

RTCA, Inc.
1828 L Street, NW, Suite 805
Washington, DC 20036 USA

**MINIMUM AVIATION SYSTEM PERFORMANCE
STANDARDS (MASPS) FOR THE AERONAUTICAL
MOBILE-SATELLITE (R) SERVICE (A(MS(R)S)
AS USED IN AERONAUTICAL DATA LINKS**

RTCA/DO-270
October 12, 2001

Prepared by SC-165
© 2001 RTCA, Inc.

Copies of this document may be obtained from

RTCA, Inc.
1828 L Street, NW, Suite 805
Washington, DC 20036 USA

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

Please call RTCA for price and ordering information.

Currently in preview, click buy full version

FOREWORD

This document was prepared by RTCA Special Committee 165. It was approved by the Program Management Committee on October 12, 2001.

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 helps 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 a basis for government and private sector decisions as well as the foundation for many Federal Aviation Administration Technical Standard Orders.

As 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 endorsed by the U. S. government organization or agency having statutory jurisdiction over any matters to which the recommendations relate.

Currently in preview, click buy full version

This page intentionally left blank.

TABLE OF CONTENTS

1	PURPOSE AND SCOPE	1
1.1	Introduction	1
1.2	System Overview	2
1.2.1	System Architecture	2
1.2.2	ICAO Global CNS/ATM and System Performance Concepts	2
1.2.3	AMS(R)S System Overview	2
1.2.4	End-to-End Communications Environments	3
1.2.4.1	The Aeronautical Telecommunications Network (ATN)	3
1.2.4.2	FANS 1/A Data Link	4
1.2.5	AMS(R)S Service Responsibilities	4
1.3	Operational Applications	5
1.3.1	Air Traffic Services	5
1.3.2	Aeronautical Operational Control	5
1.3.3	Non-Safety Communications Services	5
1.4	Operational Goals	7
1.4.1	Coverage	7
1.4.2	Compatibility and Interoperability	7
1.4.3	Priority of Safety Communications	7
1.4.4	Failure Modes, Warnings, and Flags	7
1.4.5	Human Factors Considerations	7
1.5	Assumptions	8
1.5.1	Assumptions Regarding Required Communications Performance (RCP)	8
1.5.2	Assumptions Regarding the ATN	8
1.6	Verification Procedures	8
1.7	Reference Documents	9
1.8	Definition of Terms	9
2	SUBNETWORK PERFORMANCE REQUIREMENTS	11
2.1	General Requirements	11
2.2	Specific Requirements	11
2.2.1	Standard Operating Conditions	12
2.2.2	Spectrum Requirements	12
2.2.2.1	Emission Designators	12
2.2.2.2	Interference	14
2.2.2.2.1	Emissions	14
2.2.2.2.2	Susceptibility	14
2.2.3	Coverage Volume	14
2.2.4	Priority, Precedence and Preemption	15
2.2.4.1	Priority Levels	15
2.2.4.2	Precedence	15
2.2.4.3	Preemption	15
2.2.5	Subnetwork Installed Communications Performance (ICP)	15
2.2.5.1	Transfer Delay	16
2.2.5.1.1	Traffic Model	16
2.2.5.1.2	Subnetwork Model	17

2.2.5.1.3	Transfer Delay Performance	17
2.2.5.1.3.1	Chapter 4 SARPs-Compliant Systems	17
2.2.5.1.3.2	Next Generation Satellite Systems	17
2.2.5.1.4	Transfer Delay Characterization	18
2.2.5.2	Integrity	18
2.2.5.3	Service Availability Criteria	19
2.2.5.3.1	Service Outages	19
2.2.5.3.2	Availability Ratio	20
2.2.5.3.3	Multi-User Availability	20
2.2.5.3.4	Single-User Availability	20
2.2.5.4	Continuity of Service Criteria	21
2.2.5.4.1	Continuity of Service Event	21
2.2.5.4.2	Continuity of Service	21
2.2.5.4.3	Multi-User Continuity of Service	21
2.2.5.4.4	Single-User Continuity of Service	21
2.2.6	Service Monitoring	21
2.2.7	Subnetwork Interoperability	22
2.2.7.1	Subnetwork Communications Protocols	22
2.2.7.2	Transparency to User Data	22
2.2.7.3	Interactions with External Elements	22
2.2.7.3.1	Connection Establishment Delay	22
2.2.7.3.2	Connectivity Events	23
2.2.7.3.3	System Control Interactions	23
3	SUBSYSTEM REQUIREMENTS	25
3.1	Performance Partitioning Methodologies	26
3.1.1	RF Performance	26
3.1.2	Transfer Delay Partitioning Methodology	27
3.1.2.1	Latency Transfer Delay Component	27
3.1.2.2	Mean Transfer Delay	27
3.1.2.3	95th Percentile Transfer Delay	27
3.1.3	Integrity Methodology	27
3.1.4	Availability Methodology	28
3.1.4.1	Methodology for Computing Multi-User Availability	28
3.1.4.2	Methodology for Computing Single User Availability	28
3.1.5	Continuity Methodology	29
3.1.5.1	Methodology for Computing Multi-User Continuity of Service	29
3.1.5.2	Methodology for Computing Single User Continuity of Service	30
3.2	AES Subsystem Requirements	30
3.3	Satellite Network Infrastructure (SNI) Requirements	31
3.3.1	SNI Performance Requirements	31
3.3.1.1	RF Link Performance Requirements	31
3.3.1.2	Mitigation of Harmful Interference	31
3.3.1.2.1	Intrasystem Interference	31
3.3.1.2.2	Intersystem Interference	31
3.3.1.3	Network Coordination and Control Function	32
3.3.1.3.1	Intrasystem Coordination	32
3.3.1.3.2	Intersystem Coordination: Same Frequency Band, Same Protocols	32
3.3.1.3.3	Intersystem Coordination: Different Frequency Bands	33
3.3.1.3.4	Intersystem Coordination: Same Frequency Band, Different Protocols	33
3.3.2	SNI Functional Requirements	33

4	SUBNETWORK PERFORMANCE VERIFICATION PROCEDURES	35
4.1	Verification Techniques	35
4.2	Verification of Specific Requirements	36
4.2.1	Standard Operating Conditions	36
4.2.2	Spectrum Requirements	36
4.2.2.1	Emissions Designators	36
4.2.2.2	Interference	36
4.2.2.2.1	Emissions	36
4.2.2.2.2	Susceptibility	37
4.2.3	Coverage Volume	37
4.2.4	Priority, Precedence and Preemption	38
4.2.4.1	Priority Levels	39
4.2.4.2	Precedence	40
4.2.4.3	Preemption	40
4.2.5	Subnetwork Installed Communications Performance	40
4.2.5.1	Transfer Delay	40
4.2.5.1.1	Traffic Model	41
4.2.5.1.2	Subnetwork Model	41
4.2.5.1.3	Transfer Delay Performance	41
4.2.5.1.3.1	Chapter 4 SARPs-Compliant Systems	41
4.2.5.1.3.2	Next Generation Satellite Systems	42
4.2.5.1.4	Transfer Delay Characterization	42
4.2.5.2	Integrity	44
4.2.5.3	Service Availability Criteria	44
4.2.5.3.1	Service Outages	44
4.2.5.3.2	Availability Ratio	45
4.2.5.3.3	Multi-User Availability	45
4.2.5.3.4	Single-User Availability	45
4.2.5.4	Continuity of Service Criteria	46
4.2.5.4.1	Continuity of Service Event	46
4.2.5.4.2	Continuity of Service	46
4.2.5.4.3	Multi-User Continuity of Service	47
4.2.5.4.4	Single User Continuity of Service	47
4.2.6	Service Monitoring	48
4.2.7	Subnetwork Interoperability	48
4.2.7.1	Subnetwork Communications Protocols	48
4.2.7.2	Transparency to User Data	49
4.2.7.3	Interactions with External Elements	49
4.2.7.3.1	Connection Establishment Delay	49
4.2.7.3.2	Connectivity Events	50
4.2.7.3.3	System Control Interactions	50
4.3	Verification of Section 3 Requirements	50
M	MEMBERSHIP	51

APPENDICES

Appendix A—ACRONYMS AND GLOSSARY

A.1	List of Acronyms	A-1
-----	------------------	-----

A.2	Glossary and Definitions	A-4
-----	--------------------------	-----

Appendix B—METHODOLOGY FOR PREPARATION OF LINK BUDGETS FOR SYSTEMS PROVIDING AMS(R)S (NORMATIVE)

B.1	Introduction	B-1
B.2	RF Link Analytical Methodology	B-1
B.2.1	System-specific Constants	B-3
B.2.1.1	RF Link Naming Conventions	B-3
B.2.2	RF Link Performance Criteria	B-4
B.2.3	Computing the Achieved Carrier-to-Noise Density Ratio	B-5
B.2.3.1	Computing the Nominal Carrier-to-Noise-Density Ratio	B-6
B.2.3.2	Accounting for Interference Terms	B-6
B.2.3.2.1	Locally Generated Interference	B-7
B.2.3.2.2	Remotely Generated Interference	B-8
B.2.3.2.3	Allocation for External Interference Effects	B-9
B.2.3.3	Accounting for Random Variations in the Received Carrier Level	B-9
B.2.3.3.1	Accounting for Polarization Losses	B-10
B.2.3.3.2	The Pro-Forma Random Loss Budget for	B-12
B.2.4	Propagation Effects	B-13
B.2.4.1	Multipath	B-13
B.2.4.2	Scintillation	B-15
B.2.5	Computing the Required Carrier-to-Noise Density Ratio	B-17
B.2.5.1	Computing the Theoretical Energy-to-Noise Density Ratio	B-18
B.2.5.2	Addressing Multipath Effects in the Modem Pro Forma	B-19
B.2.5.3	Modem Implementation Losses	B-20
B.2.5.4	Completing the Modem Pro Forma	B-20
B.3	Example Pro Forma Analysis	B-21
B.3.1	Basic Uplink Computations	B-22
B.3.2	Uplink Interference	B-25
B.3.3	Downlink Terms	B-26
B.3.4	Total System Terms	B-26
B.3.5	Example Random Loss Budget	B-27
B.3.6	Example Modem Budget	B-29
B.3.7	Example Computation of "Excess" System Margin	B-30
B.4	References for Appendix B	B-31

Appendix C—METHODOLOGY FOR COMPUTING AND PARTITIONING AVAILABILITY AND CONTINUITY OF SERVICE (NORMATIVE)

C.1	Introduction	C-1
C.2	Key Analysis Equations	C-1
C.2.1	Availability Analysis Equations	C-2
C.2.1.1	Outage Duration	C-2
C.2.1.2	Outage Rate/Mean Time Between Outage	C-2
C.2.1.3	Outage Restoration Rate/Mean Restoration Time	C-3
C.2.1.4	Availability Ratio	C-3
C.2.1.5	Geographically Dependent Availability Ratio	C-4
C.2.1.6	Availability Calculation Using Independent Elements	C-5
C.2.1.7	Availability Effects of Traffic Loading	C-6
C.2.1.8	Effect of Redundancy on Availability Calculations	C-8

C.2.1.8.1	K-redundancy with common repair	C-8
C.2.1.8.2	K-redundancy with independent repair	C-9
C.2.1.8.3	K-redundancy without repair	C-9
C.2.2	Continuity of Service Analysis Equations	C-9
C.2.2.1	Rate of Continuity of Service Events	C-11
C.2.2.2	Geographically Dependent Continuity of Service Event Rate	C-11
C.2.2.3	Estimating the Rate from the Probability	C-11
C.2.2.4	Estimating the Continuity of Service	C-12
C.3	AMS(R)S Availability Model	C-12
C.3.1	Fault-Free Rare Events	C-13
C.3.1.1	RF Link Events	C-14
C.3.1.2	Scintillation Events	C-15
C.3.1.3	Interference Events	C-16
C.3.1.4	Capacity Overload Events	C-16
C.3.2	System Component Failure Events	C-17
C.3.2.1	GES Failure Events	C-18
C.3.2.2	Satellite Failure Events	C-19
C.3.2.3	NCS Failure Events	C-20
C.3.2.4	AES Failure Events	C-20
C.3.3	Multi-User vs. Single User Availability	C-21
C.3.3.1	Multi-User Availability	C-21
C.3.3.2	Single-User Availability	C-22
C.4	AMS(R)S Availability Example	C-23
C.4.1	Example System Parameters	C-23
C.4.2	Fault-Free Rare Events	C-24
C.4.2.1	RF Link Events	C-24
C.4.2.2	Scintillation	C-24
C.4.2.3	Interference	C-26
C.4.2.4	Capacity Overload	C-26
C.4.2.5	Fault Free Rare Event Summary	C-29
C.4.3	System Component Failures	C-29
C.4.3.1	GES Failure Events	C-29
C.4.3.2	Satellite Failure Events	C-29
C.4.3.3	NCS Failure Events	C-31
C.4.3.4	AES	C-31
C.4.3.5	System Element Failures	C-31
C.4.4	System Availability Estimate	C-31
C.5	AMS(R)S Continuity of Service Model	C-31
C.5.1	Fault-Free Rare Events	C-32
C.5.1.1	RF Events	C-32
C.5.1.2	Scintillation Events	C-32
C.5.1.3	Interference Events	C-32
C.5.1.4	Capacity Overload Events	C-32
C.5.2	System Component Failures	C-33
C.5.3	Multi-User vs. Single User Continuity of Service	C-33
C.6	AMS(R)S Continuity of Service Example	C-34
C.6.1	Fault-Free Rare Events	C-34
C.6.1.1	RF Link	C-34
C.6.1.2	Scintillation	C-34
C.6.1.2.1	Equatorial Region	C-34

C.6.1.2.2	High Latitude Regions	C-35
C.6.1.2.3	Continuity of Service	C-35
C.6.1.3	Interference	C-35
C.6.1.4	Capacity Overload	C-36
C.6.1.4.1	Uplink	C-36
C.6.1.4.2	Downlink	C-37
C.6.1.4.3	Total COS Effect of Capacity Overload	C-38
C.6.1.5	Fault Free Rare Event Summary	C-38
C.6.2	System Component Failures	C-38
C.6.2.1	GES	C-38
C.6.2.2	Satellites	C-38
C.6.2.3	NCS	C-40
C.6.2.4	AES	C-40
C.6.2.5	System Element Failures	C-40
C.6.3	System Availability Estimate	C-40
C.7	References for Appendix C	C-40

Appendix D—METHODOLOGY FOR COMPUTING AND PARTITIONING COMMUNICATIONS INTEGRITY (NORMATIVE)

D.1	Introduction	D-1
D.2	Integrity Analysis Methodology	D-2
D.2.1	Integrity Analysis Terms and Equations	D-2
D.2.1.1	Integrity Assumptions and Related Requirement	D-2
D.2.1.2	Forward Error Correction	D-2
D.2.1.2.1	Acknowledge-Request Protocol	D-3
D.2.1.2.2	Union Bound	D-3
D.2.1.3	Hamming Weight	D-4
D.2.1.4	Weight Enumerating Function	D-4
D.2.1.5	Signal-to-Noise Ratio	D-4
D.2.1.5.1	Burst Errors	D-5
D.3	Integrity Analysis Methodology	D-5
D.3.1	Fault Tree	D-5
D.3.2	Parameter Declaration	D-6
D.3.3	Data Integrity	D-6
D.3.3.1	Word Error Rate	D-6
D.3.3.1.1	Frame Check Sequence	D-10
D.3.3.1.2	Overall User Data Integrity	D-10
D.3.4	Address Integrity	D-10
D.3.5	Overall Communications Integrity	D-10
D.4	Integrity Analysis Example	D-10
D.4.1	System Assumptions	D-10
D.4.2	Forward Link	D-11
D.4.2.1	Weight Enumerating Function	D-11
D.4.2.2	Word Error Rate	D-12
D.4.2.2.1	Address Block	D-12
D.4.2.2.2	Data Block	D-13
D.4.2.3	Data Integrity	D-13
D.4.3	Reverse Link	D-13
D.4.3.1	Weight Enumerating Function	D-13
D.4.3.2	Word Error Rate	D-14

D.4.3.2.1	Address Block	D-14
D.4.3.2.2	Data Block	D-14
D.4.3.3	Data Integrity	D-14
D.5	References for Appendix D	D-15
Appendix E—MINIMUM TRAFFIC MODEL (FOR OCEANIC AND REMOTE AREAS) (NORMATIVE)		
E.1	Introduction	E-1
E.2	Discussion	E-1
E.3	Segmentation and Block Overhead Approximations:	E-2
Appendix F—METHODS OF COMBINING AND PARTITIONING ICP FACTOR VALUES (INFORMATIVE)		
F.1	Introduction	F-1
F.2	Combinatorial Methods	F-1
F.2.1	Availability and Continuity	F-1
F.2.2	Integrity	F-1
F.2.3	Transfer Delay	F-1
F.2.3.1	Sources and Manipulation of Transfer Delay Data	F-1
F.2.3.2	Analysis by Data Probability Distributions	F-3
F.2.3.3	An Approximation Technique for Aggregation and Partitioning of Transfer Delay Data	F-5
F.3	Illustrations of Transfer Delay Partitioning by Various Methods	F-7
F.3.1	Aggregation	F-7
F.3.2	Partitioning for Allocation and Allotment	F-8
F.3.3	Conclusions	F-9
F.4	Reference for Appendix F	F-10
Appendix G—A VOLUMETRIC MODEL FOR ASSESSING INTERFERENCE BETWEEN SATCOM- EQUIPPED AIRCRAFT IN THE SAME AIRSPACE (INFORMATIVE)		
G.1	Introduction	G-1
G.2	Model Development	G-1
G.2.1	Estimating the Worst Case Interference	G-1
G.2.2	Computing the Interference Volume	G-3
G.2.2.1	Stratified Airspace	G-3
G.2.2.2	Transmit (Source) Antenna Pattern	G-4
G.2.2.3	Receiver (Victim) Antenna Pattern	G-5
G.2.2.4	Computing the Total Volume of the Stratified Airspace	G-7
G.2.3	Interference Airspace	G-7
G.2.4	Computing the Average Load Per Aircraft	G-7
G.2.5	Computing the Number of Active Communications Attempts	G-8
G.2.6	Computing the Unavailability Ratio	G-8
G.2.7	Multi-User Unavailability	G-9
G.3	Example Volumetric Interference Computation	G-10
G.3.1	System Assumptions	G-10
G.3.2	Estimating the Worst-Case Interference	G-11
G.3.3	Computing the Interference Volume	G-11

G.3.3.1	Transmit (Source) Antenna Pattern	G-11
G.3.3.2	Receiver (Victim) Antenna Pattern.	G-11
G.3.3.3	Computing the Total Volume of Stratified Airspace	G-12
G.3.3.4	Interference Airspace	G-13
G.3.3.5	Average Load Per Aircraft	G-13
G.3.3.6	Number of Active Communications Attempts	G-13
G.3.3.7	Compute the Single User Unavailability	G-14
G.3.3.8	Compute Multi-User Unavailability	G-14
G.4	Detailed Derivations Supporting the Volumetric Model	G-15
G.4.1	Determination of the Interference Volume	G-15
G.4.2	Determination of Interference Limits in the Radial Direction.	G-19
G.5	References for Appendix G	G-19

Appendix H—OVERVIEW OF AMS(R)S SYSTEMS AND THEIR ENVIRONMENTS

H.1	AMSS and AMS(R)S Systems in the Spectrum Regulatory Environment	H-1
H.2	AMSS/AMS(R)S System Architectures	H-2
H.2.1	System Elements and Their Functions	H-2
H.2.1.1	Satellite and RF Path	H-2
H.2.1.2	Ground Earth Station (GES).	H-2
H.2.1.3	Aircraft Earth Station (AES)	H-2
H.2.1.4	Network Control and Coordination Functions	H-2
H.2.2	Satellite System Architectures	H-3
H.2.2.1	Coverage	H-3
H.2.2.1.1	Geostationary Orbit Constellations	H-3
H.2.2.1.2	Low Earth Orbit (LEO) and Medium Earth Orbit (MEO) Constellations	H-3
H.2.2.2	Feeder Links	H-4
H.2.2.3	AMS(R)S Operational Service Levels	H-4
H.3	End-to-End Communications Environments	H-4
H.3.1	End-to-End Data Link	H-4
H.3.1.1	The Aeronautical Telecommunications Network (ATN).	H-5
H.3.1.2	FANS 1/A Data Link	H-5
H.3.1.3	Transceiver Avionics Interface Modes	H-6
H.3.1.3.1	Data-2 Interface	H-6
H.3.1.3.2	Data-3 Interface	H-6
H.4	Data and Voice Communication	H-6
H.5	AMS(R)S Service Responsibilities	H-7
H.6	AMS(R)S Performance as a Component of Global CNS/ATM	H-7
H.6.1	Assumptions Regarding the Required Communications Performance (RCP) Concept	H-8
H.6.1.1	Required Communications Technical Performance (RCTP)	H-8
H.6.1.2	Installed Communications Performance (ICP).	H-8
H.6.1.3	Actual Communications Performance (ACP)	H-9
H.6.2	Installed Communications Performance (ICP) Parameters	H-9
H.6.2.1	Transfer Delay	H-9
H.6.2.2	Integrity	H-10
H.6.2.3	Availability and Continuity	H-10
H.7	Throughput and Capacity	H-10

TABLE OF FIGURES

<u>Figure 1-1</u>	Aeronautical Mobile Satellite System (AMSS) End-to-End Model	4
<u>Figure 1-2</u>	End-to-End Packet-Mode Services System Structure	6
<u>Figure 2-1</u>	AMS(R)S Subnetwork and Performance Reference Points (ISO 8208 protocol is representative only)	12
<u>Figure 3-1</u>	Partitioning Air-to-Ground Subnetwork into AES and SNI	25
<u>Figure 4-1</u>	Harmonic Bandwidths for Interference Analysis.	37
<u>Figure 4-2</u>	Example of To-Aircraft-Direction Transfer Delay Measurement System.	43
<u>Figure B-1</u>	RF Link Naming Conventions	B-4
<u>Figure B-2</u>	Example CDFs for Polarization Loss.	B-11
<u>Figure B-3</u>	Global Pattern of Ionospheric Scintillation	B-16
<u>Figure C-1</u>	Timing of Outage Duration Events	C-2
<u>Figure C-2</u>	Example of Non-Delivery that Does Not Result in Outage.	C-2
<u>Figure C-3</u>	“Availability Tree” Methodology	C-13
<u>Figure C-4</u>	Examples of Fading Rate Effects on Signal Interruptions	C-15
<u>Figure C-5</u>	Examples of External and Internal Networking Between GES Sites.	C-19
<u>Figure C-6</u>	Example Probability of Outage Given a Known Satellite Failure	C-30
<u>Figure D-1</u>	Sample Fault Trees for Integrity Analysis	D-8
<u>Figure F-1</u>	Representative Histogram of Transfer Delay Data	F-2
<u>Figure F-2</u>	Comparison of Normalized Histogram Data and Fitted Distribution; (a) PDF and (b) CDF	F-4
<u>Figure G-1</u>	"Stratified Airspace" as a Basis for Interference Analysis.	G-5
<u>Figure G-2</u>	Example Idealized Receive Antenna Pattern	G-6
<u>Figure G-3</u>	Effective Range Computed Using Normalized, Idealized Antenna Pattern (Example Only, Not for General Use)	G-13
<u>Figure G-4</u>	Multi-User Unavailability Due to Interference at $LE=0.05$ Erlang	G-14
<u>Figure G-5</u>	Definition of Interference Volume V_k in y-z Plane.	G-16
<u>Figure G-6</u>	Definition of Interference Volume, V_k , in x-y Plane.	G-18

TABLE OF TABLES

<u>Table 2-1</u>	Pro Forma for System Characteristic Declaration	13
<u>Table 2-2</u>	Pro-forma Table for Transfer Delay Characteristics	18
<u>Table B-1</u>	Pro-Forma RF Link Analysis Budget for AMSS/AMS(R)S Systems	B-2
<u>Table B-2</u>	Example Pro-Forma Random Loss Budget	B-13
<u>Table B-3</u>	Pro Forma Modem Budget for Computation of Required C/No	B-18
<u>Table B-4</u>	Theoretical BER Equations for Common Modulations	B-19
<u>Table B-5</u>	System-specific Parameters for Example Pro Forma Analysis	B-22
<u>Table B-6</u>	Sample Pro-Forma Link Budget Suitable for Inclusion in MASPS Appendix	B-23
<u>Table B-7</u>	Example Random Loss Budget, Return Link	B-27
<u>Table B-8</u>	Example Modem Budget	B-29
<u>Table C-1</u>	Declared and Derived Parameters for Traffic Load Analysis.	C-7
<u>Table C-2</u>	Parameters for Example Computation of Traffic Overload Effect.	C-28
<u>Table D-1</u>	Simple Code Example	D-4
<u>Table D-2</u>	Declared Parameters for Integrity Analysis	D-9
<u>Table D-3</u>	Declared Parameters for Example Integrity Analysis.	D-12
<u>Table E-1</u>	Minimum Uplink Data Traffic Model (To-Aircraft)	E-3
<u>Table E-2</u>	Minimum Downlink Data Traffic Model (From-Aircraft).	E-4
<u>Table E-3</u>	Assumed Data Block Characteristics Corresponding to Traffic Types	E-5
<u>Table F-1</u>	Comparison of Raw Data and Fitted Curve Parameters.	F-4
<u>Table F-2</u>	Comparison of Combining Algorithm with True Convolved Values	F-6
<u>Table G-1</u>	Baseline assumptions for Interference Analysis.	G-1
<u>Table G-2</u>	Pro Forma Baseline Budget for Determination of	G-3
<u>Table G-3</u>	Baseline assumptionsfor Example Interference Analysis.	G-11
<u>Table G-4</u>	Pro Forma Baseline Budget for Determination of	G-12
<u>Table G-5</u>	Determination of Integration Limits for Volumetric Model.	G-17

1 PURPOSE AND SCOPE

1.1 Introduction

This document contains minimum aviation system performance standards for communications utilizing aeronautical mobile satellite systems for the air-ground communications subnetwork in an Aeronautical Telecommunications Network (ATN) environment. The FANS 1/A data link environment is also addressed. These standards specify characteristics that should be useful to designers, installers, manufacturers, service providers and users of systems intended for operational use within the United States National Airspace System (NAS). Where systems are global in nature, the system may have international applications that are taken into consideration.

Compliance with these standards is recommended as one means of assuring that the system and each subsystem will perform its intended function(s) satisfactorily under conditions normally encountered in routine aeronautical operations for the environments intended. The MASPS may be implemented by one or more regulatory documents and/or advisory documents (e.g., certification, authorization, approval, commissioning, advisory circular, notice, etc.) and may be implemented in part or in total. Any regulatory application of this document is the sole responsibility of appropriate governmental agencies.

Communications supporting the Air Traffic Service (ATS) and Aeronautical Operational Control (AOC) may be provided by one or more satellite systems, each of which has particular operating characteristics. The technical details of each individual system will be in system-specific attachments prepared in accordance with this document. The system-specific performance will become the minimum performance requirements for that system. This document anticipates that the system-specific attachment(s) will provide one means of assessing whether a particular AMS(R)S system is appropriate for a specific operational environment. The requirements for operational environments will be developed in accordance with DO-264. A system-specific attachment will not require RTCA approval or publication.

Section 1 of this document describes a generalized Aeronautical Mobile Satellite Service (AMSS) System, the particular characteristics of its AMS(R)S component, and the data link environment in which it is used. Section 1 also provides information needed to understand the rationale for system characteristics and requirements that are stated within this document. This section contains typical applications and envisioned operational goals and assumptions necessary to establish a basis for the subsequent sections.

Section 2 defines the general requirements of an AMS(R)S subnetwork, specific requirements for its interfaces, and specific minimum Installed Communications Performance (ICP) requirements when viewed as an air/ground subnetwork of an end-to-end data network. The ICP requirements include delay, integrity, availability and continuity of service parameters.

Section 3 establishes requirements for specific information that must be provided in the system-specific attachments and establishes pro-forma tables and methodology by which that information is to be provided. The purpose of this disclosure is to provide confidence that the subnetwork design will achieve the "Point B-to-Point C" performance specified in Section 2, prior to the approval of that system for AMS(R)S. The ultimate proof of performance at the subnetwork level is the verification procedures of Section 4.

Section 4 describes procedures recommended for verifying compliance of the subnetwork with the minimum performance requirements in Section 2.

Appendices of this document are structured to contain either normative or informative material, and are so identified in each case. Normative appendices contain material, such