FEDERAL AVIATION AGENCY
FLIGHT STANDARDS SERVICE
Washington 25, D. C.

October 10, 1962

REGULATIONS OF THE ADMINISTRATOR DRAFT RELEASE NO. 62-43

SUBJECT: Revision to Technical Standard Order C36a "Airborne ILS Localizer Receiving Equipment (For Air Carrier Aircraft)"

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The Flight Standards Service of the Federal Aviation Agency has under consideration an amendment to Part 514 of the Regulations of the Administrator to revise Technical Standard Order C36a "Airborne ILS Localizer Receiving Equipment (For Air Carrier Aircraft)". The reasons therefor are set forth in the explanatory statement of the attached proposal which is being published in the Federal Register as a notice of proposed rule making.

The Flight Standards Service desires that all persons who will be affected by the requirements of this proposal be fully informed as to its effect upon them and is therefore circulating copies in order to afford interested persons ample opportunity to submit comments as they may desire.

Because of the large number of comments which we anticipate receiving in response to this draft release, we will be unable to acknowledge receipt of each reply. However, you may be assured that all comment will be given careful consideration.

It should be noted that comments should be submitted, preferably in duplicate, to the Docket Section of the Federal Aviation Agency, and in order to insure consideration must be received on or before January 15, 1962.

George C. Pratt

Director
Flight Standards Service

FEDERAL AVIATION AGENCY

*FLIGHT STANDARDS SERVICE*

(14 CFR 514)

/Regulatory Docket No. 1428; Draft Release No. 62-43/

TECHNICAL STANDARD ORDERS FOR AIRCRAFT MATERIALS,

PARTS AND APPLIANCES

NOTICE OF PROPOSED RULE MAKING

Pursuant to the authority delegated to me by the Administrator (14 CFR Part 405) notice is hereby given that the Federal Aviation Agency has under consideration a proposal to revise Section 514.61 of Part 514 of the Regulations of the Administrator (14 CFR Part 514) by adding a new technical standard order. This Technical Standard Order establishes *minimum performance standards for airborne ILS localizer receiving* equipment to be used on civil aircraft of the United States engaged in air carrier operations.

The amendment is proposed to incorporate new environmental test procedures which were developed to be more compatible with existing and anticipated aircraft environmental conditions. These are in a new FAA standard replacing RTCA Paper 89-54/DO-59 referenced in TSO-C36a (§ 514.61). A change to the emission of spurious radio frequency energy/requirement is the only change to the minimum performance standards. Otherwise the FAA standard is similar to RTCA Paper 89-54/DO-59.

Interested persons may participate in the making of the proposed rule by submitting such written data, views or arguments as they may desire. Communications should be submitted in duplicate to the Docket Section of the Federal Aviation Agency, Room A-103, 1711 New York Avenue, N. W., Washington 25, D. C. All communications received on or before January 15, 1962, will be considered by the Administrator before taking action on the proposed rule. The proposals contained in this notice may be changed in light of the comments received. All comments submitted will be available in the Docket Section for examination by interested persons at any time.

This amendment is proposed under the authority of Sections 313(a) and 601 of the Federal Aviation Act of 1958 (72 Stat. 752, 775; 49 U.S.C. 1354(a), 1421).

In consideration of the foregoing it is proposed to amend Part 514 as follows:

By revising section 514.61 to read as follows:

§ 514.61 Airborne ILS localizer receiving equipment (for air carrier aircraft)- TSO-C36b - (a) Applicability--(1) Minimum performance standards. Minimum performance standards are hereby established for airborne ILS localizer receiving equipment which is to be used on civil aircraft of the United States engaged in air carrier operations. New models of airborne ILS localizer receiving equipment manufactured for use on civil air carrier aircraft on or after the effective date of this section shall meet the minimum performance standards contained in Federal Aviation Agency Standard entitled "Minimum Performance Standards for Airborne ILS Localizer Receiving Equipment", 1/ dated June 15, 1962, and Radio Technical Commission for Aeronautics Paper 120-61/DO-108 2/ entitled "Environmental Test Procedures Airborne Electronic Equipment", dated July 13, 1961, with the exceptions to these standards listed in subparagraph (2) of this paragraph.

(2) Exception. Radio Technical Commission for Aeronautics Paper 120-61/DO-108 outlines various test procedures which define the environmental extremes over which the equipment shall be designed to operate. Some test procedures have categories established and some do not. Where categories are established, only equipment which qualifies under the following categories, as specified in RTCA Paper 120-61/DO-108, is eligible under this order:

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1/ Copies may be obtained upon request addressed to Publishing and Graphics Branch, Inquiry Section, MS-158, Federal Aviation Agency, Washington 25, D. C.

2/ Copies of this paper may be obtained from the RTCA Secretariat, Room 1072, T-5 Building, 16th & Constitution Avenue, N. W., Washington 25, D. C., at a cost of 75 cents per copy.

(i) Temperature-Altitude Test - Categories A, B, C, or D.

(ii) Humidity Test - Categories A or B.

(iii) Vibration Test - Categories A, B, C, D, E, or F.

(iv) Audio-Frequency Magnetic Field Susceptibility Test - Categories A or B.

(v) Radio-Frequency Susceptibility Test - Category A.

(vi) Emission of Spurious Radio-Frequency Energy Test - Category A.

(b) Marking. (1) In addition to the markings specified in § 514.3(d), the equipment shall be marked to indicate the environmental extremes over which it has been designed to operate. There are seven environmental test procedures outlined in RTCA Paper 120-61/DO-108 which have categories established. These should be identified on the nameplate by the words "environmental categories" or, as abbreviated, "Env. Cat." followed by seven letters which identify the categories designated in RTCA Paper 120-61/DO-108. Reading from left to right, the category designations shall appear on the nameplate in the following order so that they may be readily identified:

(i) Temperature-Altitude Test Category.

(ii) Humidity Test Category.

(iii) Vibration Test Category

(iv) Audio-Frequency Magnetic Field Susceptibility Test Category.

(v) Radio-Frequency Susceptibility Test Category.

(vi) Emission of Spurious Radio-Frequency Energy Test Category.

(vii) Explosion Test.

(2) Equipment which meets the explosion test requirement shall be identified by the letter "E". Equipment which does not meet the explosion test requirement shall be identified by the letter "X". A typical nameplate identification would be as follows: Env. Cat. DABAAAX.

(3) In some cases such as under the Temperature-Altitude Test Category, a manufacturer may wish to substantiate his equipment under two categories. In this case, the nameplate shall be marked with both categories in the space designated for that category by placing one letter above the other in the following manner: Env. Cat. $\frac{A}{D}$ABAAAX.

(4) Each major component of equipment (antenna, power supply, etc.) shall be identified with at least the manufacturers' name, TSO number, and the environmental categories over which the equipment component is designed to operate.

(c) Data requirements. Six copies each of the following, except where noted, shall be furnished to the Chief, Engineering and Manufacturing Branch, Flight Standards Division, Federal Aviation Agency, in the region in which the manufacturer is located:

(1) Manufacturer's operating instructions and equipment limitations.

(2) Installation procedures with applicable schematic drawings, wiring diagrams, and specifications. Indicate any limitations, restrictions, or other conditions pertinent to installation.

(3) One copy of the manufacturer's test report.

George C. Pratt

Director
Flight Standards Service

Issued in Washington, D. C., on October 10, 1962.

FEDERAL AVIATION AGENCY

WASHINGTON, D.C.

# MINIMUM PERFORMANCE STANDARDS FOR AIRBORNE ILS LOCALIZER RECEIVING EQUIPMENT

JUNE 15, 1962

# INTRODUCTION

This document sets forth minimum performance standards for airborne ILS localizer receiving equipment.

Compliance with these standards by manufacturers and users is required as a means of assuring that the equipment will satisfactorily perform its intended function.

Inasmuch as the measured values of radio equipment performance characteristics may be a function of the method of measurement, standard test conditions and methods of test are also included in this document.

The word "equipment" as used herein includes all of the components or units necessary (as determined by the equipment manufacturer) for the equipment to perform properly its intended function. For example, an airborne ILS localizer receiving "equipment" may include an antenna, a receiver unit, a control box, a power supply, a shock mount, etc. In the case of this example, all of the foregoing components or units comprise the "equipment". It should not be inferred from this example, however, that every airborne ILS localizer receiving equipment will necessarily include all of the foregoing components. This will depend on the design used by the equipment manufacturer.

Acknowledgement is hereby given to the Radio Technical Commission for Aeronautics (RTCA), Washington, D.C., for use of its report entitled - "Minimum Performance Standards - Airborne ILS Localizer Receiving Equipment" (RTCA Paper 89-54/DO-59 dated July 15, 1954) which is the basic source of the standards contained herein.

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## 1.0 GENERAL STANDARDS

### 1.1 Rating of Components

The equipment shall not incorporate in its design a component of such rating that, when the equipment is operated throughout the range of the specified environmental tests, the rating established by the manufacturer of the component is exceeded. For electron tubes, the continuous commercial service rating of the tube manufacturer is applicable except for the heaters and filaments. The voltage applied to the heaters and filaments of electron tubes shall be within 5% of the manufacturer's rating when the equipment is operated under standard test conditions. When the heaters and filaments are connected in series, the 5% tolerance shall apply to the sum of their voltage ratings.

### 1.2 Operation of Controls

The design of the equipment shall be such that the controls intended for use during flight cannot be operated in any possible position combination or sequence which would result in a condition whose presence or continuation would be detrimental to the reliability of the equipment.

### 1.3 Effects of Test

The design of the equipment shall be such that the application of the specified tests produces no discernible condition which would be detrimental to the reliability of equipment manufactured in accordance with such design.

### 1.4 Accessibility of Controls

Controls which are not normally adjusted in flight shall not be readily accessible to flight personnel.

1.5 Deviation Indicator Deflection Range

The deviation indicator shall be capable of deflecting at least five-eighths of an inch on both sides of its center zero position. In the case of "cross pointer" type instruments, the reference deflection line shall be the centered glide slope deviation indicator needle. In the case of other type indicators, the reference deflection line shall be its scale.

2.0 MINIMUM PERFORMANCE STANDARDS UNDER STANDARD TEST CONDITIONS

The test procedures applicable to a determination of the performance of airborne ILS localizer receiving equipment under standard test conditions are set forth in Appendix "A" of this paper.

2.1 Voltage Standing Wave Ratio (Receiver)

When the receiver is designed for use with a transmission line, the voltage standing wave ratio on the transmission line shall not exceed a value of 10 over the rf frequency range from 108.0 Mc to 112.0 Mc.

2.2 Voltage Standing Wave Ratio (Antenna)

When the antenna to be used with the receiver is designed for use with a transmission line, the voltage standing wave ratio on the transmission line shall not exceed a value of 6 over the rf frequency range from 108.0 Mc to 112.0 Mc.

2.3 Centering Characteristic

The deviation indication shall not depart from the centering position by more than 10% of the standard deflection when the level of a standard localizer centering signal is varied over the range of 40 to 20,000 uv.

2.4 Sensitivity and Deflection Characteristic

The deviation indicator deflection shall remain within a range equal to 20% of the deflection at 1000 uv input when the level of a standard localizer deviation signal is varied over the range of 40 to 20,000 uv.

2.5 Deflection Linearity

Over the deflection range of the deviation indicator, the amount of deflection shall be within 10% of being proportional to the difference in depth of modulation[1]/ of the 90 and 150 c.p.s. signals, or the amount of deflection shall be within 10% of standard deflection of being proportional to the difference in depth of modulation, whichever is greater. Additionally, as the difference in depth of modulation is increased beyond that producing maximum deflection to a value of .4 ddm, the deflection shall not be less than its maximum value. These standards shall be met over the range of signal input level from 40 to 20,000 uv.

2.6 Selectivity

a. Receivers designed for selection of frequency channels in discrete increments.

(1) The level of an input signal required to produce a given output shall not vary more than 6 db over the input signal frequency range -

From:

The assigned channel frequency -2.5 kc, -.005% of the assigned channel frequency, minus the maximum positive departure of center response frequency 2/ from the assigned channel frequency under the Temperature Variation Test;

To:

The assigned channel frequency +2.5 kc, +.005% of the assigned channel frequency, plus the maximum negative departure of center response frequency from the assigned channel frequency under the Temperature Variation Test.

1/ Difference in depth of modulation (ddm) is the percentage modulation depth of the larger signal minus the percentage modulation depth of the smaller signal divided by 100.

2/ Center response frequency is the frequency midway between the two frequencies at which the receiver response, as shown by the selectivity curve, is 6 db down from maximum.

NOTE: Airborne receivers in which the nose bandwidth of the selectivity characteristic is at least as broad as that defined in the above standard have been demonstrated to provide adequate sensitivity and deviation indicator deflection characteristics in aircraft operations. A nose bandwidth less than that set forth above may be used provided that the standards in Paragraphs 2.3, Centering Characteristic; 2.4, Sensitivity and Deflection Characteristic; and 2.5, Deflection Linearity are met for all localizer signal carrier frequencies.

(2) The level of an input signal required to produce a given output shall be at least 60 db greater than the level required to produce the given output at the frequency of maximum response -

At a frequency equal to:

The assigned channel frequency +100 kc -.005% of the assigned channel frequency minus the maximum positive departure of center response frequency from the assigned channel frequency occurring under the Temperature Variation Test;

And at a frequency equal to:

The assigned channel frequency -100 kc +.005% of the assigned channel frequency plus the maximum negative departure of center response frequency from the assigned channel frequency occurring under the Temperature Variation Test.

b. Receivers in which the resonant frequency changes continuously when tuning from one channel to another.

(1) The level of an input signal required to produce a given output shall not vary more than 6 db over the input signal frequency range from at least 20 kc below center response frequency to at least 20 kc above center response frequency.

(2) The level of an input signal required to produce a given output at frequencies of plus and minus 160 kc from the center response frequency shall be at least 60 db greater than the level required to produce the same output at the frequency of maximum response.

NOTE: As of the date of this report, the spacing between VOR/LOC frequency channels within the band 108.0 to 112.0 Mc is 100 kc. Experience has shown that the criteria used to select frequencies for VOR/LOC facilities permits tunable receivers, having the selectivity characteristics set forth above, to be adjusted to provide satisfactory reception at distances not exceeding 25 nautical miles from the facility and at altitudes not exceeding 2,000 feet above the facility. When it is intended that satisfactory receiver operation be obtained at greater distances and at higher altitudes, additional selectivity is required to suppress signals from VOR facilities 100 kc removed from the desired signal.

.7 Spurious Response

The response of the receiver shall be at least 60 db below the response at center response frequency when an input signal modulated 30% at 150 cps is varied over the frequency range of .190 Mc to 1500 Mc, excluding the frequency band 107.8 Mc to 112.2 Mc.

.8 Cross Modulation

With the simultaneous application of a standard localizer centering signal at maximum response frequency (desired signal) and a signal consisting of an rf carrier amplitude modulated 30% at 150 cps at other than maximum response frequency (undesired signal), the alarm signaling device shall indicate a usable signal, and the deviation indication shall not depart from its centered position due to cross modulation by more than 10% of standard deflection under the following conditions:

| Level of Desired Signal | Level of Undesired Signal | Frequency Range Over Which Undesired Signal is Varied |
|---|---|---|
| 200 uv | 10,000 uv | 107.0 Mc -112.0 Mc, excluding the band within 200 kc of the desired signal frequency |
| 1,000 uv | 20,000 uv | |

2.9 Alarm Signal

An alarm signaling device shall be provided. The device shall:

a. Be plainly visible in the absence of an rf signal. Be plainly visible in the absence of 90 and 150 cps modulation on a 1000 uv carrier at center response frequency.

b. At least begin to appear when the percentage modulation of the 90 and 150 cps signals of a standard localizer centering signal is reduced to 10% of each and when the percentage modulation of either the 90 or 150 cps signal is zero and the other 20%.

c. At least begin to appear when the level of a standard localizer deviation signal produces 50% of standard deflection of the deviation indicator.

d. Be energized and its indicator off or out of sight when the level of a standard localizer test signal is varied over the range of at least 40 to 20,000 uv.

2.10 Emission of Radio-Frequency Energy

The level of conducted and radiated spurious radio-frequency energy emitted by the equipment shall not exceed those levels specified in Appendix A to RTCA Paper 120-61/DO-108 "Environmental Test Procedures - Airborne Electronic Equipment," dated July 13, 1961, for the aircraft category for which the equipment is designed.

2.11 Damping Characteristic

When a standard localizer test signal of 1000 uv is abruptly changed from a standard localizer centering signal to a standard localizer deviation signal, the deviation indicator shall, in not more than two seconds, move to the point which is removed from the final stabilized position of the indicator by a distance of no more than 10% of standard deflection. The initial "overshoot" of the indicator shall not exceed 2% of standard deflection.

NOTE: The amount of indicator damping required for satisfactory service operation of a localizer receiver may exceed the amount specified above. The additional damping may be provided through adjustment within the receiver or through external damping means.

2.12 Power Source Frequency Variation

When the receiver is designed for operation from an AC power source of variable frequency and the frequency is slowly varied through the range for which the receiver is designed, the deviation indication shall not vary more than 5% of standard deflection in the presence of a standard localizer centering signal of 1000 uv.

2.13 Deviation Indicator Stability with Change in Frequency of 90 and 150 cps Signals

a. The deviation indicator shall not change from its centered position by more than 10% of standard deflection when the frequency of the modulation signals of a 1000 uv standard localizer centering signal is simultaneously varied over the range from 97.5% to 102.5% of 90 and 150 cps.

b. The deviation indicator shall not depart from standard deflection by more than 15% of standard deflection when the frequency of the modulation signals of a 1000 uv standard localizer deviation signal is simultaneously varied over the range from 97.5% to 102.5% of 90 and 150 cps.

2.14 Deviation Indicator Sensitivity Adjustment Range

Means shall be provided for the service adjustment of the deviation indicator sensitivity over the range of at least from .4 to .8 of full deflection when the input signal is a standard localizer deviation signal of 1000 uv. At all sensitivity adjustments over the range of .4 to .8 of full deflection, the standards of Sections 2.3, 2.4 and 2.5 shall be met except that, in this case, the deflection obtained with a standard localizer deviation signal of 1000 uv at the particular deflection sensitivity setting shall be used instead of standard deflection.

NOTE: Adjustment of deviation indicator deflection sensitivity may be accomplished by means of a variable control or by replacing circuit elements, such as resistors, with those having another value.

2.15 Operation of Two Localizer Receivers from the Same Antenna

(This standard is applicable to those receivers designed to operate from an antenna which also supplies signals to another receiver.)

When the receiver is connected in accordance with the manufacturer's instructions to an antenna which also supplies signals to another receiver and both receivers are operated in accordance with the manufacturer's instructions, the standards of all paragraphs of Section 2 shall be met and, in addition, the deviation indication inaccuracies resulting from interaction between the two receivers when operated on the same rf frequency shall not exceed 5% of standard deflection. For the purpose of this

standard, the junction of the two transmission lines connected to the receivers shall be considered the receiver input.

NOTE: It is recognized that two receivers meeting the above standard may interfere with one another on some combinations of channel settings. While it is desirable that two receivers so connected cannot interfere with one another at all channel setting combinations, the state of the art is such that it is impracticable to set forth an equipment standard in these terms. It is recommended that equipment manufacturers take cognizance of this and make a determined effort to reduce the number of channel setting combinations where interference might occur and to reduce the severity of the interference in those cases where it cannot be eliminated.

2.16 Audio Frequency Response

The receiver audio output level shall not vary more than 9db when the audio modulating frequency of a standard localizer audio signal is varied over the range of 350 to 2500 cps. The rf input level shall be held constant at a value producing an output signal-plus-noise to noise ratio of 25db, and the output at 1000 cps shall be not less than 90% of the rated output.

NOTE: The above standard on audio frequency response defines a minimum acceptable performance in accordance with current practice. The equipment designer should be aware, however, that advances in air/ground communications system design may dictate a revision of this standard in the future.

2.17 Audio Output Regulation and Distortion

With an output load of 200% of design impedance and with an output load of 50% of design impedance, the combined distortion and noise in the receiver audio output shall not exceed 20% of the total output, and the output power level shall be within 2:1 of the level when the load is that for which the receiver is designed. This requirement shall be met over the rf input range of 40 to 20,000 uv and over the audio frequency range of 350 to 2500 cps.

2.18 Percentage Modulation Characteristic

The deviation indicator shall not depart from its centered position by more than 5% of standard deflection when a standard localizer audio signal is applied to the receiver input and the percentage modulation of the 90 and 150 cps signals is increased from 20% each to 25% each.

3.0 MINIMUM PERFORMANCE STANDARDS UNDER ENVIRONMENTAL TEST CONDITIONS

Unless otherwise specified, the test procedures applicable to a determination of the performance of this equipment under environmental test conditions are set forth in RTCA Paper 120-61/DO-108 - "Environmental Test Procedures - Airborne Electronic Equipment", dated July 13, 1961.

3.1 Temperature - Altitude Test

3.1.1 Low Temperature Test

When the equipment is subjected to this test:

a. The receiver sensitivity, as defined in paragraph k of Appendix A, shall be 80 uv or better.

b. The deviation indicator deflection with a 1000 uv standard localizer centering signal shall not change from that obtained under standard test conditions by more than 15% of standard deflection.

c. The deviation indicator deflection with a 1000 uv standard localizer deviation signal shall not change from that obtained under standard test conditions by more than -30% to +40% of standard deflection.

3.1.2 High Temperature Test

a. When the equipment is operated at the High Short-Time Operating Temperature:

(1) All mechanical devices shall operate satisfactorily.

(2) There shall be no evidence of materials, such as

grease or potting and sealing compounds, exuding or dripping from the equipment.

b. When the equipment is operated at the High Operating Temperature:

(1) The receiver sensitivity as defined in paragraph k of Appendix A shall be 80 uv or better.

(2) The deviation indicator deflection with a 1000 uv standard localizer centering signal shall not change from that obtained under standard test conditions by more than 15% of standard deflection.

(3) The deviation indicator deflection with a 1000 uv standard localizer deviation signal shall not change from that obtained under standard test conditions by more than -30% to +40% of standard deflection.

3.1.3 Decompression Test (When Required)

When the equipment is subjected to this test the performance requirements of paragraphs 2.3 and 2.4 shall be met.

3.1.4 Altitude Test

When the equipment is subjected to this test the performance requirements of paragraphs 2.3 and 2.4 shall be met.

3.2 Humidity Test

After subjection to humidity and

a. Within 15 minutes from the time primary power is applied, the sensitivity shall be within 4:1 of that obtained under standard test conditions; the deviation indicator deflection, with a standard localizer centering signal of 1000 uv, shall not exceed 15% of standard deflection; and the deviation indicator deflection, with a standard localizer deviation signal of 1000 uv, shall not depart from standard deflection by more than 30% of standard deflection.

b. Within four hours from the time primary power is applied, the sensitivity shall be within 1.25:1 or

±2 uv, whichever is greater, of that obtained under standard test conditions; the deviation indicator deflection, with a standard localizer centering signal of 1000 uv, shall not exceed 5% of standard deflection; and the deviation deflection, with a standard localizer deviation signal of 1000 uv, shall not depart from standard deflection by more than 10% of standard deflection.

3.3 Shock Test

a. Following the application of the Operational Shocks, the requirements of paragraphs 2.3 and 2.4 shall be met.

b. Following the application of the Crash Safety Shocks, the equipment shall have remained in its mounting and no parts of the equipment or its mounting shall have become detached and free of the shock test table or of the equipment under test. 1/

3.4 Vibration Test

When subjected to this test:

a. The deviation indicator shall not depart from its centered position by more than 10% of standard deflection when a standard localizer centering signal is applied to the receiver input and the equipment is subjected to the vibration test.

b. The deviation indicator shall not depart from standard deflection by more than 20% of standard deflection when a standard localizer deviation signal is applied to the receiver input and the equipment is subjected to the vibration test.

3.5 Temperature Variation Test

When the equipment is subjected to the temperature variation test:

a. The center response frequency of the receiver shall

1/ The application of this test and that required by paragraph 3.6(c) may result in damage to the equipment under test. Therefore, they may be conducted after the other tests are completed. Paragraph 1.3 does not apply.

remain within:

(1) 12 kc of the assigned channel frequency in the case of receivers designed to select the assigned frequency channels in discrete increments.

(2) 0.1% of the assigned channel frequency in the case of continuously tunable receivers.

b. The deviation indicator deflection, with a 1000 uv standard localizer centering signal, shall not change from that obtained under standard test conditions by more than 15% of standard deflection.

c. The deviation indicator deflection, with a 1000 uv standard localizer deviation signal, shall not change from that obtained under standard test conditions by more than 30% of standard deflection.

NOTE: In the case of continuously tunable receivers, the receiver shall meet the standards of paragraphs b. and c. above when it is tuned to the center response frequency.

3.6 Low Voltage Test

a. When the primary power voltage(s) of DC operated equipment is 80% and when that of AC operated equipment is 87-1/2% of standard test voltage(s), the equipment shall start and continue to operate electrically and mechanically. Degradation of performance is tolerable.

b. DC operated equipment shall operate satisfactorily within two (2) minutes upon returning the primary power voltage(s) to normal after the gradual reduction of the primary power voltage(s) from 80% to 50% of standard test voltage(s).

c. The gradual reduction of the primary power voltage(s) of DC operated equipment from 50% to 0% of standard test voltage(s) shall produce no evidence of the presence of fire or smoke. 1/

1/ The application of this test and that required by paragraph 3.3(b) may result in damage to the equipment under test. Therefore, they may be conducted after the other tests are completed. Paragraph 1.3 does not apply.

3.7 Conducted Voltage Transients Tests

a. Following the Intermittent Transients Test, the requirements of paragraphs 2.3 and 2.4 shall be met.

b. During the Repetitive Transients Test, the requirements of paragraphs 2.3 and 2.4 shall be met.

3.8 Conducted Audio-Frequency Susceptibility Test

When the equipment is subjected to this test the requirements of paragraphs 2.3 and 2.4 shall be met, excepting within the band of $\pm$ 100 kc of the frequency to which the receiver is tuned.

3.9 Audio-Frequency Magnetic Field Susceptibility Test

When the equipment is subjected to this test, the requirements of paragraph 2.4 shall be met.

3.10 Radio-Frequency Susceptibility Test (Radiated and Conducted)

When the equipment is subjected to this test, the requirements of paragraphs 2.3 and 2.4 shall be met.

3.11 Explosion Test (When Required)

During the application of this test, the equipment shall not cause detonation of the explosive mixture within the test chamber.

# APPENDIX A

## TEST PROCEDURES
## AIRBORNE ILS LOCALIZER RECEIVING EQUIPMENT

**NOTE:**

THE TEST PROCEDURES SET FORTH IN PART II OF THIS APPENDIX ARE SATISFACTORY FOR USE IN DETERMINING THE PERFORMANCE OF AIRBORNE ILS LOCALIZER RECEIVING EQUIPMENT. TEST PROCEDURES WHICH PROVIDE EQUIVALENT INFORMATION MAY BE USED.

## PART I

## DEFINITIONS OF TERMS AND CONDITIONS OF TEST

The following definitions of terms and conditions of test are applicable to the receiving equipment tests specified herein:

a. Power Input Voltage

Unless otherwise specified, all tests shall be conducted with the power input voltage adjusted to design voltage ±2%. The input voltage shall be measured at the receiver input terminals.

NOTE: Design voltages in use as of the date of this report are 13.75 v DC, 27.5 v DC, and 115 v AC.

b. Power Input Frequency

1. In the case of receivers designed for operation from an AC power source of essentially constant frequency (e.g., 400 cps), the input frequency shall be adjusted to design frequency ±2%.

2. In the case of equipment designed for operation from an AC power source of variable frequency (e.g., 300 to 1000 cps), unless otherwise specified, tests shall be conducted with the input frequency adjusted to within 5% of a selected frequency and within the range for which the equipment is designed.

c. Adjustment of Equipment

The circuits of the equipment under test shall be properly aligned and otherwise adjusted in accordance with the manufacturer's recommended practices prior to the application of the specified tests.

d. Test Instrument Precautions

Due precautions shall be taken during the conduct of the tests to prevent the introduction of errors resulting from the connection of headphones, voltmeters, oscilloscopes, and other test instruments across the input and output impedances of the equipment under test.

e. Ambient Conditions

Unless otherwise specified, all tests shall be conducted under conditions of ambient room temperature, pressure, and humidity. However, the room temperature shall be not lower than 10°C.

f. Warm-up Period

Unless otherwise specified, all tests shall be conducted after a warm-up period of not less than fifteen (15) minutes.

g. Connected Load

Unless otherwise specified, all tests shall be performed with the equipment connected to loads having the impedance values for which it is designed.

h. RF Input Voltage

The "rf input voltage" is defined as the "open circuit" voltage of the circuit connected to the receiver input. The circuit connected to the receiver input shall be the equivalent of the rf input voltage in series with an impedance having a resistance within 10% and a reactance of not more than 10% of the characteristic impedance of the transmission line for which the receiver is designed.

NOTE: The rf input voltages specified herein are for the case of a receiver designed for a transmission line having a nominal characteristic impedance of 52 ohms. In the case of a receiver designed for a transmission line having a nominal characteristic impedance of other than 52 ohms, the rf input voltage values shall be computed according to the following equation:

$$E_2 = \sqrt{\frac{E_1^2 \times R_2}{52}}$$

Where $E_2$ is the rf input voltage to be used in the case of a receiver designed for a transmission line having a nominal characteristic impedance other than 52 ohms -

$E_1$ is the rf input voltage specified herein -

$R_2$ is the nominal characteristic impedance of the transmission line for which the receiver is designed.

i. Standard Test Signals

Unless otherwise specified, the rf input signals shall be as follows:

Standard Localizer Test Signal

An rf carrier amplitude modulated simultaneously with 90 ± .3% and 150 ± .3% cps signals so that the sum of their separate modulation percentages equals 40 ± 2%.

Standard Localizer Centering Signal

A standard localizer test signal in which the difference in depth of modulation 1/ of the 90 and 150 cps signals is less than .002 (.1 db).

Standard Localizer Deviation Signal

A standard localizer test signal in which the difference in depth of modulation of the 90 and 150 cps signals is 0.093 ± .002 (4 ± .1 db).

Standard Localizer Audio Signal

A standard localizer test signal to which is added an audio signal amplitude modulating the carrier 30%.

j. Standard Deflection

"Standard Deflection" shall be .6 of the center to full scale deflection of the deviation indicator. The receiver shall be adjusted to produce standard deflection when the input signal is a standard localizer deviation signal of 1000 uv.

k. Receiver Sensitivity

The receiver sensitivity is the minimum level in microvolts of a standard localizer deviation signal required to produce simultaneously (1) a deflection of the deviation indicator of at least 60% of standard deflection and (2) erratic movement of the deviation indicator due to noise of not more than ± 5% of standard deflection.

1/ Difference in depth of modulation (ddm) is the percentage modulation depth of the larger signal minus the percentage modulation depth of the smaller signal divided by 100.

## PART II

## DETAILED TEST PROCEDURES

### T-1 VOLTAGE STANDING WAVE RATIO (RECEIVER)

The test procedures set forth below are satisfactory for use in determining the performance of airborne ILS localizer receiving equipment. Test procedures which provide equivalent information may be used.

Equipment Required:

RF Signal Generator (Boonton Model 211A or equivalent)

Slotted Line having an impedance equal to that for which the receiver input is designed.

An impedance bridge may be used in lieu of the slotted line.

Measurement Procedure:

(a) Slotted Line Method:

With the receiver operating and the slotted line connected to the receiver input, apply an rf signal to the input of the slotted line. Measure the minimum and maximum rf voltages along the slotted line and compute the VSWR.

The level of the input signal shall not be high enough to overload the receiver input circuit.

(b) Impedance Bridge Method:

With the impedance bridge, measure the impedance of the receiver input circuit and compute the VSWR.

The level of the signal shall not be high enough to overload the receiver input circuit.

### T-2 VOLTAGE STANDING WAVE RATIO (ANTENNA)

Equipment Required:

RF signal generator (Boonton Model 211A or equivalent).

Slotted Line having an impedance equal to that for which the antenna input is designed.

An Impedance Bridge may be used in lieu of the slotted line.

Measurement Procedure:

(a) Slotted Line Method:

Apply to the antenna input, through the slotted line, an rf signal. Measure the minimum and maximum rf voltages along the slotted line and compute the VSWR.

(b) Impedance Bridge Method:

With the impedance bridge, measure the impedance of the antenna input circuit and compute the VSWR.

CENTERING CHARACTERISTIC

Equipment Required:

RF Signal Generator (Boonton Model 211A or equivalent)

AF Signal Generator (Military Type MD83 or equivalent)

Deviation indicator having an accuracy of ±1%. A meter of equivalent resistance may be substituted for the deviation indicator.

Measurement Procedure:

Apply to the receiver input a standard localizer centering signal. Vary the signal input level over the range of 40 to 20,000 uv. Determine the maximum deviation of the indicator from its centered position.

-4 SENSITIVITY AND DEFLECTION CHARACTERISTIC

Equipment Required:

RF Signal Generator (Boonton Model 211A or equivalent)

AF Signal Generator (Military Type MD83 or equivalent)

Deviation indicator having an accuracy of ±1%. A meter of equivalent resistance may be substituted for the deviation indicator.

Measurement Procedure:

Apply to the receiver input a standard localizer deviation signal. Determine the range of deviation indicator deflection when the level of the input signal is varied over the range of 40 to 20,000 uv.

5 DEFLECTION LINEARITY

Equipment Required:

RF Signal Generator (Boonton Model 211A or equivalent)

AF Signal Generator (Military Type MD83 or equivalent)

Deviation Indicator having an accuracy of ±1%. A meter of equivalent resistance may be substituted for the deviation indicator.

Measurement Procedure:

Apply to the receiver input a standard localizer

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test signal. Vary the difference in depth of modulation of the 90 and 150 c.p.s. signals over the range of 0 to .4 and determine the proportionality of the difference in depth of modulation to deviation indicator deflection up to maximum deviation indicator deflection. For values of difference in depth of modulation beyond that producing maximum deviation indicator deflection, determine whether the deflection is less than its maximum value. This test shall be conducted at rf input signal levels of 40; 100; 200; 1000; 10,000; and 20,000 uv.

## SELECTIVITY

### Equipment Required:

RF Signal Generator (Boonton Model 211A or equivalent)

Audio Signal Generator (Military Type MD83 or equivalent)

Output Power Meter (General Radio Model 583-A or equivalent)

### Measurement Procedure:

Apply to the receiver input a radio-frequency signal of such a level that the receiver operates below the knee of the AVC characteristic and note the receiver output at center response frequency. Determine the frequencies on both sides of center response frequency to which the signal generator must be tuned to produce the output noted above when the level of the input signal is two times (6 db.) and 1000 times (60 db.) the input required to produce the output noted above at the maximum response frequency.

T-7 SPURIOUS RESPONSE

Equipment Required:

RF Signal Generators (General Radio Model 805-C and Hewlett-Packard Models 608-A, 610-B and 614-A, or equivalent)

AF Signal Generator (Hewlett-Packard Model 200-B or equivalent)

Measurement Procedure:

Apply to the receiver input an rf signal modulated 30% at 150 cps and having a level 60 db greater than that producing .6 of standard deflection at center response frequency. Vary the radio-frequency of the input signal over the range from .190 Mc to 1500 Mc, excluding the band 107.8 Mc to 112.2 Mc, and determine whether the indicator deflection exceeds .6 of standard deflection over this frequency range.

T-8 CROSS MODULATION

Equipment Required:

2 RF Signal Generators (Boonton Model 211A or equivalent)

AF Signal Generator (Military Type MD83 or equivalent)

Combining Unit (See Figure 1)

Measurement Procedure

Connect the two signal generators together by means of the Combining Unit. Apply, simultaneously, to the receiver input a standard localizer centering signal having a level of 200 uv at maximum response frequency (desired signal) and a signal consisting of an rf carrier amplitude modulated 30% of 150 cps and having a level of 10,000 uv (undesired signal).

Vary the radio-frequency of the undesired signal over the range from 107.0 Mc to 112.0 Mc, excluding the band from -200 kc of maximum response frequency

to +200 kc of maximum response frequency. Determine the maximum amount of deflection of the deviation indicator from its centered position due to cross modulation.

Repeat this test with the level of designed signal at 1000 uv and the level of the undesired signal at 20,000 uv.

ALARM SIGNAL

Equipment Required:

RF Signal Generator (Boonton Model 211A or equivalent)

AF Signal Generator (Military Type MD83 or equivalent)

Deviation indicator having an accuracy of $\pm$ 1%. A meter of equivalent resistance may be substituted for the deviation indicator.

Measurement Procedure:

Apply to the receiver input a standard localizer test signal having a level of 1000 uv. Determine the position or response of the alarm signal under the following conditions:

(a) When the 90 and 150 cps modulation is removed from the carrier.

(b) When the modulation percentages of the 90 and 150 cps signals are 10% each.

(c) When the level of the standard localizer deviation signal is that which produces 50% of standard deflection.

(d) When the level of the standard localizer test signal is varied over the range from 40 uv to 20,000 uv.

T-10 EMISSION OF SPURIOUS RADIO-FREQUENCY ENERGY

Equipment Required:

See Paragraph 1 and 2, Page 3 of Appendix A of RTCA Paper 120-61/DO-108.

Measurement Procedure:

See Paragraph 3, Page 5 of Appendix A of RTCA Paper 120-61/DO-108.

T-11 DAMPING CHARACTERISTIC

Equipment Required:

RF Signal Generator (Boonton Model 211A or equivalent)

AF Signal Generator (Military Type MD83 or equivalent)

Measurement Procedure:

Apply to the receiver input a standard localizer test signal of 1000 uv. Abruptly change the signal from a standard centering signal to a standard deviation signal and determine the time required for the deviation indicator needle to move from its centered position to the point which is removed from its final stabilized position by a distance equal to 10% of standard deflection. Determine the amount the deviation indicator needle overshoots its stabilized position.

## T-12 POWER SOURCE FREQUENCY VARIATION

This test applies to that equipment designed for operation from an AC power source of variable frequency.

Equipment Required:

RF signal generator (Boonton Model 211A or equivalent)

AF signal generator (Military Type MD83 or equivalent)

Deviation indicator having an accuracy of $\pm$ 1%. A meter of equivalent resistance may be substituted for the deviation indicator.

AC power source having a frequency range equal to at least that for which the equipment is designed.

Measurement Procedure:

Apply to the receiver input a standard localizer centering signal having a level of 1000 uv. Vary the frequency of the AC power source over the range for which the equipment is designed and determine the maximum change in deflection of the deviation indicator from its centered position.

## T-13 DEVIATION INDICATOR STABILITY WITH CHANGE IN FREQUENCY OF 90 and 150 CPS SIGNALS

Equipment Required:

RF Signal Generator (Boonton Model 211A or equivalent)

AF Signal Generator (Military Type MD83 or equivalent)

AC power supply whose frequency may be varied over the range of 58.5 to 61.5 cps.

Deviation indicator having an accuracy of $\pm$ 1%. A meter of equivalent resistance may be substituted for the deviation indicator.

Measurement Procedure:

(a) Apply to the receiver input a standard localizer centering signal of 1000 uv. Vary the frequency of the modulation signals simultaneously over the range from 97.5% to 102.5% of 90 and 150 cps. Determine the maximum change in deviation indicator deflection from its centered position.

(b) Apply to the receiver inputs a standard localizer deviation signal of 1000 uv. Vary the frequency of the modulation signals simultaneously over the range from 97.5% to 102.5% of 90 and 150 cps. Determine the maximum change in deviation indicator deflection from standard deflection.

T-14 DEVIATION INDICATOR SENSITIVITY ADJUSTMENT RANGE

Equipment Required:

RF Signal Generator (Boonton Model 211A or equivalent)

AF Signal Generator (Military Type MD83 or equivalent)

Deviation indicator having an accuracy of ±1%. A meter of equivalent resistance may be substituted for the deviation indicator.

Measurement Procedure:

(a) Apply to the receiver input a standard localizer deviation signal of 1000 uv. Determine the deviation indicator deflection when the value of the component or components controlling deviation indicator sensitivity is varied over the range for which the equipment is designed.

(b) Conduct the tests set forth in procedures T-3, T-4 and T-5 with the deviation indicator sensitivity adjusted to the high and to the low limits set forth in paragraph 2.16.

T-15 OPERATION OF TWO LOCALIZER RECEIVERS FROM THE SAME ANTENNA

This test is applicable to those receivers designed to operate from an antenna which also supplies signals to another receiver.

Equipment Required:

RF Signal Generator (Boonton Model 211A or equivalent)

AF Signal Generator (Military Type MD83 or equivalent)

Deviation Indicator having an accuracy of ±1%. A meter of equivalent resistance may be substituted for the deviation indicator.

Measurement Procedure:

Connect the receivers to the antenna transmission lines in accordance with the manufacturer's instructions.

(a) Apply at the junction of the two transmission lines to the receiver inputs a standard localizer centering signal of 1000 uv.

Set the receiver under test to receive the standard localizer centering signal. Set the other receiver to all possible channel settings and determine the maximum change in deflection of the deviation indicator from its centered position.

Repeat this test on each radio frequency localizer channel for which the equipment is designed.

(b) Conduct tests as required to determine whether the equipment meets all of the standards set forth in section 2. For these tests, the receiver input shall be the junction of the two transmission lines connected to the receivers.

AUDIO FREQUENCY RESPONSE

Equipment Required:

RF Signal Generator (Boonton Model 211A or equivalent)

AF Signal Generator (Military Type MD83 or equivalent)

AF Signal Generator (Hewlett-Packard Model 200B or equivalent)

Measurement Procedure:

Apply to the receiver input a standard localizer audio signal modulated 1000 cps. Adjust the rf signal level

and the receiver gain control (if provided) to produce a signal plus noise-to-noise ratio of at least 25 db and an output equal to at least 90% of rated output.

Vary the frequency of the audio modulation signal from 200 to 6000 cps. Determine (a) the receiver output level at 350 and 2500 cps and (b) the maximum and minimum receiver output levels over the range of 350 to 2500 cps.

T-17 AUDIO OUTPUT REGULATION AND DISTORTION

Equipment Required:

RF Signal Generator (Boonton Model 211A or equivalent)

AF Signal Generator (Hewlett-Packard Model 200B or equivalent)

Distortion and Noise Meter (General Radio Model 1932A or equivalent)

Measurement Procedure

Apply to the receiver input a standard localizer audio signal of 1000 uv. Using a 1000 cps audio modulation signal, determine the output and the distortion plus noise with receiver output load impedances of 50%, 100% and 200% of that for which the receiver is designed. Repeat the above test for audio modulation signals of 350, 500, 1800 and 2500 cps and for rf input levels of 40 and 20,000 uv.

T-18 PERCENTAGE MODULATION CHARACTERISTIC

Equipment Required:

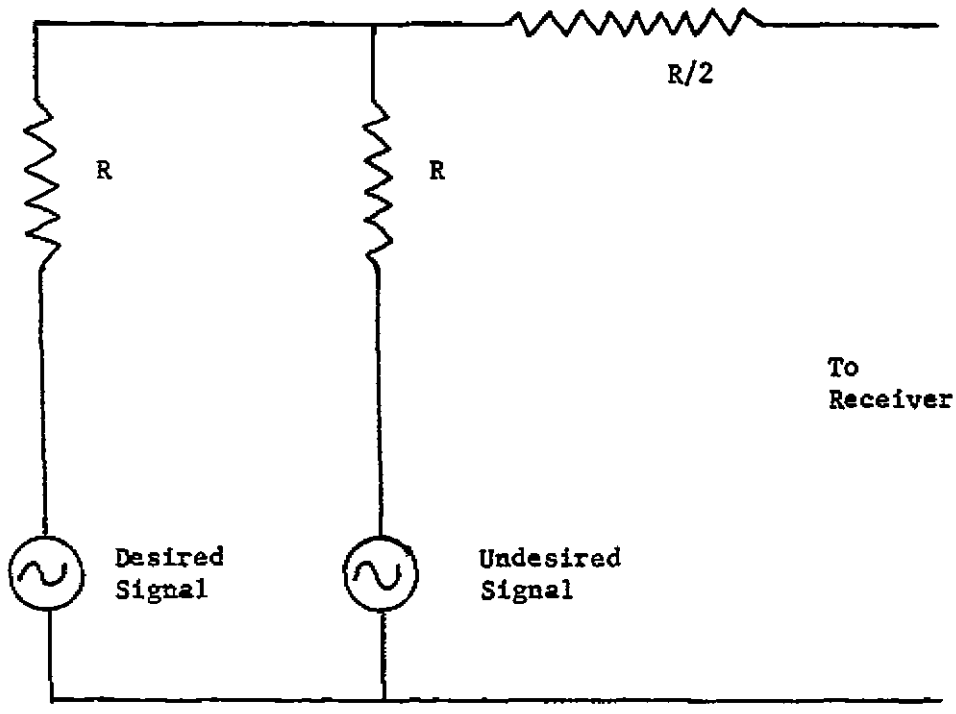
RF Signal Generator (Boonton Model 211A or equivalent)

AF Signal Generator (Military Type MD83 or equivalent)

Deviation indicator having an accuracy of $\pm$1%. A meter of equivalent resistance may be substituted for the deviation indicator.

Measurement Procedure:

Apply to the receiver input a standard localizer centering signal of 1000 uv. Increase the percentage modulation produced by the 90 and 150 cps signals from 20% each to 25% each and determine the change in deviation indicator deflection.




R = Characteristic impedance of the transmission line for which the receiver is designed.

FIGURE 1 - COMBINING UNIT



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