RTCA
1828 L Street, NW, Suite 805
Washington, DC 20036

Minimum Performance Standards Airborne Low-Range Radar Altimeters

RTCA DO-155
November 1, 1974

Prepared by:
ICG-2

Copies of this document may be obtained from

RTCA, Incorporated
1828 L Street, NW, Suite 805
Washington, D.C. 20036-5133 U.S.A.

Telephone: 202-833-9339
Facsimile: 202-833-9434

Internet: www.rtca.org

Please contact RTCA for price and ordering information.

F O R E W O R D

This Document was prepared by International Coordinating Group 2 (ICG-2) of the Radio Technical Commission for Aeronautics (RTCA). It was approved by RTCA on November 1, 1974.

RTCA is an association of aeronautical organizations of the United States from both government and industry. Dedicated to the advancement of aeronautics, RTCA seeks sound technical solutions to problems involving the application of electronics and telecommunications to aeronautical operations. Its objective is the resolution of such problems by mutual agreement of its member organizations.

The findings of RTCA are in the nature of recommendations to all organizations concerned. As RTCA is not an official agency of the government of the United States, its recommendations may not be regarded as statements of official government policy unless so enunciated by the government organization or agency having statutory jurisdiction over any matters to which the recommendations relate.

TABLE OF CONTENTS

		Page
FOREWORD		i
INTRODUCTION		vii
1.0	GENERAL STANDARDS	1
1.1	Operation of Controls	1
1.2	Accessibility of Controls	1
1.3	Effects of Tests	1
2.0	MINIMUM PERFORMANCE STANDARDS UNDER STANDARD TEST CONDITIONS	3
2.1	Accuracy of Pilot's Display	3
2.2	Accuracy of the Precision Equipment Output	4
2.3	Precision Equipment Output Noise	4
2.4	Time Constant	4
2.5	Rate Data	5
2.6	Failure Warning System	5
2.6.1	Warning Conditions	5
2.6.2	Warning Indication Characteristics	6
2.7	Transmitter Operating Frequency	6
2.8	Emission of Radio-Frequency Energy	6
2.9	Multiplex Operation	6
2.10	Self-Test Feature	6
3.0	MINIMUM PERFORMANCE STANDARDS UNDER ENVIRONMENTAL TEST CONDITIONS	7
3.1	Temperature - Altitude Tests	7
3.1.1	Low Temperature Test	7
3.1.2	High Temperature Test	7
3.1.3	Decompression Test (When Required)	8
3.1.4	Altitude Test	8
3.1.5	Overpressure Test (When Required)	8
3.2	Humidity Test	9
3.3	Shock Test	9
3.4	Vibration Test	10

Page

3.5 Temperature Variation Test 10
3.6 Power Input Test 10

3.6.1 Electrical Input Variation Test . 10
3.6.2 Low Voltage Test 10

3.7 Conducted Voltage Transient Test 11
3.8 Conducted Audio-Frequency Susceptibility Test 11
3.9 Audio-Frequency Magnetic Field Susceptibility Test 12
3.10 Radio-Frequency Susceptibility Test (Radiated and Conducted) 12
3.11 Explosion Test (When Required) 12
3.12 Waterproofness (Drip Proof) Test (When Required) 12
3.13 Hydraulic Fluid Test (When Required) ... 12
3.14 Sand and Dust Test (When Required) 12
3.15 Fungus Resistance Test (When Required).. 13
3.16 Salt Spray Test (When Required) 13

TABLE 1 3

MEMBERSHIP 15

APPENDIX A - TEST PROCEDURES - AIRBORNE LOW RANGE RADAR ALTIMETERS .....

PART I - DEFINITIONS OF TERMS AND CONDITIONS OF TEST 1

A. Power Input Voltage - Direct Current ... 1
B. Power Input Voltage - Alternating Current 1
C. Adjustment of Equipment 1
D. Test Instrument Precautions 2
E. Ambient Conditions 2
F. Warm-Up Period 2
G. Connected Load 2
H. Description of Test Equipment 2

PART II - DETAILED TEST PROCEDURES 5

T-1 Accuracy (In Flight) 5
T-2 Altitude Accuracy and Loop Gain 5
T-3 Altitude Noise 6
T-4 Time Constant 7

FIGURE 1 8
FIGURE 2 9
FIGURE 3 9

Page

APPENDIX B - MINIMUM PERFORMANCE STANDARDS FOR LOW RANGE RADAR ALTIMETERS (EXTERNAL LOOP LOSS STANDARDS) .....

1.0 Definition of External Loop Loss 1
2.0 Characteristics of External Loop Loss .. 1
3.0 External Loop Loss, Beam Limited Case .. 1
4.0 External Loop Loss, Pulse Limited Case . 2
5.0 Essentials of F or F(H)..... 2
5.1 M(H) 2
5.2 V*(H) 3
6.0 Curves of External Loop Loss 3

Figure 1 5
Figure 2 6
Figure 3 7
Figure 4 8
Figure 5 9
Figure 6 10

APPENDIX C - ANTENNA CONCEPTS .....

1.0 Antenna Concepts 1

2.0 The Calculation of External Loop Loss (CW or Beam Limited Pulse Case) 2

2.1 General Expression 2
2.2 Derivation of the General Expression 3
2.3 External Loop Loss for Constant Beam and $\sigma_o(\theta)$ 5
2.4 External Loop Loss for Constant Beam and Lambert Law Scattering ... 7
2.5 External Loop Loss for $\cos^m \theta$ Beam and Lambert Law Scattering 8
2.6 Simple Derivation for External Loop Loss 8

3.0 Pulsed Altimeter Case 10

3.1 A Simple Derivation for the Pulse Limited Case 11

4.0 The Choice of $\sigma_o(0)$ 12

4.1 Pulse Limited Case 13
4.2 Less Than 100 Ft Performance 13

	Page
5.0 Effects of Antenna Spacing	14
5.1 First Approach to the Effects	14
5.2 Value of V in Respect to the Assumptions	17
FIGURE 1	3
FIGURE 2	16

I N T R O D U C T I O N

This Document sets forth minimum performance standards for those characteristics of the airborne low-range radar altimeter which are essential for its operation in applications which provide measured height above terrain for clearance and landing data. The potentially diverse range of applications for this equipment precludes the precise definition of the term "low-range." It should be recognized that very limited capabilities may suffice in some installations while other installations may require a broader range of altitude (height) data. The maximum range envisioned by system designers at the date of this Document is of the order of 2500 feet.

The term "altitude" shall be defined for the purposes of this Document as height or distance from the terrain to the altimeter antennas.

Compliance with these standards is recommended as a means of assuring that the equipment will satisfactorily perform its intended functions over all conditions normally encountered in routine aeronautical operations.

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