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

Minimum Operational Performance Standards for Automatic Direction Finding (ADF) Equipment

RTCA DO-179
May 13, 1982

Prepared by:
SC-146

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.

FOREWORD

This document was prepared by Special Committee 146 of the Radio Technical Commission for Aeronautics (RTCA). It was approved by RTCA on May 13, 1982, and supersedes RTCA/DO-137, "Minimum Operational Characteristics Airborne Automatic Direction Finding (ADF) Systems," April 11, 1968 and RTCA/DO-142, "Minimum Performance Standards - Airborne Radio Receiving and Direction Finding Equipment Operating Within the Radio-Frequency Range of 200-850 Kilohertz," January 8, 1970.

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 concerned 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 federal government organization or agency having statutory jurisdiction over any matters to which the recommendations relate.

Although these standards were coordinated with the European Organisation for Civil Aviation Electronics (EUROCAE) WG-7D, it should be noted that the NDB environment in Europe is significantly different from that in the United States and the work of EUROCAE addresses factors outside the scope of this document. Therefore, the standards specified in this document pertain only to the NDB environment of the United States.

TABLE OF CONTENTS

		Page
	FOREWORD	i
	TABLE OF CONTENTS	iii
1.0	PURPOSE AND SCOPE	1
1.1	Introduction	1
1.2	System Overview	2
	1.2.1 Basic System Description	2
	1.2.2 Background	3
	1.2.3 Future Direction	3
	1.2.4 Transition Strategy	4
1.3	Operational Applications	5
1.4	Operational Goals	6
	1.4.1 Sensitivity	6
	1.4.2 Receiver Selectivity	6
	1.4.3 Spurious Response, Cross Modulation and Intermodulation	7
	1.4.4 Bearing Accuracy	7
1.5	Assumptions	7
	1.5.1 Field Strength	7
	1.5.2 Selectivity	8
	1.5.3 Warnings and Flags	8
1.6	Test Procedures	8
	1.6.1 Environmental Tests	9
	1.6.2 Bench Tests	9
	1.6.3 Installed System Tests	9
	1.6.4 Operational Tests	10
1.7	Definitions of Terms	10

2.0 AUTOMATIC DIRECTION FINDING EQUIPMENT PERFORMANCE REQUIREMENTS AND TEST PROCEDURES 11

2.1 General Requirements 11

2.1.1 Airworthiness 11
2.1.2 Intended Function 11
2.1.3 Federal Communications Commission Rules 11
2.1.4 Fire Protection 11
2.1.5 Operation of Controls 11
2.1.6 Accessibility of Controls 11
2.1.7 Effects of Test 11

2.2 Equipment Performance - Standard Conditions 12

2.2.1 Tuning Resolution 12
2.2.2 Ground Station Interoperability 12
2.2.3 Sensitivity (MCW Receiver Function) 12
2.2.4 Sensitivity (CW Receiver Function) 13
2.2.5 Bearing Accuracy (ADF Function) 13
2.2.6 Station Passage (ADF Function) 13
2.2.7 Audio Frequency Response 13
2.2.8 Audio Output Level Variation With Load Impedance 13
2.2.9 Distortion 14
2.2.10 AGC Characteristics 14
2.2.11 Receiver Selectivity (MCW Receiver Function) 14
2.2.12 Receiver Selectivity (ADF Function) 14
2.2.13 Spurious Response 15
2.2.14 Cross Modulation 15
2.2.15 Intermodulation 16
2.2.16 Direction Finder Operation with Beat Frequency Oscillator 16

2.3 Equipment Performance - Environmental Conditions 17

2.3.1 Temperature and Altitude Tests 17
2.3.2 Temperature Variation Test 19
2.3.3 Humidity Test 19
2.3.4 Shock Tests 19
2.3.5 Vibration Tests 20
2.3.6 Explosion Test 20
2.3.7 Waterproofness Test 20
2.3.8 Fluids Susceptibility Tests 21
2.3.9 Sand and Dust Test 21
2.3.10 Fungus Resistance Test 22
2.3.11 Salt Spray Test 22
2.3.12 Magnetic Effect Test 22

2.3.13 Power Input Tests 22
2.3.14 Voltage Spike Conducted Test 23
2.3.15 Audio Frequency Conducted Susceptibility Test 23
2.3.16 Induced Signal Susceptibility Test 24
2.3.17 Radio Frequency Susceptibility Test 24
2.3.18 Emission of Radio Frequency Energy Test 24

2.4 Equipment Test Procedures 25

2.4.1 Definitions of Terms and Conditions of Test 25
2.4.2 Detailed Test Procedures 34

3.0 INSTALLED EQUIPMENT PERFORMANCE 43

3.1 Test Conditions 43

3.1.1 Power Input 43
3.1.2 Associated Equipment 43
3.1.3 Environment 43
3.1.4 Adjustment of Equipment 43
3.1.5 Warm-up Period 43

3.2 Equipment Installation 43

3.2.1 Equipment Accessibility 43
3.2.2 Display Visibility 43
3.2.3 Interference Effects 44
3.2.4 Dynamic Response During Maneuvers 44
3.2.5 Inadvertent Turnoff 44
3.2.6 Aircraft Power Source 44

3.3 Minimum Installed Equipment Performance 44

3.3.1 Controls and Displays 44
3.3.2 Audio Reception 44
3.3.3 Bearing Accuracy 44

4.0 OPERATIONAL CHARACTERISTICS 45

4.1 Required Operational Characteristics 45

4.1.1 Power Input 45
4.1.2 Equipment Operating Modes 45

4.2 Test Procedures for Operational Characteristics 45

4.2.1 Power Input 45
4.2.2 Equipment Operating Modes 45

MEMBERSHIP 47

1.0 PURPOSE AND SCOPE

1.1 Introduction

This document sets forth minimum operational performance standards for automatic direction finding (ADF) equipment within the United States NDB environment. Incorporated in these standards are system characteristics that will benefit users of the system as well as designers, manufacturers and installers. These characteristics are intended to be in accord with requirements of various users. These characteristics are also intended to be in accord with the ground system characteristics and the intended operational use.

Section 1.0 of this document is intended to be tutorial in nature and provides information needed to understand the rationale for equipment characteristics and requirements stated in the remaining sections. It describes typical equipment applications and operational goals, as envisioned by the members of Special Committee 146, and is the basis for the standards stated in Sections 2.0 through 4.0. Definitions and assumptions essential to proper understanding of this document are also provided in Section 1.0.

Section 2.0 contains the minimum performance standards for the equipment. These standards define the required performance under standard operating conditions and stressed physical environmental conditions. It also details the recommended bench test procedures necessary to demonstrate compliance.

Section 3.0 describes the performance required of the installed equipment. Tests for the installed equipment are included when performance cannot be adequately determined through bench testing.

Section 4.0 describes the operational characteristics for equipment installations and defines conditions that will assure the operator that operations can be conducted safely and reliably in the expected operational environment.

Compliance with these standards by manufacturers, installers and users is recommended as a means of assuring that the equipment will satisfactorily perform its intended function(s) under all conditions normally encountered in routine aeronautical operations.

If the equipment implementation includes a computer software package, the guidelines contained in RTCA/DO-178, "Software Considerations in Airborne Systems and Equipment Certification," November 18, 1981, should be considered.

It is recognized that any regulatory application of this

document in whole, or in part, is the sole reponsibility of appropriate governmental agencies.

Since the measured values of equipment performance characteristics may be a function of the method of measurement, standard test conditions and methods of test are recommended in this document.

This document considers a configuration of airborne receiving equipment including: Antenna system(s), transmission lines, radio receiver, receiver control unit and a bearing indication display. Additional functions and components that refer to expanded capabilities are identified as optional features. Features that are beyond the scope of this document may be developed in future RTCA activities.

The word "system" as used in this document refers to the NDB/ADF system. It includes all portions of both the NDB ground transmitter and the ADF equipment.

The word "equipment" as used in this document includes all components necessary for the equipment to properly perform its intended function. For example, ADF receiving "equipment" may include an antenna, a receiver unit, a control unit, a bearing indicator, 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 receiving equipment will necessarily include all of the foregoing components. This will depend on the design used by the equipment manufacturer.

1.2 System Overview

1.2.1 Basic System Description

The NDB/ADF system consists of airborne direction finders (ADF) and ground stations called nondirectional beacons (NDB).

The ADF senses and automatically indicates the direction of arrival of the NDB signal. Direction is indicated to the pilot as a magnetic bearing or as a relative bearing to the longitudinal axis of the aircraft, depending on the type of indicator installed in the aircraft. The equipment may be used to monitor MCW or CW transmissions. A typical example of this operation is the reception of the NDB station identifier.

The NDB is a ground station transmitting omni-directional signals. When the NDB is operational, it transmits a station identifier using either MCW or CW modulation. When the NDB is installed as a part of the instrument landing system (ILS), it is normally called a compass locator.