selected for sampling tests by the Government Inspector in accordance with the following:

Quantity of Equipments Offered for Acceptance	Quantity to be Selected For Sampling Test
First 10	1
Next 50	1
Next 75	1
Next 100	1
	1 for each additional 200 or fraction thereof

4.4.2.1 Scope of Tests:

As a minimum, each equipment selected for sampling tests shall be subjected to the following tests:

(1) Complete operational test at ambient room conditions, making all necessary measurements to assure that all applicable specification requirements have been met.

(2) Operational test at certain environmental conditions. The conditions may vary for each equipment tested and should be based on results of the preproduction, production and special tests.

(3) Manufacturing reliability test specified in para. 4.4.1.3 except that the test duration shall he 120 hours with no restriction on the number of failures. However, each failure shall be analyzed as to cause and remedial action necessary to reduce the possibility of its recurrence in future equipment.

4.4.3 Special Tests:

Special tests shall be conducted on a quantity of equipments for the purpose of checking the effect of any design or material change on the performance of the equipment and to assure adequate quality control. The equipment selected for special tests may be selected from equipments previously subjected to the sampling tests.

4.4.3.1 Special Tests Schedule:

Selection of equipments for special tests shall be made as follows; except that when a Reduction Sample is requested and delivered to a government laboratory for test (see para. 4.3) the requirement for a special test on an early production equipment may be omitted.

(1) On an early production equipment.

(2) On an early equipment after an engineering change.

(3) Whenever failure reports or other information indicate additional equipments should be tested. (This will be determined by the procuring activity.)

4.4.3.2 Scope of Tests:

Special tests shall consist of such tests as are approved by the procuring activity. Test procedures previously approved for the preproduction and sampling tests shall be used where applicable. When not applicable, the contractor shall prepare a test procedure and submit it to the procuring activity for approval prior to conducting the tests. As a minimum, the following tests shall be made, except that for those equipments selected as a result of design changes and failure reports, only those tests required to check the characteristics in question need be conducted.

(1) Temperature - Altitude Tests

(2) Vibration Test (60 minutes cycling in each of 3 planes)

(3) Humidity Tests

4.4.4 Equipment Failure:

Should a failure occur during either the sampling or special tests, the following action shall be taken:

(1) Determine the cause of failure.

(2) Determine if the failure is an isolated case or design defect.

(3) Submit to the procuring activity for approval, proposed corrective action intended to reduce the possibility of the same failure(s) occurring in future tests.

(4) Where practical, include a test in the individual test to check all equipment for this requirement until reasonable assurance is obtained that the defect has been satisfactorily corrected.

4.5 Life Test:

The contractor shall furnish all samples and shall be responsible for accomplishing the life test. The test shall be of 300-hours duration and shall be conducted on equipments that have passed the individual test. The life test shall be performed under the conditions specified in 4.5.1. The life test sample shall be selected by the government inspector in accordance with the following; except that when a production sample equipment is requested and submitted to the procuring activity for test then the first equipment specified below need not be selected or subjected to this test. (Equipments which have successfully passed the sampling tests or special tests may be selected for life tests.)

Quantity of Equipments Offered for Acceptance	Quantity to be Selected For Life Test
First 25	1
Next 175	1
Next 300	1
	1 for each additional 500 or fraction thereof

4.5.1 Test Conditions:

The life test shall be conducted under the following simulated service conditions.

Temperature	Normal room
Altitude	Normal ground (0 - 5000 ft.)
Humidity	Room ambient
A. C. Voltage	115 ±5 volts (at lowest applicable frequency)
D. C. Voltage	27.0 ± 2.0 volts

4.5.2 Test Periods:

The test may be run continuously or intermittently. Any period of operation shall be of sufficient duration to permit the equipment temperature to stabilize. Periodically, the equipment shall be turned on and off several times and put through its various phases of operation.

4.5.3 Performance Check:

At approximately 8-hour intervals during the test, a limited performance check shall be made. The performance check proposed by the contractor shall be subject to approval by the procuring activity.

4.5.4 Test Data:

The contractor shall keep a daily record of the performance of the equipment, making particular note of any deficiencies or failures. In the event of part failures, the defective part shall be replaced and the operation resumed for the balance of the test period. A record shall be kept of all failures throughout the test, including all tube failures. This record shall indicate the following.

(1) Part type number

(2) The circuit reference symbol number

(3) The part function

(4) Name of the manufacturer

(5) Nature of the failure

(6) The number of hours which the part operated prior to failure

4.5.4.1 Failure Report:

In the event of a failure, the government inspector shall be notified immediately. A report shall be submitted to the procuring activity upon completion of the test. In this report, the contractor shall propose suitable and adequate design or material corrections for all failures which occurred. The procuring activity will review such proposals and determine whether they are acceptable.

4.5.5 Reconditioning of Life Test Samples:

An equipment which has been subjected to the life test shall be reconditioned as follows:

(1) On completion of the life test, the equipment shall be reworked by the contractor by replacing all "wear" items. The "wear" items shall be determined by agreement between the contractor and the procuring activity.

(2) After reworking, the contractor may resubmit the equipment for acceptance.

4.6 Test Procedures:

The procedures used for conducting preproduction tests, acceptance tests and life tests shall be prepared by the contractor and submitted to the procuring activity for review and approval. The right is reserved by the procuring activity or the goverment inspector to modify the tests or require any additional tests deemed necessary to determine compliance with the requirements of this specification or the contract. Specification MIL-T-18303 shall be used as a guide for preparation of test procedures. When test procedures are available from previous contracts such procedures may be used when approved by the procuring activity.

4.7 Presubmission Testing:

No item, part or complete equipment shall be submitted by the contractor until it has been previously tested and inspected by the contractor and found to comply, to the best of his knowledge and belief, with all applicable requirements.

4.8 Rejection and Retest:

Equipment which has been rejected may be reworked or have parts replaced to correct the defects and resubmitted for acceptance. Before resubmitting, full particulars concerning previous rejection and the action taken to correct the defects found in the original shall be furnished the government inspector.

4.9 Equipment Changes:

After approval of the preproduction model, no changes which affect weight, installation interchangeability and interchangeability of maintenance parts or assemblies shall be incorporated in the equipment unless approved by the procuring activity. To obtain procuring activity approval, the contractor shall submit an Engineering Change Proposal (ECP) giving the necessary information concerning the change. This shall apply for either a procuring activity's recommended change or a contractor's proposed change. When required, the contractor shall also prepare a Material Change (MC) and a Material Bulletin (MB) to cover the approved change. Engineering Change Proposals, Material Changes and Material Bulletins shall be prepared in accordance with SAR-300.

5. PREPARATION FOR DELIVERY

5.1 General:

All major units and parts of the equipment shall be presented, packed and marked for the level of shipment specified in the contract or order in accordance with Specification MIL-E-17555.

6. NOTES

6.1 Intended Use:

This equipment is intended for use in aircraft to provide voice, cw, and FSK communications in the h-f frequency range.

6.2 Test Values:

Normal and limiting values of performance data shall be determined at input voltages of 27.5 ± 0.5 V DC and 115 ±1.0 V AC as applicable. These data are to be used in testing the equipment at installation points for compliance with minimum acceptable standard of perfomance.

6.3 Performance Objectives:

Minimum size and weight, simplicity of operation, ease of maintenance, and an improvement in the performance and reliability of the specific functions beyond the requirements of this specification are objective which shall be considered in the production of this equipment. Where it appears a substantial reduction in size and weight or improvement in simplicity of design, performance, ease of maintenance of reliability will result from the use of materials, parts and processes other than those specified, it is desired their use be investigated. When investigation shows advantages can be realized, a request for approval shall be submitted to the procuring activity for consideration. Each request shall be accompanied by complete supporting information.

6.4 As a general rule non-repairable subassemblies should be encapsulated or hermetically-sealed. The number of connections internal to the subassembly should be held to a minimum. Detail parts tolerances and ratings should be so selected that the life of the subassembly is greater than that of a similar repairable one. With few exceptions (such as high voltage power supplies), the non-repairable subassembly should evidence a Mean-time-to-failure greater than 5000 hours, and for any applications this figure must be nearer 50,000 hours.

6.5 Precedence of Documents:

When the requirements of the contract, this specification, or applicable subsidiary specifications are in conflict, the following precedence shall apply:

(1) Contract - The contract shall have precedence over any specification.

6.5 (Continued)

(2) This Specification - This specification shall have precedence over all applicable subsidiary specifications. Any deviation from this specification, or from subsidiary specifications where applicable, shall be specifically approval in writing by the procuring activity.

(3) Referenced Specifications - Any referenced specification shall have precedence over all applicable subsidiary specifications referenced therein. All referenced specifications shall apply to the extent specified.

6.6 The parentheses (*), when used in the type designation, shall be replaced by either a number or letter furnished by the procuring activity upon application by the contractor for assignment of nomenclature in accordance with MIL-M-18307. The complete type number shall be used on nameplates, shipping records and instruction book, as applicable.

6.7 Definitions:

6.7.1 For definitions of part, subassembly, assembly, unit, set and systems, Standard MIL-STD-280 till apply.

6.7.2 Accessory:

An accessory is an assembly of a group of parts or a unit which is not always required for the operation of a set or unit as originally designed but serves to extend the functions or capabilities of the set, such as headphones for a radio set supplied with a loudspeaker, a vibrator power unit for use with a set having a built-in power supply, or a remote control unit for use with a set having integral controls.

6.7.3 Equipment:

Equipment is a general term characterizing the broad category of electronic items (units, sub-systems, systems, etc.).

6.7.4 Complete Operating Equipment:

6.7.4 (Continued)

A complete operating equipment is defined as an equipment together with the necessary detail parts, accessories, and components, or any combination thereof, required for the performance of specified operational function. Certain equipments may be complete within themselves and not require the addtion of detail parts, accessories, or components to perform a specified operational function.

6.7.5 Installation (Complete Equipment):

An installation (complete equipment) is defined as combination of assemblies, accessories, and detail parts required to make one complete operating equipment. An installation comprises a group of permanently installed parts and group of removable assemblies.

6.7.6 Permanently Installed Part:

A permanently installed part is defined as a detail part or assembly which is permanently installed as a part of the aircraft. Examples: Rigid or whip antenna, bracket, cable assembly, fairlead, mounting, and plug.

6.7.7 Removable Assembly:

A removable assembly is defined as an assembly which is easily removable from the aircraft. Examples: Dynamotor unit, indicator unit, radio receiver, and radio transmitter.

6.7.8 Electronic Standard Specification:

For the purpose of this specification, electronic standard specifications are those listed in ANA Bulletin No. 400.

6.7.9 Electronics:

The term “electronics” is defined as a system, or equipment, the primary purpose of which is the transmission or reception of intelligence and includes or comprises, communications or signal equipment, radio, radar, radiation, radio-controlling

6.7.9 (Continued)

devices, meterological, fire control, bombing, flight and navigational instruments, powerplant controls, synchronizers, photographic and test equipment when such portions employ circuits which utilise a combination of electron tubes, capacitors, resistors, inductors, transformers, etc., to generate or control any form of radio or audio-frequency currents, or both.

6.7.10 Hermetic Sealing:

Hermetic sealing is the process by which an item is totally enclosed by a suitable metal structure or case by fusion or metallic or ceramic materials. This includes the fusion of metals by welding, brazing, or soldering; the fusion of ceramic materials under heat or pressure; and the fusion of ceramic materials into a metallic support.

6.7.11 Interconnecting Cable:

Interconnecting cable is an assembly of a definite continuous length of one or more insulated, parallel, or twisted electrical conductors having both ends terminated with fittings which provide for connections to components of an electrical circuit.

6.7.12 Performance Requirements of the Equipments:

Wherever referenced in this specification, the “performance requirements of equipment” is to be understood to mean the satisfactory performance of all electrical and mechanical characteristics performed under the “conditioning,” “destructive,” and “accelerated life tests” described in the equipment specification for the purpose of simulating anticipated field service demands as closely as possible.

6.7.13 Flammable:

Flammable is defined as capable of bursting into flame when a spark or open flame is passed efficiently near, as with fumes and vapors from hot oils, or volatile combustible liquids, and with finely powdered, combustible solid.

6.7.14 Research Model(s):

Those include any one or all of the following described: Breadboard model, experimental model, and developmental model.

6.7.14.1 Breadboard Model:

This is as assembly of preliminary circuits and parts to prove the feasibility of a device, circuit, equipment, system, or principle in rough form without regard to the eventual overall design or form of parts.

6.7.14.2 Experimental Model:

This is a model of the complete equipment constructed to demonstrate the technical soundness of the basic idea. This model need not have the required final form factor or necessarily contain parts of final design. It may be used to demonstrate the reproducibility of the equipment.

6.7.14.3 Developmental Model:

This is a model designed to meet the performance requirement. of the specification or to establish technical requirements for production equipment. This model need not have the required final form factor or necessarily contain parts of final design. It may be used to demonstrate the reproducibility of the equipment.

6.7.15 Service Test Model:

This is a model to be used for test under service conditions for evaluation of suitability and performance. It closely approximates final design, has the required form factor, and employs approved parts or their interchangeable equivalents.

6.7.16 Prototype Model (Preproduction):

This is a model suitable for complete evaluation of mechanical and electrical form, design, and performance. It is of final mechanical and electrical form, employs approved parts, and is completely representative of final equipment.

6.7.17 Production Model:

This is an equipment in its final mechanical and electrical form of final production design and made by production tools, jigs, fixtures, and methods.

6.7.18 Insulation Classes:

(a) Class A: Class A insulation consists of (1) cotton, silk, paper, and similar organic materials when either impregnated or immersed in a liquid dielectric; (2) molded and laminated materials with cellulose filler, phenolic resins, and other rosins of similar properties; (3) films and sheets of cellulose acetate and other cellulose derivatives of similar properties; and (4) varnishes (enamel) as applied to conductors.

(b) Class B: Class B insulation consists of mica, asbestor, fiber glass, and similar inorganic materials in a built-up form with organic binding substances.

(c) Class C: Class C insulation consists of mica, porcelain, glass, quartz, and similar inorganic materials.

(d) Class H: Class H insulation is defined in RTMA and AIEE standards.

6.7.19 Intermittent and Short-time Operation:

Intermittent and short-tire operations are the alternating periods of operation for the specified time followed by 15 minutes of non-operation.

6.8 Use of Helium:

Helium should not be used as a pressurizing gas in sealed units containing electron tubes. When it is necessary to use helium for leak detection purposes, exposure should be limited to the time necessary for the test, followed by thorough purging.

6.9 Finishes:

Changes necessary to Military specifications believed required by 3.1.11 should be brought to the attention of the procuring activity.

6.10 Publications:

In the design of electronic equipment consideration should be given to the information contained in the following publications:

(a)	Electronic Equipment, Piloted Aircraft Design Criteria for	ANA Bulletin No. 444
(b)	Handbook, Preferred Circuit, Navy Aeronautical Electronic Equipment	NAVAER-16-1-519
(c)	Design Factors for Aircraft Electronic Equipment	WADC Tech Report 56-148 (ASTIA NO). AD142204)
(d)	Final Report of the Advisory Group on Reliability of Electronic Equipment	Department of Defense
(e)	Techniques for Application of Electronic Component Parts in Military Equipment, Resistors, Relay, Capacitors	WADC Tech Report 57-1 Volume I (ASTIA NO. AD110672)
(f)	Crystal Handbook	WADC Tech Report 56-156
(g)	Electronic Circuits	Standard MIL-STD-439

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