MIL-I-6181

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Superseding
AN-I-42
25 May 1948

MILITARY SPECIFICATION

INTERFERENCE LIMITS AND TESTS;
AIRCRAFT ELECTRICAL AND ELECTRONIC EQUIPMENT

This specification was approved by the Departments of the Army, the Navy, and the Air Force for use of procurement services of the respective Departments.

1. SCOPE

1.1 This specification provides interference limits and procedures for testing radio, radar, interphone, and other electrical and electronic equipment for aircraft, to insure satisfactory performance in regard to radio interference, when operating in conjunction with other equipment in an aircraft system.

2. APPLICABLE SPECIFICATIONS

2.1 The following specifications, of the issue in effect on date of invitation for bids, shall form a part of this specification to the extent specified herein:

Military

JAN-C-172	Cases and Mounting Bases; Electronic, Aircraft
JAN-I-225	Interference Measurement, Radio, Methods of, 150 Kilocycles to 20 Megacycles (For Components and Complete Assemblies)

(Copies of this specification and copies of other publications referenced herein or required for Government procurement, and the Index of Military Aeronautical (AN or MIL) Standards, may be obtained upon application to the Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio; or the Commanding Officer, U. S. Naval Air Station, Johnsville, Pennsylvania.)

3. REQUIREMENTS

3.1 Operational Requirements.- Electrical and electronic equipment shall operate satisfactorily, not only independently, but also in conjunction with other such equipment which may be placed nearby. This requires that the operation of all such equipment shall not be adversely affected by radio interference voltages and fields reaching it from external sources, and also requires that such equipment shall not itself be a source of radio interference which might adversely affect the operation of other nearby equipment.

3.2 Design.-

3.2.1 Choice of Interference-Free Design.- Interference minimization shall be carefully considered in the basic design of electronic equipment. Equipment shall be so designed that it inherently generates the least practicable radio interference before interference suppression components are applied. Such interference reduction components as must be used, such as filtering, shielding, bonding, etc., shall be in accordance with good engineering practice.

3.2.2 Component Placement.- Components shall be placed, and circuitry arranged, in such order as to result in a minimum of coupling and in the use of a minimum of filter components.

3.2.3 Line Shielding.- Whether a line shall be (a) shielded or (b) filtered shall depend upon which method results in the least weight and space penalty for the overall system. In general, however, it is preferred that interference reduction be accomplished inside the equipment units when such means give results equal to or better than use of a shielded line.

3.2.4 Case Shielding.- Shielding and bonding shall be as specified in Specification JAN-C-172.

3.2.5 Shielded Antenna Lead-In.- When practicable, the equipment shall be so designed that proper operation may be obtained when used with a shielded antenna lead-in.

3.3 Interference Limits.-

3.3.1 Conducted.- No radio interference voltage generated by the equipment or components in excess of the values indicated on figure 1, between the frequencies of 0.2 and 20 megacycles per second, shall appear on any conductor whatsoever. Measurements shall be made at the point of entry to each unit. The detail specifications may exempt from this requirement certain leads deemed incapable of conducting interference into any other equipments.

3.3.2 Radiated.- No radio frequency interference voltage in excess of the values listed in table I shall be radiated from any unit, cable (including control and input power cables), or interconnecting wiring of the equipment. Transmitter antenna leads are exempt from this requirement at the radio frequencies and multiples thereof necessary for operation of the equipment; these requirements will be covered by the detail specification for the particular equipment.

TABLE I

Test Equipment and Interference Limits in Equivalent Microvolts Input

Frequency (megacycles)	Ferris Model 32A	Measurements Corporation Model 58	TS-587/U	AN/URM-28
0.15-20	2.5	---	---	---
21-38	---	2.5	2.5	---
39-65	---	2.5	2.5	See Figure 2
66-100	---	5.0	5.0	See Figure 2
101-150	---	10.0	10.0	See Figure 2
151-400	---	---	15.0	See Figure 2
401-650	---	---	---	See Figure 2
651-1000	---	---	---	Receiver Background

3.4 Susceptibility Limits.-

3.4.1 General.- A sine wave signal of 1,000 microvolts applied between any external circuit or lead (excepting antenna or antennas) and ground at the point of entry to the unit shall produce no change in indications nor any degradation of performance. The signal shall be any frequency throughout the range of 0.150 to 150 mc and shall be (a) unmodulated and (b) modulated 30 percent with either 400 or 1,000 cycles.

3.4.2 Special.- Equipment operating below 0.150 mc or having radio frequencies associated therewith which are lower than 0.150 mc shall, in addition, meet the above requirements when signals of 2,000 microvolts in this lower frequency range are applied.

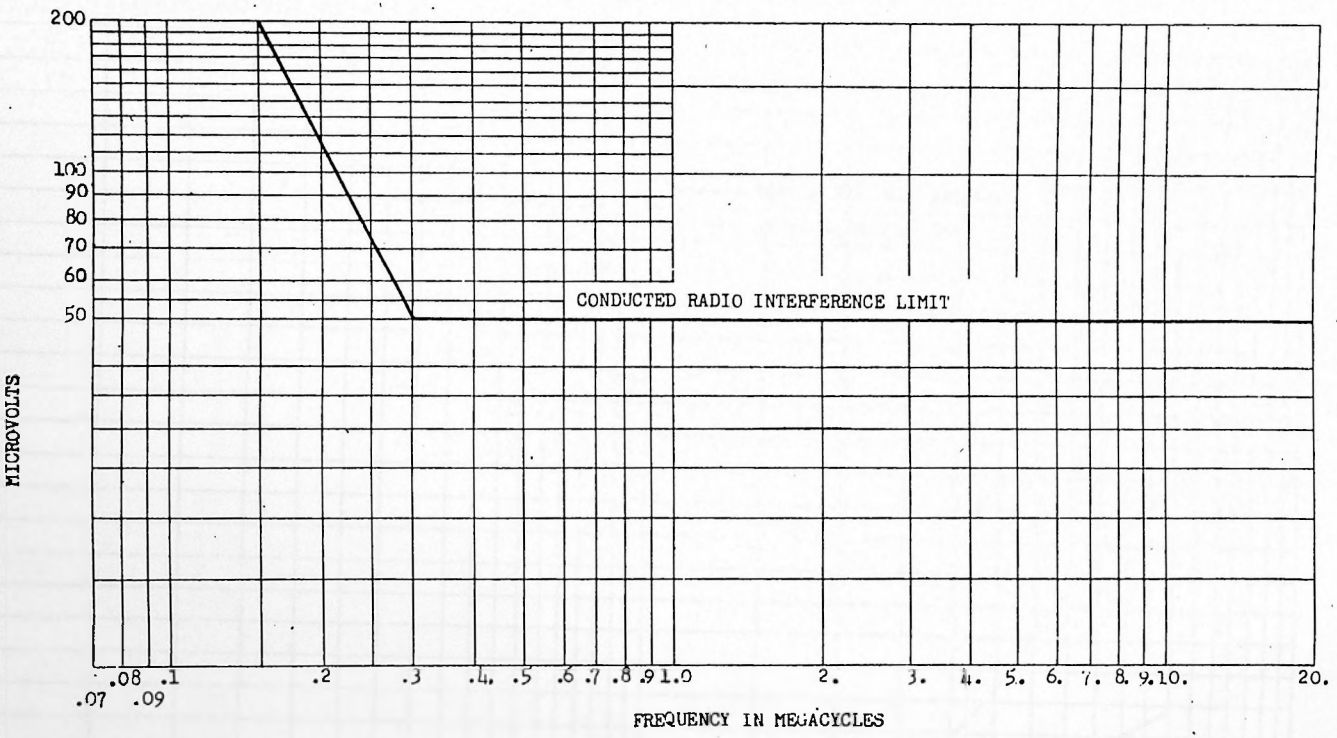

FIGURE 1. Conducted Radio Interference Limit

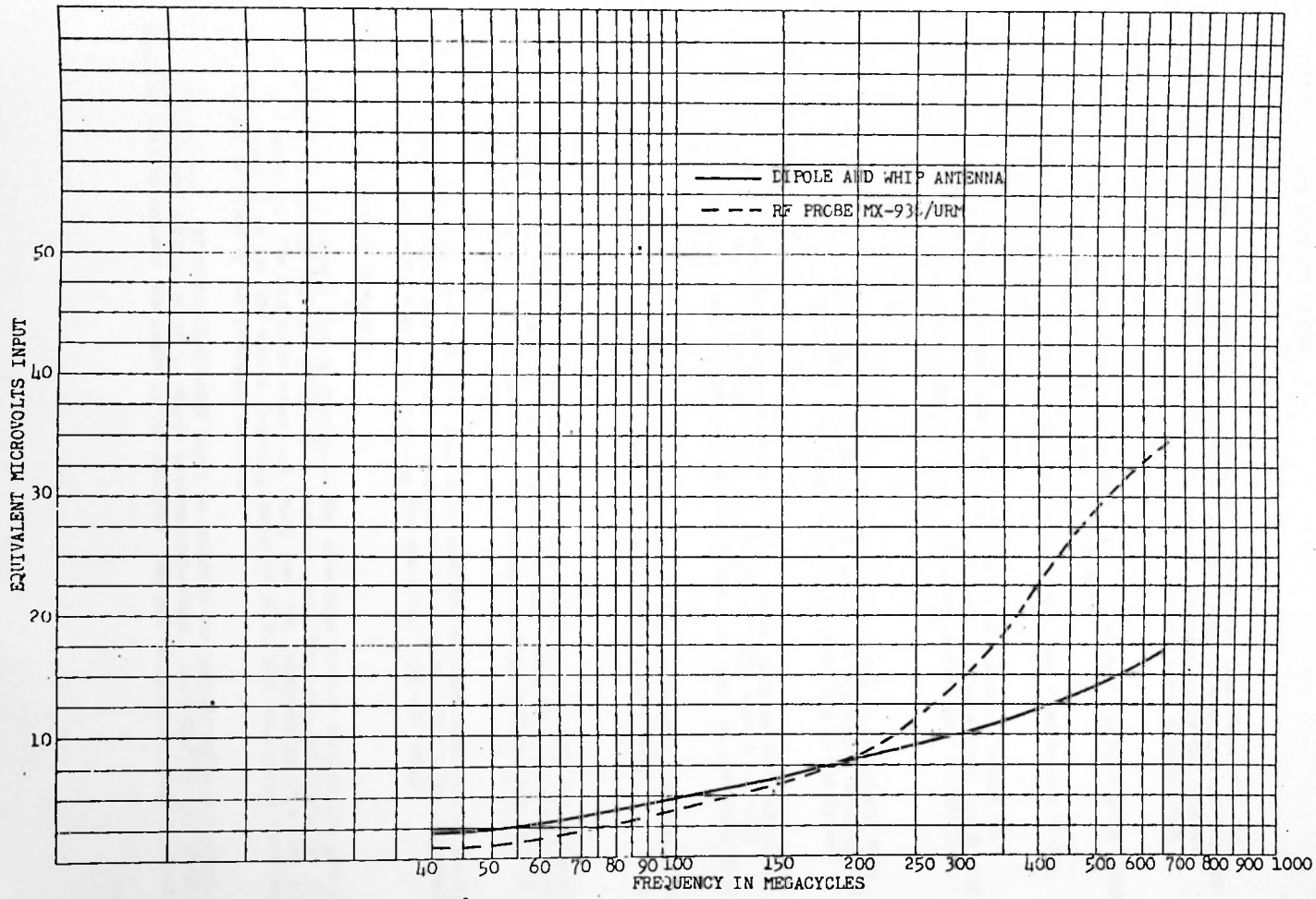

FIGURE 2. Allowable Limits Using AN/URM-28

4. INSPECTION AND TEST PROCEDURES

4.1 General.-

4.1.1 All tests specified herein, conducted to determine compliance with this specification, shall be accomplished by the contractor under the supervision and subject to the approval of the Government Inspector. If reports are required by the contract, they shall contain a section stating the results of interference tests accomplished in accordance with this or related specifications.

4.1.2 During all tests, supply bus-voltage shall be filtered and maintained within limits specified in the detail requirements of the equipment.

4.1.3 For all tests, a location shall be chosen where area interference is not detectable in the test equipment.

4.1.4 The complete equipment under test shall be in an operating condition simulating the conditions under which it will normally be used. Transmitters and receivers shall be operated into a shielded dummy load which simulates actual load condition.

4.2 Interference Tests.-

4.2.1 In general, all Interference tests shall be conducted in accordance with Specification JAN-I-225. The modes of operation, arrangement of equipment, inter-connecting cable assemblies, and supporting structures shall be as specified in the detail equipment specification.

4.2.2 All interference measurements shall be monitored using matched headsets. The headset used with the RF Interference Test Set AN/URM-28 shall have a properly matched 600 ohms impedance headset, HS-33-A, or equivalent, and shall be connected during all measurements.

4.2.3 Conducted Interference.- Conducted interference tests shall be made with a Ferris Noise Meter, Model 32A, in accordance with Specification JAN-I-225.

4.2.4 Radiated Interference.-

4.2.4.1 For radiated interference, measurements shall be made with the equipment specified in table I as designated by the Procuring Service. When RF Interference Test Set AN/URM-28 is being used as the measuring instrument, readings between 78 mc and 95 mc shall be taken using Tuning Unit TN-16.

4.2.4.2 Frequencies.- Not less than three frequencies representative of the most severe indication of radio interference in each band of the noise meter being used shall be selected for test after completely scanning the specified frequency range.

4.2.4.3 Pick-Up Devices.-

4.2.4.3.1 Alternate Pick-Up Devices.- Two alternate pick-up devices are provided for the RF Interference Test Set AN/URM-28 to permit flexibility and constitute two distinct test methods. The equipment under test shall meet the requirements of either pick-up device above 38 mc for the entire frequency range of 38 to 1000 mc, unless preference for a method is given by the Procuring Service.

4.2.4.3.1.1 RF probe MX-936/URM shall be oriented and positioned with respect to the equipment and cabling so as to obtain maximum indication. Cord CG-55/U (20 ft 0 in.) shall be used to connect the probe to the receiver. No pad termination shall be used.

4.2.4.3.1.2 Whip Antennas AS-89/ART, AS-97/ART, AS-161/ART, and Dipole Antenna AT-275/URM-28 shall be located and oriented for maximum indication at a distance of 1 foot from the radiating source of the equipment and interconnecting assemblies. Tuning of the dipole antenna shall be in accordance with figure 3. Cord CG-55/U (20 ft 0 in.), a 20-foot length of Cable RG-8/U terminated on both ends by a radio-frequency plug UG-21/U, shall be used in connecting the dipole antenna to the receiver. Adapter UG-83/U shall be used with this cable when connecting it to the whip antenna.

4.2.4.3.2 The antennas used with the Ferris Model 32A, Measurements Corporation Model 58, and Noise-Field Intensity Meter TS-587/U shall be the rod or dipole antenna specified in the equipment instruction manual. The positioning of the antenna shall be in the same manner as that specified for the whip and dipole antennas used with the RF Interference Test Set AN/URM-28.

4.2.4.4 Noise Meter Adjustment.-

4.2.4.4.1 Whenever the interference is readily tunable, appears to be confined to a narrow band, or there is reason to suspect a CW-type interference, the measuring equipment being used shall be adjusted as though measuring a CW signal.

4.2.4.4.2 The function switch of the Ferris 32A, the Measurements Corporation Model 58, and the Noise-Field Intensity Meter TS-587/U shall be set for "RADIO NOISE," "PEAK," and "QUASI-PEAK" indication respectively, except when measuring narrow-band CW-type interference, at which time the "FIELD INTENSITY" position of all meters shall be used.

4.2.4.4.3 Calibration and Adjustment of RF Interference and Test Set AN/URM-28.- Calibration curves in microvolts input vs volts output above background, and in microvolts input vs microamperes output above background shall be used to determine the equivalent microvolt input for equal increases in volts output or microamperes output above background when evaluating radio interference. Calibration shall be obtained with the heterodyne switch "OFF," wide-narrow switch at "NARROW," and volume control at the maximum volume position.

4.2.4.4.3.1 Calibration for wide-band type of interference shall be made with a signal modulated 30 percent with 1,000 cycles, and the data recorded in volts output above background. The output impedance of the signal generator shall be, or be corrected to, 50 ohms; and the interconnecting cable shall be a 20-foot length of RG-8/U cable. The "IF ATTENUATOR" shall be placed in the position that gives an output reading between 1/2 and 1 volt of receiver background with the signal input.

4.2.4.4.3.2 Each instrument shall also be calibrated for CW-type of interference with the output read on the diode meter. The "IF ATTENUATOR" shall be placed in the lowest setting that prevents the diode meter from reading off scale. Above background values in microamperes should be computed from the combination of diode meter reading and "IF ATTENUATOR" setting.

4.2.4.4.3.3 The output meter used shall be a Weston 571, Weston 687, Simpson 427, or equivalent, having a least 1,000 ohms-per-volt impedance and similar mechanical damping characteristics.

4.2.4.4.3.4 The calibration of the instrument shall be checked periodically for sensitivity changes. It should be recalibrated whenever the receiver background, with antenna pick-up device connected, has changed more then 25 percent.

4.2.4.4.3.5 The power supply voltage shall be 115 volts ac, and shall not vary more than 1 volt. A 600-ohm headset properly matched to the meter shall be connected to the output during calibration.

4.2.4.4.3.6 The adjustment of controls of the RF Interference Test Set AN/URM-28 for wide-band and CW-type interference measurements shall be the same as those used in calibrating the instrument for the particular measurement to be performed.

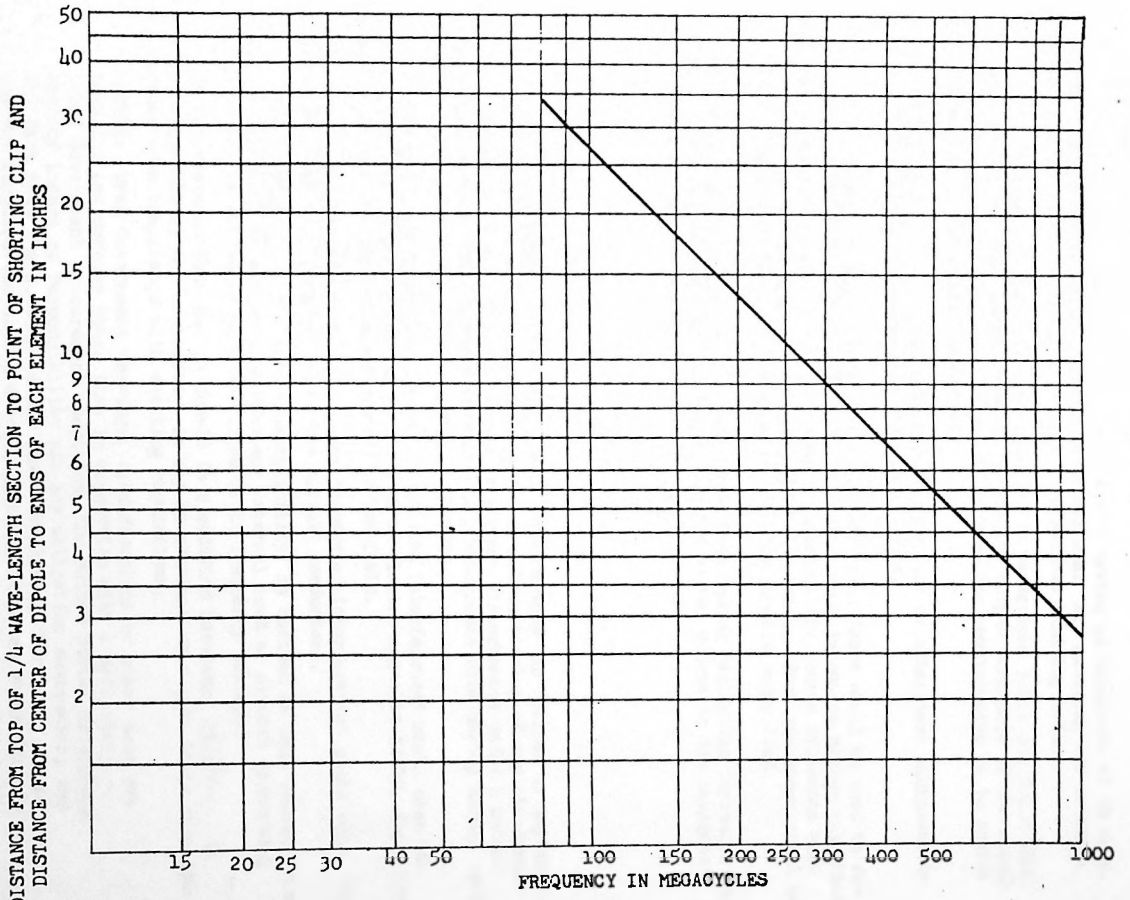

FIGURE 3. Calibration Curve for Dipole Antenna AT-275/URM-28

4.3 Susceptibility Tests.-

4.3.1 The signal shall be supplied from a source having an impedance of 50 ohms. All external and internal gain controls shall be at maximum. All external and internal controls for squelch or limiters shall be set to give minimum limiting action.

4.3.2 Test Voltages.- The voltages specified in paragraphs 3.4.1 and 3.4.2 shall be those voltages which are calculated to exist across the output terminals of the signal source when no impedance other than that necessary to meet the requirements as to source impedance is connected to the signal generator.

4.3.3 Signal Source.- Any applicable signal generator or other test equipment in normal condition may be used in connection with these tests.

4.3.3.1 Adjustment of Source Impedance.- A shunt resistance shall be used to reduce source impedance when the signal generator has an internal impedance higher than that stipulated, and a series resistance shall be used to increase the source impedance when the signal generator has an impedance lower than that stipulated. Such resistors shall be connected between the signal generator termination and the circuit under load.

4.3.3.2 Blocking Capacitors.- 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.

5. NOTES

5.1 Definitions.-

5.1.1 Radio Interference.- The term "radio interference" is defined as any electrical disturbance which causes undesirable response or malfunctioning of any electronic equipment for a duration of more than 1 second. Transient disturbances under 1 second duration are considered as radio interference if their recurrence rate during normal operation of the aircraft is greater than one every 3 minutes.

5.1.2 Radiated Interference.- The term "radiated interference" shall mean the radio interference that is propagated in the form of an electro-magnetic field, including both the radiation and the induction components of the field.

5.1.3 Conducted Interference.- The term "conducted interference" shall mean the radio interference that is propagated along the circuit conductors.

5.1.4 Susceptibility.- The term "susceptibility" is defined as that characteristic which causes an equipment to malfunction when any external load or cirucit (excepting antenna or antennas) is subjected to a specified radio frequency voltage.

5.2 RF Interference Test Set AN/URM-28 is a modified Receiver, AN/APR-4. If not otherwise obtainable by the contractor, it may be obtained on a loan basis from the Procuring Service upon compliance with existing regulations.

Custodian:
Air Force

Other interest:
Navy - BuAer