

STANDARDS FOR AERONAUTICAL INFORMATION

RTCA DO-201A
April 19, 2000

Prepared by:
SC-181

Copies of this document may be obtained from

RTCA, Inc.
1140 Connecticut Avenue, NW, Suite 1020
Washington, DC 20036-4001 USA

Telephone: 202-833-9339
Facsimile: 202-833-9434
Internet: www.rtca.org

Please call RTCA for price and ordering information.

Foreword

This report was prepared by Special Committee 181 (SC-181) and approved by the RTCA Program Management Committee (PMC) on April 19, 2000.

RTCA, Incorporated is a not-for-profit corporation formed to advance the art and science of aviation and aviation electronic systems for the benefit of the public. The organization functions as a Federal Advisory Committee and develops consensus-based recommendations on contemporary aviation issues. RTCA's objectives include but are not limited to:

- coalescing aviation system user and provider technical requirements in a manner that help government and industry meet their mutual objectives and responsibilities;
- analyzing and recommending solutions to the system technical issues that aviation faces as it continues to pursue increased safety, system capacity and efficiency;
- developing consensus on the application of pertinent technology to fulfill user and provider requirements, including development of minimum operational performance standards for electronic systems and equipment that support aviation; and
- assisting in developing the appropriate technical material upon which positions for the International Civil Aviation Organization and the International Telecommunication Union and other appropriate international organizations can be based.

The organization's recommendations are often used as the basis for government and private sector decisions as well as the foundation for many Federal Aviation Administration Technical Standard Orders.

Since RTCA is not an official agency of the United States Government, its recommendations may not be regarded as statements of official government policy unless so enunciated by the U.S. government organization or agency having statutory jurisdiction over any matters to which the recommendations relate.

This Page Intentionally Left Blank

EXECUTIVE SUMMARY

1. The RTCA Technical Management Committee established Special Committee 181 (SC-181) to:
 - a. Develop Minimum Aviation System Performance Standards (MASPS) for area navigation systems operating in Required Navigation Performance (RNP) airspace.
 - b. Investigate the processes related to the loading of aeronautical databases and produce guidance to ensure that:
 - 1) The integrity of the civil aviation authority created source data and the processing of this data is not degraded for RNP and non-RNP, area navigation (RNAV) operations; and
 - 2) The databases are compatible with the type of equipment in which they will be used.
 - c. Review current practices used in defining aeronautical data and recommend any changes needed to provide improved operational effectiveness for airborne navigation systems that use stored databases.
 - d. Coordinate its work with the European Organization for Civil Aviation Equipment, Working Group 13 (EUROCAE WG 13). The results will be the combined effort of these two organizations, RTCA SC-181/EUROCAE WG 13.
2. The work of SC-181/EUROCAE WG 13 has resulted in three new documents, two of which were published to satisfy the terms of reference in paragraphs 1a. and 1b. above. These two documents are:
 - a. RTCA DO-236/EUROCAE ED-75, “Minimum Aviation System Performance Standards: Required Navigation Performance for Area Navigation”; and
 - b. RTCA DO-200A/EUROCAE ED-76, “Standards for Processing Aeronautical Data”.
3. RTCA DO-201A/EUROCAE ED-77, this Document, is the third document and supports the terms of reference in paragraph 1. above. It is submitted to the aviation community as a collection of disciplines necessary to provide assurance that aeronautical information used by the aviation industry meets the high quality and integrity for safe flight. The aviation industry requires that organizations who develop and publish aeronautical information consider the type, accuracy, resolution, and procedure design concepts presented.
4. Several standards presented in this document are already available in International Civil Aviation Organization (ICAO) Standards and Recommended Practices (SARPS). These are appropriately referenced to ICAO. Their inclusion in this document is to emphasize the importance of ICAO compliance. Others are currently being developed by the ICAO Panels such as the Obstacle Clearance Panel (OCP) as well as various industry groups. The words “standards” and “requirements” are used in context with the following Oxford Dictionary definitions.

Standards – Object or quality or measure to which others should conform or against which others are judged; a required degree of excellence, etc.

Requirements – Things needed or depended on for success.

5. Graphic illustrations appearing in different Sections and Appendices of this document are conceptual and were developed strictly to support textual discussions. They are not intended to be used for developing cartographic charting criteria or standards. Illustrations contain graphic symbols copyrighted by Jeppesen which have been reproduced with permission. The equivalent graphic symbols to be used by States are specified in ICAO Annex 4.
6. RTCA DO-201A/EUROCAE ED-77 is organized as follows.

Section 1.0 Purpose and Scope explains the purpose of the document and summarizes the introduction of new concepts and terminology.

Section 2.0 General Requirements and Standards discusses the need for standards that will accommodate the requirements for aeronautical data elements including accuracy, resolution, calculation conventions, naming convention, and the timely dissemination of the finished data.

Section 2.1 specifies aeronautical data elements required by the aviation industry and a standard for the accuracy, resolution, and integrity of the associated values.

Section 2.2 discusses the requirements for a calculation convention and presents specific conventions that should be used as a standard for calculating fixes. Examples are provided in Appendix D.

Section 2.3 presents the requirements for naming conventions and prescribes standard conventions for: the naming of fixes; assigning identifiers to aerodromes and airways; and assigning designators to domestic airways.

Section 2.4 explains the importance of timely dissemination of accurate and complete aeronautical information and stresses the use of the standard ICAO Aeronautical Information Regulation and Control (AIRAC) schedule. An AIRAC schedule through the year 2008 is included.

Section 3.0 Specific Requirements and Standards describes operational requirements that civil aviation authorities, procedure designers, and airspace planners should consider when developing procedures in the en route, arrival, departure, approach, and aerodrome environments. Standards are proposed where appropriate.

Section 3.1 specifies the types of route segments to be used in the design of arrivals, departures, and approaches with emphasis on those types required for RNAV operations in RNP airspace.

Section 3.2 presents aeronautical information requirements to support navigation systems conducting arrivals and departures. The standards will enhance non-computer as well as computer-based navigation.

Section 3.3 includes several specific instrument approach procedure requirements of importance to the industry and proposes standards where appropriate.

Section 3.4 discusses the requirement for a quality graphic representation of the aerodrome environment.

Appendix A is a glossary of terms, abbreviations and acronyms used in the document. ICAO definitions were used when ever available. Where acronyms/abbreviations differ from those prescribed by ICAO, the ICAO acronym/abbreviation is shown in brackets.

Appendix B discusses Cyclic Redundancy Check (CRC) methodology to support the integrity classifications in Section 2.1 and the GNSS Precision Approach Path Point Concept of Sections 3.3.6.

Appendix C provides background information on the determination of geographic coordinates including a brief summary of WGS 84.

Appendix D presents examples of fix calculations using the calculation convention standards prescribed in Section 2.2. Formulas for direct and indirect geodesic calculations are included.

Appendix E presents the FAA philosophy behind the development of the basic “T” RNAV instrument approach procedure design concept.

Appendix F includes several examples of how the “T” and “AA” procedure design concepts of Section 3.3.2 and 3.3.3 might be applied in various situations.

Appendix G presents a naming convention for waypoints in the terminal area. The concept is used in Europe and proposed by the European aviation community for use internationally.

Appendix H contains an algorithm that can be used to calculate the forward and reverse bearing/distance between two points.

Appendix I provides a list of reference material for reader convenience.

This Page Intentionally Left Blank

TABLE OF CONTENTS

1.0	PURPOSE AND SCOPE.....	1
1.1	Introduction.....	1
1.2	Required Navigation Performance (RNP) and Area Navigation (RNAV).....	2
1.2.1	RNP Airspace	3
1.2.2	RNP Types.....	3
1.2.3	RNP RNAV.....	3
1.2.4	Transition to RNP RNAV Procedures.....	4
1.3	Approach Procedure Definitions.....	4
1.4	Evolving Procedure Design Concepts.....	5
1.4.1	The Basic “T” Design for RNAV Approach Procedures.....	5
1.4.2	Terminal Arrival Area (TAA)	5
1.4.3	Vertical Navigation (VNAV).....	5
1.4.4	Curved Path Route Segments.....	6
1.4.5	GNSS Precision Approach Procedures.....	6
1.5	Using Geodesic Rather Than Great Circle Terminology.....	6
1.6	Vertical Measurements.....	7
1.7	Continuing Issues of Concern.....	7
1.7.1	Aeronautical Information Development Practices.....	7
1.7.2	The Quality of Aeronautical Information.....	7
1.7.3	The Integrity of Aeronautical Information.....	8
1.7.4	A Need for Civil Aeronautical Information Standard.....	8
1.7.5	Navaid Supporting RNAV Operations.....	8
1.7.6	Converting Meters and Feet.....	8
2.0	GENERAL REQUIREMENTS AND STANDARDS.....	9
2.1	Aeronautical Data Element Standards	9
2.1.1	Introduction.....	9
2.1.2	Standard Geodetic Datum for Latitude and Longitude coordinates (<i>RNP RNAV Significant</i>).....	10
2.1.3	Vertical Data (<i>RNP RNAV Significant</i>).....	11
2.1.4	Standard Types of Aeronautical Data Elements Requiring Numerical Values (<i>RNP RNAV Significant</i>).....	11
2.1.5	Data Accuracy and Resolution (<i>RNP RNAV Significant</i>).....	11
2.1.6	Column Heading Explanation for Tables 2-1 Through 2-8.....	11

2.1.7	Quality and Integrity Management of Numerical Aeronautical Data (<i>RNP RNAV Significant</i>).....	20
2.2	Calculation Convention Standards.....	23
2.2.1	Introduction.....	23
2.2.2	Standard Rules to Establish the Calculation Framework (<i>RNP RNAV Significant</i>).....	24
2.2.3	Standard Rules for Determining Tracks (<i>RNP RNAV Significant</i>).....	25
2.2.4	Standard Rules for Applying Station Declination and Magnetic Variation to True Radials and Bearings (<i>RNP RNAV Significant</i>).....	25
2.2.5	Standard Rules for Selecting Aeronautical Data to be Used in the Calculation of Terminal and En Route Fixes (<i>RNP RNAV Significant</i>).....	27
2.2.6	Standard Rules for Determining Tracks and Calculating Fixes That Define RNAV Instrument Approach Procedures (<i>RNP RNAV Significant</i>).....	28
2.2.7	Standard Rules for Determining the Positions of Markers and Compass Locators.....	28
2.2.8	Standard Rounding Convention (<i>RNP RNAV Significant</i>).....	30
2.3	Standards for Names and Identifiers.....	33
2.3.1	Introduction.....	33
2.3.2	Naming Fixes Using the ICAO Standard.....	34
2.3.3	Naming Fixes Where Deviation From the ICAO Standard May be Necessary.....	37
2.3.4	Naming of Navaids.....	39
2.3.5	Creating a Domestic Aerodrome and Helipoint Identifier Standard.....	39
2.3.6	Establishing Unique Radio Navigation Aid Identifiers.....	39
2.4	Standards Related to the Dissemination of Aeronautical Information.....	45
2.4.1	Introduction.....	45
2.4.2	Distribution Schedule of Aeronautical Data (<i>RNP RNAV Significant</i>).....	45
2.4.3	Application of Changes to all Affected Documents.....	46
2.4.4	Avoiding Last Minute Postponements.....	47
2.4.5	Volume of Changes for a Single AIRAC Cycle.....	50
2.4.6	Preceding Maintenance on Navaids That Support RNAV and RNP RNAV Operations (<i>RNP RNAV Significant</i>).....	51
2.4.7	Providing the Current Status of Published Documents.....	51
3.0	SPECIFIC REQUIREMENTS AND STANDARDS.....	53
3.1	Route Segments to be Used in the Design of En Route, Arrival, Departure, and Approach Procedures.....	53
3.1.1	Introduction.....	53
3.1.2	General Design Rules (<i>RNP RNAV Significant</i>).....	54
3.1.3	Path and Terminator Concept.....	55
3.1.4	ARRIVAL, DEPARTURE, AND APPROACH ROUTE SEGMENTS TO BE USED WHERE RNP IS SPECIFIED (<i>RNP RNAV Significant</i>).....	61

3.1.5	ARRIVAL, DEPARTURE, AND APPROACH ROUTE SEGMENTS THAT ARE ACCEPTABLE BUT HIGHLY DISCOURAGED WHERE RNP IS SPECIFIED (<i>RNP RNAV Significant</i>).....	64
3.1.6	ARRIVAL, DEPARTURE, AND APPROACH ROUTE SEGMENT TO BE AVOIDED AFTER THE TRANSITION TO RNP (<i>RNP RNAV Significant</i>).....	65
3.1.7	ARRIVAL, DEPARTURE, AND APPROACH ROUTE SEGMENTS TO BE USED WHERE RNP IS NOT SPECIFIED.....	66
3.2	Arrival and Departure Instrument Procedure Requirements and Standards.....	75
3.2.1	Introduction.....	75
3.2.2	Requirements Unique to Arrival Procedures.....	76
3.2.3	Requirements Unique to Departure Procedures.....	85
3.2.4	Requirements Common to Both Arrival and Departure Procedures.....	93
3.3	Instrument Approach Procedure Requirements and Standards.....	103
3.3.1	Introduction.....	103
3.3.2	An RNAV Approach Procedure Design Standard (<i>RNP RNAV Significant</i>).....	103
3.3.3	Terminal Arrival Area (TAA) (<i>RNP RNAV Significant</i>).....	107
3.3.4	Final Approach Segment Descent Path Angles to Support Vertical Navigation (VNAV) (<i>RNP RNAV Significant</i>).....	109
3.3.5	Curved Path Route Segment Concepts (<i>RNP RNAV Significant</i>).....	121
3.3.6	GNSS Precision Approach Procedures.....	128
3.3.7	Minimizing Procedure Design Complexity, All Procedures (<i>RNP RNAV Significant</i>).....	136
3.3.8	Eliminating the Use of Multiple Category Based Tracks on a Single Approach Chart.....	136
3.4	Airport Environment Standards.....	137
3.4.1	Introduction.....	137
3.4.2	Accurate and Complete Aerodrome Graphics (Electronic and/or Paper).....	137
	MEMBERSHIP LIST.....	141
<u>APPENDIX A</u>	- GLOSSARY OF TERMS, ABBREVIATIONS, AND ACRONYMS	
<u>APPENDIX B</u>	- OVERVIEW AND APPLICATION OF CYCLIC REDUNDANCY CHECKS	
<u>APPENDIX C</u>	- GEOGRAPHIC COORDINATES AND NAVIGATION SYSTEMS	
<u>APPENDIX D</u>	- CALCULATION CONVENTION EXAMPLES	

<u>APPENDIX E</u>	-	PHILOSOPHY BEHIND THE BASIC “T” INSTRUMENT APPROACH PROCEDURE DESIGN CONCEPT
<u>APPENDIX F</u>	-	VARIATIONS IN THE APPLICATION OF THE “T” AND “TAA” PROCEDURE DESIGN CONCEPT
<u>APPENDIX G</u>	-	ALTERNATIVE WAYPOINT NAMING CONVENTION FOR WAYPOINTS IN THE TERMINAL AREA
<u>APPENDIX H</u>	-	ALGORITHM FOR CALCULATING THE FORWARD AND REVERSE GEODESIC BEARING/DISTANCE BETWEEN TWO POINTS
<u>APPENDIX I</u>	-	REFERENCE DOCUMENTS

Table of Figures

Figure 2-1	Vertical Measurements.....	11
Figure 2-2	Offset Markers.....	29
Figure 2-3	Waypoint Naming Practices.....	41
Figure 2-4	Waypoints Named According to ICAO Annex 11.....	42
Figure 2-5	Properly Named Gateway Fixes.....	43
Figure 2-6	Un-Named Gateway Fixes.....	44
Figure 3-1	Fixed Radius Transitions.....	59
Figure 3-2	Initial Fix (IF).....	61
Figure 3-3	Track to a Fix (TF).....	62
Figure 3-4	Radius to a Fix (RF).....	63
Figure 3-5	Direct to a Fix (DF).....	65
Figure 3-6	Course From a Fix to an Altitude (FA).....	65
Figure 3-7	Course to a Fix (CF).....	66
Figure 3-8	Course to an Altitude (CA).....	67
Figure 3-9	Course to Intercept (CI).....	67
Figure 3-10	Course to a DME Distance (CD).....	68
Figure 3-11	Course to a VOR Radial (CR).....	68
Figure 3-12	Course From a Fix to a Distance (FC).....	69
Figure 3-13	Course From a Fix to a DME Distance (FD).....	69
Figure 3-14	Course From a Fix to a Manual Termination (FM).....	70
Figure 3-15	DME Arc to a Fix (AF).....	70
Figure 3-16	Heading to a DME Distance (VD).....	71
Figure 3-17	Heading to an Altitude (VA).....	71
Figure 3-18	Heading to a Manual Termination (VM).....	72
Figure 3-19	Heading to Intercept Next Segment (VI).....	72
Figure 3-20	Heading to a VOR Radial (VR).....	73
Figure 3-21	THATCH ONE ARRIVAL.....	77
Figure 3-22	PASSMORE THREE ARRIVAL.....	79
Figure 3-23	STATE TWO ARRIVAL.....	80
Figure 3-24	DURANT TWO ARRIVAL.....	82
Figure 3-25	BANJO FOUR ARRIVAL.....	83
Figure 3-26	NORTH AND WEST ARRIVALS.....	84
Figure 3-27	BRIGHAM ONE DEPARTURE.....	86

Figure 3-28	WILLIAMS DEPARTURE.....	89
Figure 3-29	MARANVILLE FIVE DEPARTURE.....	90
Figure 3-30	FISHER TWO DEPARTURE.....	92
Figure 3-31	BEVERLY FOUR DEPARTURE.....	94
Figure 3-32	JAMES TWO ARRIVAL.....	95
Figure 3-33	MASSON TWO DEPARTURE.....	97
Figure 3-34	THOMAS ONE ARRIVAL.....	99
Figure 3-35	HUMPHREY TWO DEPARTURE.....	100
Figure 3-36	WINK, WISC RNAV Rwy 18.....	106
Figure 3-37	Terminal Arrival Area.....	108
Figure 3-38	ELLER (VNAV).....	111
Figure 3-39	MONTE (VNAV).....	113
Figure 3-40	ELTON (VNAV).....	114
Figure 3-41	VDP (VNAV).....	115
Figure 3-42	MINDY (VNAV).....	116
Figure 3-43	LORCH (VNAV).....	117
Figure 3-44	FAF Anticipation.....	118
Figure 3-45	Overshoot at FAF (VNAV).....	118
Figure 3-46	Calculation Factor at FAF (VNAV).....	119
Figure 3-47	Basic Obstacle Assessment (VNAV).....	120
Figure 3-48	NPV Obstacle Assessment (VNAV).....	121
Figure 3-49	NPV Plan and Profile View Rwy 18.....	123
Figure 3-50	NPV Plan and Profile View Rwy 21.....	124
Figure 3-51	NPV Plan and Profile View Rwy 09.....	125
Figure 3-52	NPV Plan and Profile View Rwy 31.....	126
Figure 3-53	NPV Plan and Profile View Rwy 23.....	127
Figure 3-54	Precision Approach Path Points.....	131
Figure 3-55	Airport Data Elements.....	139

Table of Tables

Table 2-1	Latitude and Longitude Data.....	16
Table 2-2	Elevation Data.....	17
Table 2-3	Declination and Magnetic Variation Data.....	18
Table 2-4	Bearing Data.....	18
Table 2-5	Length or Distance Data.....	19
Table 2-6	Width Data.....	19
Table 2-7	Offset Data.....	20
Table 2-8	Angular Data.....	20
Table 2-9	Comparison of Alpha-Character Names and Identifiers.....	33
Table 2-10	Schedule of Mailing Dates and AIRAC Effective Dates.....	48
Table 3-1	Path and Terminator Sets (Leg Types).....	57
Table 3-2	Final Approach Segment (FAS) Data Block.....	133

This Page Intentionally Left Blank

1.0 PURPOSE AND SCOPE

1.1 Introduction

The information in this document has been compiled for the purpose of stating aeronautical information requirements of the aviation industry with emphasis on RNAV operations in RNP airspace. Three types of standards are presented in support of these requirements: existing ICAO standards; standards proposed for adoption by ICAO; and developing standards to support evolving requirements. The rotorcraft community may also be able to use the standards defined within this document, however, their applicability has not been evaluated.

***Note:** Graphic illustrations appearing in different Sections and Appendices of this document are conceptual and were developed strictly to support textual discussions. They are not intended to be used for developing cartographic charting criteria or standards. Illustrations contain graphic symbols copyrighted by Jeppesen which have been reproduced with permission. The equivalent graphic symbols to be used by States are specified in ICAO Annex 4.*

The requirements and associated standards presented are not all inclusive but represent those of immediate concern to RNAV and RNP RNAV operations. RNP RNAV is a term and concept developed by RTCA SC-181/EUROCAE WG 13, refer to Section 1.2.3. Sections containing standards and concepts of specific importance to RNP RNAV operations are labeled (**RNP RNAV Significant**). Information in these Sections may also be of importance to RNAV and non-RNAV operations as well. Worldwide aeronautical information providers are urged to use information in this document while planning, organizing, developing, coordinating, and implementing RNP concepts. It is also important that this information be considered during the transition to RNP.

Sections focus on the importance of quality aeronautical information and the fact that:

- The evolution of computer navigation technology including the development of Global Navigation Satellite System (GNSS) technology and the RNP concept have a greater dependency on the accuracy, reliability, integrity, and timely availability of navigation reference data than ever before;
- There is a greater need for standardization in aeronautical information management practices than ever before; and
- There is a greater need for clear and effective guidance in the development of the aeronautical information than ever before.

Aeronautical information issues of importance to the aviation industry were addressed in RTCA DO-201, "User Recommendations for Aeronautical Information" dated November 1988. Several of these issues were never resolved and are repeated in this document. In addition and because of the increasing importance of quality and timely aeronautical information, the actions to resolve the issues were changed from recommendations in RTCA DO-201 to industry stated requirements in RTCA DO-201A/EUROCAE ED-77. Also, the title was changed to "Standards for Aeronautical Information" so that standards for supporting the requirements could be presented and emphasized. In terms of safety, navigation