or radio equipment capable of producing interference influence voltages on the power line should be connected to the circuit between the battery and the distribution bus. This is for the purpose of taking advantage of the filtering action of the storage battery. It is desirable that this circuit be separately routed whenever possible.

(g) The circuit which furnishes power to the radio receivers should be connected to the main distribution bus at or as close as possible to the point where the storage battery is connected. This circuit should *not* be bundled with other electrical circuits. No other electrical loads should be taken off this circuit with the exception of small radio receiver panel illumination lights which might be located near the antenna "lead-in" terminals of the receiver.

(b) Electrical circuits which supply power to the radio receiving equipment or which are necessarily located near radio receiving equipment and "lead-ins" may require shielding, or occasionally may require the use of appropriate capacitor type filters.

(*i*) The electrical control circuits of antenna transfer relays may require shielding to reduce coupling of interference influence voltages to the "lead-in."

(j) Shielding of electrical circuits near transmitter circuits may be required to prevent pick-up of radiated transmitter power.

(k) Power and indicator or control circuits to remote controlled antenna reels and automatic loop antenna may require shielding in the vicinity of the antenna circuits.

(1) Electrical circuits ahead of the firewall require shielding and preferably separate routing.

(m) Common ground connections of electrical and radio equipment which might introduce common or series voltage drops should not be used.

### 3. IGNITION WIRING.

(a) Booster coils should be located as close to the magneto as possible to reduce the length of lead carrying ignition noise-influence voltages.

(b) Magneto switch circuits as well as all ignition wiring must be separately routed from other electrical circuits and completely shielded by conduit (see SR-125, part IV).

(c) Engine starter circuits, even though anticapacity switches are incorporated, may require shielding as well as isolation from other electrical circuits and should not be run in the same conduit or bundles with the magneto switch circuits.

#### 4. PROPELLERS.

(a) Electrical control and power circuits for electrical propellers should be routed separately from other electrical circuits and may require installation in conduit.

# 5. CAPACITOR AND CHOKE TYPE FILTERS.

(a) The use of filters must be kept to a minimum, both to reduce weight and the number of electrical items which might, through failure, cause malfunctioning of the aircraft electrical system.

(b) Network type filters should be limited to use in low current circuits and used in high current circuits only when absolutely necessary.

(c) Mica and paper capacitor type filters of suitable voltage breakdown characteristics should be used whenever possible in lieu of network type filters, and should provide effectively low impedance throughout the frequency range of the receiver.

(d) Capacitor type filters should be mounted directly between the power circuit and ground without the use of additional wires or leads, since these materially change the characteristics of the filter.

(e) It is pointed out that the attenuation produced by two or more capacitors in parallel is not numerically additive but that entirely new conditions exist which may produce an adverse effect.

(f) Capacitor type filters having the same physical dimensions may not have comparable electrical characteristics.

# 6. MISCELLANEOUS.

(a) Microphone and other audio circuits may require shielding to prevent cross-talk or pick-up of interference on electrical circuits or radiated transmitter power. Audio and radio receiver control circuits should be installed separately from electrical circuits.

(b) Automatically operated cowl flap circuits (operated by thermostatic control) may require shielding.

(c) In the process of designing for the elimination of conduit, care should be exercised to determine that it is not essential for mechanical protection or support, or that it is required for ease of replacement of wiring in inaccessible locations.

C.

Rev WCAB. 28 July 1944.

## AN-1-24

# ARMY-NAVY AERONAUTICAL SPECIFICA-TION INTERFERENCE LIMITS; AIRCRAFT RADIO

This specification was approved on the above date by joint action of the War and Navy Departments for use in the procurement of aircraft, and shall become effective immediately upon issue.

## A. APPLICATION.

A-1. This specification is drawn to provide interference limits and instructions for testing of radio, radar, interphone, and other electrical equipment in aircraft to determine satisfactory performance in regard to radio interference produced or caused by equipments or components of the aircraft.

### **B.** APPLICABLE SPECIFICATIONS.

B-1. There are no other specifications applicable to this specification.

## C. DEFINITIONS.

C-1. The term "radio interference," as employed in this specification, shall mean any electrical disturbance which causes undesirable response or malfunctioning of any electronic equipment.

C-2. The term, "prototype aircraft," as employed in this specification, shall mean an early production model incorporating all specified electrical and electronic equipment.

#### D. PERFORMANCE REQUIREMENTS.

D-1. GENERAL.—Radio, radar, interphone, and other electronic equipment shall operate satisfactorily when installed in the aircraft.

D-2. Satisfactory performance will be determined by the procuring agency, employing the radio interference measuring techniques and limits as specified herein.

D-3. INTERFERENCE LEVEL.-

D-3a. VHF AND MHF.—The radio interference level in VHF and MHF (0.2 to 30 mc.) radio receivers shall not exceed their inherent background noise.

D-3b. In amended contracts, as an interim measure for an interval not to exceed 90 days, the radio interference level in MHF radio receivers will be acceptable when the output meter readings obtained in the radio interference test, as specified herein, do not exceed the corresponding meter readings obtained when the receivers are calibrated with an input of one microvolt, 30 per cent modulated with 400- or 1,000-cycle tone applied through a suitable dummy antenna.

D-4. OPERATION OF ELECTRONIC EQUIP-MENT.—The operation of electronic equipment for which specific tests are not given shall be considered satisfactory when the radio interference produced or caused by equipments or components of the aircraft does not produce undesirable response or malfunctioning of the electronic equipment.

D-5. The means employed to accomplish suppression or elimination of radio interference such as the installation of capacitors, filters or shielding shall be as approved by the Procuring Agency.

# E. METHODS OF INSPECTION AND TEST.

*E-1.* GENERAL.—All tests specified herein shall be accomplished by the contractor under the supervision of an authorized Government Inspector.

*E-2.* REPORT OF TESTS.—The contractor shall furnish reports in duplicate to the inspector on all tests required by this specification.

E-3. TESTING METHODS.-

E-3a. CALIBRATED RECEIVER METHOD.— The calibrated receiver method shall be used for measuring radio interference in radio receivers.

E-3b. CALIBRATED RECEIVERS.—The procuring agency will supply calibrated receivers of each type required for making radio interference tests. The contractors shall be held responsible for handling such receivers with more than ordinary care and for reporting any suspicion of defectiveness.

*E-3c.* AUDIO FREQUENCY NOISE METER.— A standard audio frequency noise meter, RCA 302–B or equivalent, shall be used as the standard for measuring the receiver output when making radio interference measurement in aircraft.

E-3c(1). For general use, a full-wave, copperoxide volt meter of 3,000 to 5,000 ohms per volt (Weston number 571 or equivalent) may be used.

*E*-4. CONDITIONS OF TEST.—Radio interference in radio receivers shall be measured under the following conditions.

E-4a. All radio, radar, interphone, and other electronic equipment specified for the aircraft shall be installed. The aircraft shall be complete as to all other specified electrical and electronic equipment.

E-4b. All volume controls, both internal and external to the receiver, shall be full on.

E-4c. Squelch and limiter circuits will be made inoperative.

E-4d. Modulated continuous wave (MCW) reception shall be employed.

E-4e. Antenna trimmers shall be adjusted for maximum sensitivity.

E-4f. All headphones shall be ANB-H-1 or ANB-H-1A standard flat response type. The number of headsets connected to the receiver output when taking meter readings shall be the same as specified in the data supplied with the calibrated receiver.

E-4g. Radio interference measurements shall be made with the airplane in flight. The aircraft shall be flown at normal rated cruising speed, engine r. p. m., and manifold pressure over terrain relatively free from radio interference. Advantage should be taken of days on which atmospheric interference is at a low level.

F-4h. All electrical and electronic equipment in the aircraft which may be a source of radio interference, such as fuel pumps, generators, motors, inverters, instrument lights, heaters, radio and radar equipment, shall be operated in flight during the radio interference test. Items of equipment which may not be readily or safely operated during flight shall be tested on the ground.

E-4i. Each calibrated receiver, in turn, shall be tuned through its frequency range, and output meter readings noted at all maxima and at or near each point of calibration shown on the curve supplied.

E-5 PROTOTYPE TEST.

E-5a. The prototype aircraft shall be tested in accordance with the requirements of this specification.

E-5b. The prototype aircraft shall be flown at its rated service ceiling to determine that there is no increase in radio interference.

E-5c. When deemed necessary, the procuring agency may require further tests to determine that there is no increase in radio interference.

E-6. PRODUCTION TEST.

E-6a. The production test shall be conducted in accordance with the requirements of this specification, except those specified under prototype test.

E-6b. All production aircraft shall be given a production test until ten consecutive aircraft have passed without rework. Thereafter, the Government inspector shall select at random one aircraft in each group of fifty and conduct a production test.

E-6c. When an alternative installation of other electrical or electronic equipment is made, the first aircraft incorporating such change shall be given a production test.

E-6d. Any modification of the electrical or electronic installation which might adversely affect the radio interference level shall require a production test.

E-6e. The Government inspector may cause a production test to be performed on any aircraft whenever there is any doubt as to its conformance with the requirements of this specification.

E-6f. Whenever an aircraft does not meet the requirements of a production test without rework, a production test shall be made on each aircraft there-

after until ten consecutive aircraft have passed without rework.

E-6g. LISTENING TEST.—A listening tets shall be made on all aircraft on which a production test is not made. The listening test shall be made on all installed radio receivers throughout their respective frequency ranges to determine that no abnormal interference levels exist.

E-6h. Upon written application to and after formal waiver by the procuring agency, flight tests for radio interference in production aircraft may be omitted, provided proof of adequate ground test is established to the satisfaction of the procuring agency. The use of an adequately shielded structure is considered suitable for ground testing in lieu of flight testing.

F. NOTES.

F-1. SUPERSEDING DATA.—This specification supersedes Bureau of Aeronautics Specification SR-125 for aeronautical use.

F-2. DEVIATIONS.—No deviations from this specification permitted except as a war emergency measure and then only after formal authorization from the material command or the Bureau of Aeronautics through the Procuring Service's district representative.

F-3. SPECIFICATIONS—When requesting specifications, refer to both title and number.

F-3a. SOURCE.—Copies of this specification and other Army-Navy aeronautical specifications may be obtained upon application to the office of the district supervisor in the following Army Air Forces procurement districts: New York, Atlanta, Detroit, Chicago, Wichita, and Los Angeles; to the Army Air Forces, Material Command, Wright Field, Dayton, Ohio; or to the Bureau of Aeronautics, Navy Department, Washington 25, D. C. Naval activities should make application to the manager, Naval Aircraft Factory, Widener Building, Philadelphia 2, Pa.