

RTCA, Inc.  
1150 18th Street NW, Suite 910  
Washington, DC 20036  
USA

**Minimum Operational Performance Standards  
(MOPS) for Flight Information Services -  
Broadcast (FIS-B) with Universal Access  
Transceiver (UAT)**

RTCA DO-358B  
March 18, 2021

Prepared by SC-206  
© 2021, RTCA, Inc.

Copies of this document may be obtained from

RTCA, Inc.

Telephone: 202-833-9339

Facsimile: 202-833-9434

Internet: [www.rtca.org](http://www.rtca.org)

Please visit the RTCA Online Store for document pricing and ordering information.

## **FOREWORD**

This document was prepared by Special Committee 206 (SC-206) and approved by the RTCA Program Management Committee (PMC) on March 18, 2021.

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 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 the basis for government and private sector decisions as well as the foundation for many Federal Aviation Administration Technical Standard Orders and several advisory circulars.

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.

## **DISCLAIMER**

This publication is based on material submitted by various participants during the SC approval process. Neither the SC nor RTCA has made any determination whether these materials could be subject to valid claims of patent, copyright or other proprietary rights by third parties, and no representation or warranty, expressed or implied is made in this regard. Any use of or reliance on this document shall constitute an acceptance thereof "as is" and be subject to this disclaimer.

This Page Intentionally Left Blank

## TABLE OF CONTENTS

<b>1</b>	<b>PURPOSE AND SCOPE.....</b>	<b>1</b>
1.1	Introduction.....	1
1.2	System Overview.....	3
1.2.1	Document Hierarchy.....	4
1.3	Operational Application(s).....	4
1.4	Intended Function.....	5
1.5	Operational Goals.....	6
1.6	Assumptions.....	6
1.6.1	FIS-B Implementation.....	6
1.6.2	Coordinated Universal Time and Date Access.....	6
1.7	Test Procedures.....	6
1.8	Definition of Terms.....	7
1.9	Acronyms/Abbreviations.....	9
1.10	References.....	13
<b>2</b>	<b>EQUIPMENT PERFORMANCE REQUIREMENTS AND TEST PROCEDURES .....</b>	<b>15</b>
2.1	General Requirements.....	15
2.1.1	Airworthiness.....	15
2.1.2	Intended Function.....	15
2.1.3	Federal Communications Commission Rules.....	15
2.1.4	Fire Protection.....	15
2.1.5	Operation of Controls.....	15
2.1.6	Accessibility of Controls.....	15
2.1.7	Effect of Test.....	15
2.1.8	Design Assurance.....	15
2.1.9	Equipment Classes.....	16
2.2	Equipment Performance—Standard Conditions.....	17
2.2.1	Data Link Layer Interface to UAT Receiver.....	17
2.2.1.1	Error Detection.....	17
2.2.2	FIS-B Data Formats and Decoding.....	17
2.2.2.1	UAT Ground Uplink Message.....	17
2.2.2.2	UAT Frame.....	17
2.2.2.3	FIS-B APDU.....	18
2.2.2.4	Current Report List.....	18
2.2.3	General Requirements.....	18
2.2.4	FIS-B Product Requirements.....	18
2.2.4.1	Generic Text Products.....	21
2.2.4.1.1	Decoding.....	21
2.2.4.1.2	Product Title.....	21

2.2.4.1.3	Display of Full Report.....	21
2.2.4.1.4	Processing and Display Latency.....	22
2.2.4.1.5	Generic Text Reports Processing .....	22
2.2.4.1.6	Control Characters.....	22
2.2.4.2	Graphic Products Using Global Block Representation.....	23
2.2.4.2.1	Regional NEXRAD.....	23
2.2.4.2.1.1	Decoding .....	23
2.2.4.2.1.2	Product Title.....	23
2.2.4.2.1.3	Product Legend .....	23
2.2.4.2.1.4	Indication of Product Age .....	23
2.2.4.2.1.5	Explicit Indication of Missing Data .....	23
2.2.4.2.1.6	Processing and Display Latency .....	24
2.2.4.2.1.7	Timestamp Variance .....	24
2.2.4.2.1.8	Regional NEXRAD Color Use .....	24
2.2.4.2.2	CONUS NEXRAD.....	25
2.2.4.2.2.1	Decoding .....	25
2.2.4.2.2.2	Product Title.....	25
2.2.4.2.2.3	Product Legend .....	25
2.2.4.2.2.4	Indication of Product Age .....	25
2.2.4.2.2.5	Explicit Indication of Missing Data .....	26
2.2.4.2.2.6	Processing and Display Latency .....	26
2.2.4.2.2.7	Timestamp Variance .....	26
2.2.4.2.2.8	CONUS NEXRAD Color Use .....	26
2.2.4.2.3	Icing.....	27
2.2.4.2.3.1	Decoding .....	27
2.2.4.2.3.2	Product Title.....	27
2.2.4.2.3.3	Product Altitude .....	27
2.2.4.2.3.4	Product Legend .....	27
2.2.4.2.3.5	Indication of Time.....	28
2.2.4.2.3.6	Explicit Indication of Missing Data .....	28
2.2.4.2.3.7	Processing and Display Latency .....	28
2.2.4.2.3.8	Timestamp Variance .....	28
2.2.4.2.3.9	Depiction.....	28
2.2.4.2.4	Cloud Tops .....	28
2.2.4.2.4.1	Decoding .....	28
2.2.4.2.4.2	Product Title.....	29
2.2.4.2.4.3	Product Legend .....	29
2.2.4.2.4.4	Indication of Time.....	29
2.2.4.2.4.5	Explicit Indication of Missing Data .....	29
2.2.4.2.4.6	Processing and Display Latency .....	29
2.2.4.2.4.7	Timestamp Variance .....	29
2.2.4.2.5	Turbulence.....	29

2.2.4.2.5.1	Decoding .....	29
2.2.4.2.5.2	Product Title.....	30
2.2.4.2.5.3	Product Altitude .....	30
2.2.4.2.5.4	Product Legend .....	30
2.2.4.2.5.5	Indication of Time.....	30
2.2.4.2.5.6	Explicit Indication of Missing Data .....	30
2.2.4.2.5.7	Processing and Display Latency .....	30
2.2.4.2.5.8	Timestamp Variance .....	30
2.2.4.2.6	Lightning .....	31
2.2.4.2.6.1	Decoding .....	31
2.2.4.2.6.2	Product Title.....	31
2.2.4.2.6.3	Product Legend .....	31
2.2.4.2.6.4	Indication of Product Age .....	31
2.2.4.2.6.5	Explicit Indication of Missing Data .....	31
2.2.4.2.6.6	Processing and Display Latency .....	31
2.2.4.2.6.7	Timestamp Variance .....	32
2.2.4.2.6.8	Depiction.....	32
2.2.4.3	Text with Graphical Overlay Products .....	32
2.2.4.3.1	Decoding .....	32
2.2.4.3.2	Product Title.....	32
2.2.4.3.3	Control Characters.....	32
2.2.4.3.4	FIS-B Product Updates Unavailable Reports .....	33
2.2.4.3.4.1	Latency.....	33
2.2.4.3.4.2	Purging of FIS-B Product Update Unavailable Reports .....	33
2.2.4.3.5	TWGO Report Cancellation.....	33
2.2.4.3.6	TWGO Graphical Overlay Record Cancellation.....	33
2.2.4.3.7	NOTAM (D, FDC, TFR, TRA, TMOA) Text/Graphic.....	33
2.2.4.3.7.1	Text Decoding.....	33
2.2.4.3.7.2	Graphic Decoding .....	33
2.2.4.3.7.3	Association of NOTAM Text and Graphic APDUs.....	34
2.2.4.3.7.4	NOTAM Display.....	34
2.2.4.3.7.5	Latency.....	35
2.2.4.3.7.6	Displaying Special Use Airspace NOTAMs.....	36
2.2.4.3.7.7	Report Retention .....	36
2.2.4.3.8	AIRMET Text/Graphic .....	36
2.2.4.3.8.1	Text Decoding.....	36
2.2.4.3.8.2	Graphic Decoding .....	37
2.2.4.3.8.3	Association of AIRMET Text and Graphic APDUs.....	37
2.2.4.3.8.4	AIRMET Display .....	37
2.2.4.3.8.5	Latency.....	37
2.2.4.3.8.6	Report Retention .....	38
2.2.4.3.9	SIGMET/WST Text/Graphic .....	38

2.2.4.3.9.1	Text Decoding.....	38
2.2.4.3.9.2	Graphic Decoding .....	38
2.2.4.3.9.3	Association of SIGMET Text and Graphic APDUs .....	38
2.2.4.3.9.4	SIGMET Display .....	38
2.2.4.3.9.5	Latency.....	39
2.2.4.3.9.6	Report Retention .....	39
2.2.4.3.10	G-AIRMET Text/Graphic .....	39
2.2.4.3.10.1	Text Decoding.....	39
2.2.4.3.10.2	Graphic Decoding .....	39
2.2.4.3.10.3	Product Legends.....	40
2.2.4.3.10.4	Indication of Time.....	40
2.2.4.3.10.5	G-AIRMET Display.....	40
2.2.4.3.10.6	Processing and Display Latency .....	40
2.2.4.3.10.7	Report Retention .....	40
2.2.4.3.11	CWA Text/Graphic .....	40
2.2.4.3.11.1	Text Decoding.....	40
2.2.4.3.11.2	Graphic Decoding .....	40
2.2.4.3.11.3	Indication of Time.....	41
2.2.4.3.11.4	Association of CWA Text and Graphic APDUs.....	41
2.2.4.3.11.5	CWA Display.....	41
2.2.4.3.11.6	Latency.....	41
2.2.4.3.11.7	Report Retention .....	42
2.2.5	Requirements for Reassembly of Segmented APDUs into a Complete Product File.....	42
2.2.5.1	Identification.....	42
2.2.5.2	Completeness of Received Sequence .....	42
2.2.5.3	Time Integration of Segments Received.....	42
2.2.5.4	Spatial Integration of Segments Received.....	43
2.2.6	Requirements for FIS-B Avionics Maintenance of Complete FIS-B Report Unique Set.....	43
2.2.7	Dependence on UTC Time .....	43
2.2.8	Capacity .....	43
2.2.9	System Status.....	44
2.2.9.1	Reception Success Rate .....	44
2.2.9.2	Report Completeness Status .....	44
2.3	Equipment Performance—Environmental Conditions.....	45
2.3.1	Environmental Test Conditions .....	46
2.3.2	Detailed Environmental Procedures .....	48
2.3.2.1	Verification of Capacity .....	49
2.3.2.2	Verification of System Status .....	49
2.4	Equipment Test Procedures.....	49
2.4.1	Test Approach.....	50
2.4.2	Definitions of Terms and Conditions of Test.....	50
2.4.3	Detailed Test Procedures .....	52

2.4.3.1	Test Group 1 .....	52
2.4.3.2	Test Group 2 .....	52
2.4.3.3	Test Group 3 .....	52
2.4.3.4	Test Group 4 .....	53
2.4.3.5	Test Group 5 .....	53
2.4.3.6	Test Group 6 .....	53
2.4.3.7	Test Group 7 .....	54
2.4.3.8	Test Group 8 .....	54
2.4.3.9	Test Group 9 .....	55
2.4.3.10	Test Group 10 .....	55
2.4.3.11	Test Group 11 .....	55
2.4.3.12	Test Group 12 .....	56
2.4.3.13	Test Group 13 .....	56
2.4.3.14	Test Group 14 .....	56
2.4.3.15	Test Group 15 .....	57
2.4.3.16	Test Group 16 .....	57
2.4.3.17	Test Group 17 .....	57
2.4.3.18	Test Group 18 .....	58
2.4.3.19	Test Group 19 .....	58
2.4.3.20	Test Group 20 .....	58
2.4.3.21	Test Group 21 .....	59
2.4.3.22	Test Group 22 .....	59
2.4.3.23	Test Group 23 .....	59
2.4.3.24	Test Group 24 .....	60
2.4.3.25	Test Group 25 .....	60
2.4.3.26	Test Group 26 .....	60
2.4.3.27	Test Group 27 .....	61
2.4.4	Requirements Verification Summary.....	61

**3 MANUFACTURER CONSIDERATIONS FOR INSTALLED EQUIPMENT ..... 67**

3.1	Equipment Installation .....	67
3.1.1	Accessibility.....	67
3.1.2	Aircraft Environment.....	67
3.1.3	Display Visibility .....	67
3.1.4	Dynamic Range.....	67
3.1.5	Failure Protection.....	68
3.1.6	Interference Effects.....	68
3.1.7	Inadvertent Turnoff.....	68
3.1.8	Aircraft Power Source.....	68
3.1.9	Other Considerations .....	68
3.2	Installed Equipment Performance Considerations .....	68
3.3	Test Procedures for Installed Equipment Performance.....	69

<b>4</b>	<b>AIRCRAFT OPERATIONAL PERFORMANCE CHARACTERISTICS .....</b>	<b>71</b>
<b>5</b>	<b>MEMBERSHIP.....</b>	<b>73</b>
	<b>APPENDIX A FORMAT AND ENCODING OF FIS-B UPLINK PRODUCTS.....</b>	<b>A-1</b>
A.1	UAT Ground Uplink Message Format.....	A-1
A.1.1	UAT Ground Uplink Header Format.....	A-1
A.1.1.1	Radio Station Latitude/Longitude Field Encoding.....	A-2
A.1.1.2	Position Valid Field Encoding.....	A-5
A.1.1.3	UTC Coupled Field Encoding.....	A-5
A.1.1.4	Reserved Bit.....	A-5
A.1.1.5	Application Data Valid Field Encoding.....	A-5
A.1.1.6	Slot ID Field Encoding.....	A-5
A.1.1.7	TIS-B Site ID Field Encoding.....	A-6
A.1.1.8	Reserved Bits.....	A-6
A.1.2	Application Data Format.....	A-6
A.1.3	UAT Frame Format.....	A-7
A.1.3.1	Length Field Encoding.....	A-7
A.1.3.2	Reserved Field.....	A-7
A.1.3.3	Frame Type Field Encoding.....	A-7
A.1.3.3.1	Frame Type 0— APDU.....	A-8
A.1.3.3.2	Frame Type 14—CRL.....	A-8
A.1.3.3.3	Frame Type 15—TIS-B/ADS-R Service Status.....	A-8
A.1.3.3.4	Other Potential Future Frame Data Content.....	A-8
A.1.3.4	Frame Data Field Encoding.....	A-8
A.1.3.4.1	FIS-B Product Frame Data.....	A-8
A.2	APDU Header and Payload Encoding.....	A-9
A.2.1	APDU Header.....	A-11
A.2.1.1	Product Descriptor.....	A-11
A.2.1.1.1	Reserved Bits.....	A-11
A.2.1.1.2	Product Identifier.....	A-11
A.2.1.2	Segmentation Flag Bit.....	A-11
A.2.1.3	Header Time.....	A-11
A.2.1.3.1	Time Options.....	A-12
A.2.1.3.2	Month of Year (Optional).....	A-12
A.2.1.3.3	Day of Month (Optional).....	A-12
A.2.1.3.4	Hours.....	A-12
A.2.1.3.5	Minutes.....	A-12
A.2.1.4	Segmentation Block.....	A-12
A.2.1.4.1	Product File ID.....	A-13
A.2.1.4.2	Product File Length.....	A-13
A.2.1.4.3	APDU Number.....	A-13

A.2.1.5	Pad .....	A-13
A.2.2	APDU Payload.....	A-13
A.3	FIS-B Products.....	A-13
A.3.1	Generic Text (Product ID #413) .....	A-14
A.3.1.1	Generic Text Encoding .....	A-14
A.3.1.1.1	Data Link Applications Control Coding Characters.....	A-15
A.3.1.2	Text Record Formatting.....	A-16
A.3.1.3	APDU Header.....	A-17
A.3.1.4	APDU Payload .....	A-17
A.3.1.5	Product Specific Notes .....	A-17
A.3.1.5.1	APDU Timestamp Rules .....	A-17
A.3.1.5.2	APDU Header Time .....	A-18
A.3.1.5.3	Truncation of Long Product #413s.....	A-18
A.3.1.5.3.1	Description of Truncation .....	A-18
A.3.1.5.4	Winds and Temperatures Aloft .....	A-19
A.3.1.5.5	METAR Cutoff Time .....	A-20
A.3.1.5.6	PIREP With No Location Identifier .....	A-21
A.3.1.5.6.1	Background .....	A-21
A.3.1.5.6.2	FIS-B Ground System Response When No Location Identifier Provided.....	A-21
A.3.2	Global Block Representation Products .....	A-21
A.3.2.1	General Formatting.....	A-21
A.3.2.1.1	Background .....	A-21
A.3.2.1.2	The Use of Bins and Blocks .....	A-22
A.3.2.1.3	Global Block Numbering Plan .....	A-22
A.3.2.1.3.1	Grid Layout.....	A-22
A.3.2.2	Global Block Frame Formatting.....	A-24
A.3.2.2.1	The Block Reference Indicator.....	A-24
A.3.2.2.1.1	Element Identifier.....	A-25
A.3.2.2.1.2	Product Specific Bits.....	A-25
A.3.2.2.1.2.1	Product Specific Bits Encoding Type 1 .....	A-25
A.3.2.2.1.2.1.1	Hemisphere N/S.....	A-25
A.3.2.2.1.2.1.2	Scale Factor.....	A-25
A.3.2.2.1.2.2	Product Specific Bits Encoding Type 2 .....	A-26
A.3.2.2.1.3	Block Number .....	A-26
A.3.2.2.2	Run Length Encoded Element.....	A-27
A.3.2.2.3	The Empty Element.....	A-28
A.3.2.2.3.1	Bitmap Length and Bytes.....	A-29
A.3.2.2.3.1.1	Bitmap Length .....	A-29
A.3.2.2.3.1.2	Bitmap.....	A-29
A.3.2.2.3.2	Number of Potential Empty Blocks .....	A-30
A.3.2.2.3.3	Mapping Bits to Blocks.....	A-30
A.3.2.3	Regional NEXRAD (Product #63).....	A-32

A.3.2.3.1	Regional NEXRAD APDU Header.....	A-32
A.3.2.3.2	Run Length Encoding Scheme for Regional NEXRAD Global Blocks.....	A-32
A.3.2.3.3	Regional NEXRAD Data Encoding .....	A-33
A.3.2.3.4	Scaling of Regional Global Blocks .....	A-34
A.3.2.4	CONUS NEXRAD (Product #64).....	A-34
A.3.2.4.1	CONUS NEXRAD APDU Header .....	A-34
A.3.2.4.2	Run Length Encoding of CONUS NEXRAD Global Blocks .....	A-35
A.3.2.4.3	CONUS NEXRAD Data Encoding .....	A-35
A.3.2.4.4	Scaling of CONUS Global Blocks .....	A-35
A.3.2.4.5	CONUS NEXRAD Product Timing.....	A-35
A.3.2.5	Turbulence (Product ID #90 and #91).....	A-36
A.3.2.5.1	Turbulence Data Source .....	A-36
A.3.2.5.2	Turbulence-Low and Turbulence-High Altitude Products.....	A-36
A.3.2.5.3	Turbulence Product APDU Header.....	A-37
A.3.2.5.4	Run Length Encoding Scheme for Turbulence Global Blocks .....	A-38
A.3.2.5.5	Turbulence Data Encoding.....	A-40
A.3.2.5.6	Scaling of Turbulence Global Blocks.....	A-41
A.3.2.5.7	Turbulence Product Status.....	A-41
A.3.2.6	Icing (Product ID #70 and #71).....	A-41
A.3.2.6.1	Icing Data Source .....	A-41
A.3.2.6.2	Icing-Low and Icing-High Altitude Products.....	A-42
A.3.2.6.3	Icing Product APDU Header .....	A-43
A.3.2.6.4	Run Length Encoding Scheme for Icing Global Blocks .....	A-44
A.3.2.6.5	Empty Element Encoding Scheme .....	A-45
A.3.2.6.6	Icing Data Encoding.....	A-45
A.3.2.6.7	Scaling of Icing Global Blocks.....	A-47
A.3.2.6.8	Icing Product Status.....	A-47
A.3.2.7	Cloud Tops (Product ID #84) .....	A-47
A.3.2.7.1	Cloud Tops Source .....	A-47
A.3.2.7.2	Cloud Tops APDU Header.....	A-47
A.3.2.7.3	Run Length Encoding Scheme for Cloud Tops Global Blocks.....	A-48
A.3.2.7.4	Cloud Tops Data Encoding .....	A-50
A.3.2.7.5	Scaling of Cloud Tops Global Blocks.....	A-51
A.3.2.7.6	Cloud Tops Product Status .....	A-51
A.3.2.8	Lightning (Product ID #103).....	A-52
A.3.2.8.1	Lightning Source .....	A-52
A.3.2.8.2	Lightning Product APDU Header .....	A-52
A.3.2.8.3	Run Length Encoding Scheme for Lightning Global Blocks.....	A-52
A.3.2.8.4	Lightning Data Encoding .....	A-53
A.3.2.8.5	Scaling of Lightning Global Blocks.....	A-54
A.3.2.8.6	Lightning Product Status .....	A-54
A.3.3	Text with Graphical Overlay FIS-B Products.....	A-55

A.3.3.1	General Formatting.....	A-55
A.3.3.1.1	TWGO Payload Header.....	A-55
A.3.3.1.1.1	Record Format.....	A-56
A.3.3.1.1.2	Product Version.....	A-56
A.3.3.1.1.3	Record Count .....	A-56
A.3.3.1.1.4	Reserved Bits .....	A-57
A.3.3.1.1.5	Location Identifier.....	A-57
A.3.3.1.1.6	Record Reference Point.....	A-57
A.3.3.1.2	TWGO Text Record .....	A-57
A.3.3.1.2.1	Text Record Length.....	A-57
A.3.3.1.2.2	Report Number.....	A-58
A.3.3.1.2.3	Report Year .....	A-58
A.3.3.1.2.4	Report Status .....	A-58
A.3.3.1.2.5	Reserved Bits .....	A-59
A.3.3.1.2.6	Text Data Field.....	A-59
A.3.3.1.3	TWGO Graphical Overlay Record.....	A-59
A.3.3.1.3.1	Overlay Record Length.....	A-60
A.3.3.1.3.2	Report Number.....	A-60
A.3.3.1.3.3	Report Year .....	A-60
A.3.3.1.3.4	Record Applicability Year .....	A-60
A.3.3.1.3.5	Overlay Record Identifier .....	A-61
A.3.3.1.3.6	Object Label Flag.....	A-61
A.3.3.1.3.7	Object Label.....	A-61
A.3.3.1.3.8	Object Type.....	A-61
A.3.3.1.3.9	Object Element Flag.....	A-62
A.3.3.1.3.10	Object Element.....	A-62
A.3.3.1.3.11	Object Status .....	A-62
A.3.3.1.3.12	Object Qualifier Flag.....	A-63
A.3.3.1.3.13	Object Qualifier.....	A-63
A.3.3.1.3.14	Object Parameter Flag.....	A-63
A.3.3.1.3.15	Record Applicability Options .....	A-63
A.3.3.1.3.16	Date/Time Format .....	A-64
A.3.3.1.3.17	Record Applicability Start and End .....	A-65
A.3.3.1.3.18	Overlay Geometry Options .....	A-66
A.3.3.1.3.18.1	Extended Range Three-Dimensional Polygon.....	A-67
A.3.3.1.3.18.2	Extended Range Circular Prism.....	A-67
A.3.3.1.3.18.3	Extended Range 3D Point.....	A-69
A.3.3.1.3.18.4	Extended Range 3D Polyline .....	A-69
A.3.3.1.3.18.5	Angular Weighted Binary Encoding of Latitude and Longitude .....	A-70
A.3.3.1.3.19	Overlay Operator.....	A-73
A.3.3.1.3.20	Guidance for Decoding and Rendering Overlay Geometries.....	A-73
A.3.3.1.3.20.1	3D Polygons.....	A-73

A.3.3.1.3.20.1.1	Overlay Operator set to 0	A-73
A.3.3.1.3.20.1.2	Overlay Operator set to 1	A-74
A.3.3.1.3.20.2	Circular Prisms	A-75
A.3.3.1.3.20.2.1	Overlay Operator set to 0	A-75
A.3.3.1.3.20.2.2	Overlay Operator set to 1	A-75
A.3.3.1.3.20.3	3D Points	A-76
A.3.3.1.3.20.4	3D Polylines	A-76
A.3.3.1.3.21	Overlay Vertices Count	A-76
A.3.3.1.3.22	Overlay Vertices List	A-77
A.3.3.2	NOTAMs and Product Updates Unavailable (Products #8, #16, and #17)	A-77
A.3.3.2.1	APDU Header	A-77
A.3.3.2.2	Text Record Payload Example	A-78
A.3.3.2.3	Graphical Record Payload Example	A-78
A.3.3.2.4	NOTAMs Specific Notes	A-78
A.3.3.2.4.1	APDU Timestamp	A-78
A.3.3.2.4.2	Formatting of NOTAM Text Records	A-79
A.3.3.2.4.3	NOTAM Numbering	A-80
A.3.3.2.4.4	Retransmit Schedule for Text Record of NOTAM-TFR	A-80
A.3.3.2.4.5	Purging of NOTAMs by the FIS-B Ground System	A-81
A.3.3.2.4.6	Encoded Geographical Coordinates	A-81
A.3.3.2.4.7	Identifying NOTAM Status by Record Applicability Field	A-82
A.3.3.2.4.8	NOTAMs Recurring Daily	A-83
A.3.3.2.5	FIS-B Product Updates Unavailable Report	A-83
A.3.3.2.5.1	Purpose	A-83
A.3.3.2.5.2	Format of FIS-B Product Updates Unavailable Report Text	A-84
A.3.3.3	AIRMET (Product #11)	A-86
A.3.3.3.1	APDU Header	A-86
A.3.3.3.2	Text Record Payload Example	A-86
A.3.3.3.3	Graphical Record Payload Example	A-86
A.3.3.3.4	Product Specific Notes	A-87
A.3.3.3.4.1	APDU Timestamp	A-87
A.3.3.3.4.2	Modification of Text AIRMET Header by FIS-B Ground System	A-87
A.3.3.3.4.3	“Outlook” Portion of AIRMET	A-87
A.3.3.3.4.4	Updates to AIRMET	A-88
A.3.3.4	SIGMET/WST (Product #12)	A-88
A.3.3.4.1	APDU Header	A-88
A.3.3.4.2	Text Record Payload Example	A-89
A.3.3.4.3	Graphical Record Payload Example	A-89
A.3.3.4.4	Product Specific Notes	A-89
A.3.3.4.4.1	APDU Timestamp	A-89
A.3.3.4.4.2	Modification of Text SIGMET/WST Header by FIS-B Ground System	A-89
A.3.3.4.4.3	“Outlook” Portion of SIGMET/WST	A-90

A.3.3.4.4.4	Updates to SIGMET.....	A-90
A.3.3.5	G-AIRMET (Product ID #14) .....	A-90
A.3.3.5.1	G-AIRMET Issue and Valid Timing.....	A-91
A.3.3.5.1.1	Determining G-AIRMET Forecast .....	A-92
A.3.3.5.2	G-AIRMET APDU Header .....	A-93
A.3.3.5.3	G-AIRMET Product Updates Unavailable.....	A-93
A.3.3.5.4	G-AIRMET TWGO Payload Header .....	A-93
A.3.3.5.5	G-AIRMET TWGO Graphic Record .....	A-93
A.3.3.5.5.1	G-AIRMET Report Number and Report Year.....	A-93
A.3.3.5.5.2	G-AIRMET Overlay Record Identifier .....	A-93
A.3.3.5.5.3	G-AIRMET Object Fields and Flags .....	A-93
A.3.3.5.5.4	G-AIRMET Record Applicability Fields.....	A-96
A.3.3.5.5.5	G-AIRMET Geometry Types .....	A-96
A.3.3.6	CWA Product ID #15 .....	A-96
A.3.3.6.1	CWA Issue and Valid Timing .....	A-96
A.3.3.6.2	CWA APDU Header .....	A-96
A.3.3.6.3	CWA Product Updates Unavailable.....	A-97
A.3.3.6.4	CWA TWGO Payload Header .....	A-97
A.3.3.6.5	CWA TWGO Text Record Encoding.....	A-97
A.3.3.6.6	CWA TWGO Graphic Record Encoding.....	A-97
A.3.3.6.6.1	CWA Overlay Record Identifier .....	A-97
A.3.3.6.6.2	CWA Object Fields and Flags.....	A-97
A.3.3.6.6.3	CWA Record Applicability Fields.....	A-97
A.3.3.6.6.4	CWA Geometry Types.....	A-98
A.4	Current Report List .....	A-98
A.4.1	CRL Header Encoding.....	A-99
A.4.1.1	Product ID.....	A-99
A.4.1.2	TFR.....	A-100
A.4.1.3	Reserved .....	A-100
A.4.1.4	O Flag .....	A-100
A.4.1.5	L Flag.....	A-100
A.4.1.6	Product Range.....	A-100
A.4.1.7	LocID.....	A-100
A.4.1.8	Number of CRL Items Listed .....	A-100
A.4.2	CRL Payload Encoding.....	A-101
A.4.2.1	Reserved Bit .....	A-101
A.4.2.2	Report Month or Year.....	A-101
A.4.2.3	Text.....	A-101
A.4.2.4	Graphic .....	A-101
A.4.2.5	Report Number .....	A-101
<b>APPENDIX B FIS-B REPORT PRINCIPLES .....</b>		<b>B-1</b>

B.1	FIS-B Report Hierarchy .....	B-1
B.1.1	FIS-B Report.....	B-1
B.1.2	Record.....	B-1
B.1.3	Field .....	B-1
B.2	Relationship of FIS-B Reports to APDU and to Records by Product.....	B-1
B.3	Guidance for Maintaining a Complete and Unique Set of FIS-B Reports .....	B-3
B.3.1	Processing Segmented APDUs .....	B-3
B.3.2	Processing FIS-B Generated Report Numbers.....	B-3
B.3.3	Processing FIS-B Reports for NOTAMs .....	B-4
B.3.4	Processing FIS-B Reports for Generic Text Products .....	B-5
B.3.5	Processing FIS-B Reports for Global Block Representation Products .....	B-6
<b>APPENDIX C FIS-B PRODUCT UPDATE AND TRANSMISSION INTERVALS .....</b>		<b>C-1</b>
C.1	FIS-B Transmission Interval.....	C-1
C.2	FIS-B Update Interval.....	C-1
<b>APPENDIX D FIS-B RADIO STATION TIERING.....</b>		<b>D-1</b>
D.1	Introduction.....	D-1
D.2	Cellular and Tiering Concept.....	D-1
D.2.1	Cellular Channel Reuse.....	D-1
D.2.2	Tiered Cellular Assignment.....	D-2
D.2.2.1	Tier Altitude Range .....	D-2
D.2.2.2	Tier Implementation .....	D-3
D.2.2.2.1	High Tier .....	D-3
D.2.2.2.2	Medium Tier.....	D-3
D.2.2.2.3	Low Tier.....	D-4
D.2.2.2.4	Surface Assignments .....	D-5
D.3	Data Channel Assignments .....	D-5
<b>APPENDIX E BACKGROUND ON THE NEXRAD PRODUCTS.....</b>		<b>E-1</b>
E.1	NEXRAD Network .....	E-1
E.2	NEXRAD Processing for Uplink .....	E-1
<b>APPENDIX F UPLINK OF CURRENT REPORT LIST .....</b>		<b>F-1</b>
F.1	Background .....	F-1
<b>APPENDIX G GROUND RADIO STATION MEDIA ACCESS FOR FIS-B UPLINK.....</b>		<b>G-1</b>
<b>APPENDIX H UPLINK OF SPECIAL USE AIRSPACE (PRODUCT #13).....</b>		<b>H-1</b>
<b>APPENDIX I UPDATING NEXRAD AND LIGHTNING GLOBAL BLOCK DATA .....</b>		<b>I-1</b>

<b>APPENDIX J FIELD UPDATEABILITY OF FIS-B AVIONICS AND TECHNICAL SUPPORT.....</b>	<b>J-1</b>
J.1 Adaptations .....	J-1
J.1.1 Radio Station Look-Ahead Ranges.....	J-1
J.1.2 Product Tailoring .....	J-1
J.1.3 Product Transmission Interval .....	J-1
J.2 Enhancements .....	J-2
J.2.1 Potential Product Changes .....	J-2
J.3 Technical Support .....	J-2
J.3.1 Error Reporting .....	J-2
<b>APPENDIX K EQUIPMENT CLASS TO REQUIREMENT MAPPING.....</b>	<b>K-1</b>
<b>APPENDIX L DEFINITION OF THE REFERENCE RECEPTION SUCCESS RATE .....</b>	<b>L-1</b>
<b>APPENDIX M DO-358B CHANGE SUGGESTION FORM .....</b>	<b>M-1</b>

## TABLE OF FIGURES

Figure 1-1: High-level Data Flows Supporting FIS-B.....	4
Figure 2-1: Basic Test Setup.....	51
Figure A-1: UAT Ground Uplink Header Message Byte-Level Format .....	A-1
Figure A-2: Angular Weighted 24-Bit Binary Encoding of Latitude and Longitude .....	A-4
Figure A-3: Decomposition of the Application Data.....	A-6
Figure A-4: UAT Frame Byte-Level Format.....	A-7
Figure A-5: Decomposition of the Frame Data.....	A-9
Figure A-6: APDU Header Bit Level Format—No Segmentation .....	A-9
Figure A-7: APDU Header Bit Level Format When Segmentation Block Present .....	A-10
Figure A-8: APDU Header Bit Level Format—Generic Text .....	A-17
Figure A-9: Generic Text Record Byte-Level Format.....	A-17
Figure A-10: APDU Header Time Bit Level Format.....	A-18
Figure A-11: Example of WINDS Text Report as Uplinked.....	A-19
Figure A-12: WINDS Report Example as it May Appear on Display.....	A-20
Figure A-13: WINDS Report Example When Altitudes are Missing as it May Appear on Display .....	A-20
Figure A-14: Run Length Encoding Blocks Showing Constituent Bins.....	A-22
Figure A-15: Global Block Numbering Plan .....	A-23
Figure A-16: Decomposition Showing Global Block Product Formatting.....	A-24
Figure A-17: Block Reference Indicator Byte-Level Format .....	A-24
Figure A-18: Product Specific Bits Encoding Type 1 .....	A-25
Figure A-19: Product Specific Bits Encoding Type 2 .....	A-26
Figure A-20: Global Block Numbering Scheme by Scale Factor.....	A-27
Figure A-21: Run Length Encoded Element Byte-Level Format .....	A-28
Figure A-22: Empty Element Byte-Level Format .....	A-29
Figure A-23: Regional NEXRAD APDU Header Bit Level Format.....	A-32
Figure A-24: NEXRAD Product Run Encoding.....	A-32
Figure A-25: Example Block Containing 10 Runs .....	A-33
Figure A-26: CONUS NEXRAD APDU Header Bit Level Format.....	A-34
Figure A-27: Turbulence Product Timeline.....	A-38

Figure A-28: Turbulence Product Run Length Encoding for Single Byte Runs .....	A-38
Figure A-29: Turbulence Product Run Length Encoding for Two Byte Runs .....	A-39
Figure A-30: Example Block Containing Six Runs.....	A-39
Figure A-31: Icing Product Timeline.....	A-44
Figure A-32: Icing Product Run Encoding .....	A-44
Figure A-33: Example Block Containing Six Runs (Decimal values listed in order of Icing Probability, Icing Severity, SLD) .....	A-45
Figure A-34: Cloud Tops Product Timeline .....	A-48
Figure A-35: Cloud Tops Product Run Length Encoding for Single Byte Runs.....	A-49
Figure A-36: Cloud Tops Product Run Length Encoding for Two Byte Runs.....	A-49
Figure A-37: Example Block Containing Six Runs (Cloud Tops Height Value Listed as Decimal) .....	A-49
Figure A-38: Lightning Product Run Encoding.....	A-52
Figure A-39: Example Block Containing 12 Runs (Polarity: Strike Count as Decimal Values).....	A-53
Figure A-40: Decomposition Showing TWGO FIS-B Payload.....	A-55
Figure A-41: TWGO Header Byte-Level Format.....	A-56
Figure A-42: Text Record Byte-Level Format .....	A-57
Figure A-43: Graphical Record Byte-Level Format .....	A-59
Figure A-44: Record Applicability Byte-Level Format.....	A-65
Figure A-45: Extended Range Circular Prism .....	A-68
Figure A-46: Example of 3D Polygon with Mixed Altitude Reference Datums .....	A-75
Figure A-47: Example of Circular Prism with Mixed Altitude Reference Datums.....	A-76
Figure A-48: Example of a Unique Report with Multiple Record Applicability Times.....	A-83
Figure A-49: G-AIRMET Issuance Timeline .....	A-91
Figure A-50: Object Qualifier.....	A-95
Figure A-51: Decomposition Showing the CRL.....	A-98
Figure A-52: CRL Encoding.....	A-99
Figure D-1: Example of Three-Cell Reuse Pattern.....	D-2
Figure D-2: Tier Altitude Range.....	D-2
Figure D-3: FIS-B High Tier .....	D-3
Figure D-4: FIS-B Medium Tier.....	D-4
Figure D-5: FIS-B Low Tier.....	D-5

Figure E-1: CONUS NEXRAD Network ..... E-1  
Figure F-1: Example of CRL Construction..... F-3  
Figure G-1: Relationship of “Data Channel Numbers” to Transmission Time Slot Numbers .....G-2

## TABLE OF TABLES

Table 1-1: Acronyms and Abbreviations .....	9
Table 2-1: FIS-B Equipment Classes.....	16
Table 2-2: FIS-B Products According to Product Class .....	19
Table 2-3: Generic Text Product Latency.....	22
Table 2-4: Regional NEXRAD Color Use.....	25
Table 2-5: CONUS NEXRAD Color Use.....	27
Table 2-6: CRL Completeness Determination.....	45
Table 2-7: Environmental Test Groups.....	47
Table 2-8: Performance Test Requirements during Environmental Tests .....	48
Table 2-9: Expected Radio Station RSR during Environmental Tests .....	49
Table 2-10: Test Group 1 Requirements.....	52
Table 2-11: Test Group 2 Requirements.....	52
Table 2-12: Test Group 3 Requirements.....	52
Table 2-13: Test Group 4 Requirements.....	53
Table 2-14: Test Group 5 Requirements.....	53
Table 2-15: Test Group 6 Requirements.....	54
Table 2-16: Test Group 7 Requirements.....	54
Table 2-17: Test Group 8 Requirements.....	54
Table 2-18: Test Group 9 Requirements.....	55
Table 2-19: Test Group 10 Requirements.....	55
Table 2-20: Test Group 11 Requirements.....	55
Table 2-21: Test Group 12 Requirements.....	56
Table 2-22: Test Group 13 Requirements.....	56
Table 2-23: Test Group 14 Requirements.....	57
Table 2-24: Test Group 15 Requirements.....	57
Table 2-25: Test Group 16 Requirements.....	57
Table 2-26: Test Group 17 Requirements.....	58
Table 2-27: Test Group 18 Requirements.....	58
Table 2-28: Test Group 19 Requirements.....	58

Table 2-29: Test Group 20 Requirements.....	59
Table 2-30: Test Group 21 Requirements.....	59
Table 2-31: Test Group 22 Requirements.....	59
Table 2-32: Test Group 23 Requirements.....	60
Table 2-33: Test Group 24 Requirements.....	60
Table 2-34: Test Group 25 Requirements.....	60
Table 2-35: Test Group 26 Requirements.....	61
Table 2-36: Test Group 27 Requirements.....	61
Table 2-37: Requirements Verification Summary .....	61
Table A-1: Angular Weighted 24-Bit Binary Encoding of Latitude and Longitude .....	A-3
Table A-2: Frame Type Field Encoding .....	A-8
Table A-3: APDU Header Breakdown .....	A-10
Table A-4: Header Time .....	A-11
Table A-5: Time Options .....	A-12
Table A-6: Generic Text Encoding.....	A-14
Table A-7: Text Record Elements .....	A-16
Table A-8: Generic Text Product Truncation Example .....	A-19
Table A-9: Timing of the WINDS Forecast Periods.....	A-20
Table A-10: Scale Factor Encoding .....	A-26
Table A-11: Determining the Increment.....	A-30
Table A-12: Bit Map Blocks.....	A-30
Table A-13: Run Encoding for Example Block.....	A-33
Table A-14: Regional NEXRAD Data Encoding .....	A-34
Table A-15: CONUS NEXRAD Data Encoding .....	A-35
Table A-16: Turbulence-Low Product Altitude Level Encoding.....	A-37
Table A-17: Turbulence-High Product Altitude Level Encoding.....	A-37
Table A-18: Run Encoding for Example Block.....	A-40
Table A-19: Turbulence Data Encoding .....	A-40
Table A-20: Icing-Low Product Altitude Level Encoding .....	A-42
Table A-21: Icing-High Product Altitude Level Encoding.....	A-43

Table A-22: Run Encoding for Icing Example Block.....	A-45
Table A-23: Icing Severity Encoding .....	A-46
Table A-24: Icing Probability Encoding.....	A-46
Table A-25: SLD Potential Encoding .....	A-47
Table A-26: Run Encoding for Cloud Tops Height Example Block .....	A-50
Table A-27: Cloud Tops Data Encoding.....	A-51
Table A-28: Run Encoding for Lightning Example Block .....	A-53
Table A-29: Strike Count Encoding.....	A-54
Table A-30: Polarity Encoding .....	A-54
Table A-31: Record Format Options .....	A-56
Table A-32: Report Status .....	A-58
Table A-33: Report Year & Record Applicability Year Example .....	A-60
Table A-34: Object Types.....	A-62
Table A-35: Airspace Object Elements .....	A-62
Table A-36: Object Status.....	A-63
Table A-37: Record Applicability Options .....	A-64
Table A-38: Date/Time Format.....	A-65
Table A-39: Overlay Geometry Options.....	A-66
Table A-40: Overlay Geometry Encoding .....	A-70
Table A-41: Angular Weighted Binary Encoding of Latitude and Longitude.....	A-71
Table A-42: Angular Weighted Binary 19-Bit Encoding of Latitude and Longitude .....	A-72
Table A-43: Overlay Operator Encodings .....	A-73
Table A-44: NOTAM APDU Header Example .....	A-78
Table A-45: NOTAM Text Record Elements.....	A-79
Table A-46: FIS-B Product Update Unavailable Report Text Elements .....	A-84
Table A-47: AIRMET APDU Header Example .....	A-86
Table A-48: Text AIRMET Header Record Elements.....	A-87
Table A-49: SIGMET/WST APDU Header Example .....	A-88
Table A-50: SIGMET/WST Header Text Record Elements.....	A-90
Table A-51: G-AIRMET Regular Issuance Uplink Cycle.....	A-91

Table A-52: G-AIRMET Forecast Hour Determination .....	A-92
Table A-53: G-AIRMET Hazard Conditions.....	A-94
Table A-54: G-AIRMET Mountain Obscuration & IFR Conditions.....	A-95
Table B-1: Relationships of FIS-B Reports to APDU and to Records .....	B-1
Table B-2: Example Report Number Ranges .....	B-4
Table B-3: Report Number Ranges for FIS-B NOTAMs .....	B-5
Table B-4: Recommended Tag for Unique Identification of Generic Text Products .....	B-6
Table C-1: FIS-B Product Transmission Intervals.....	C-1
Table C-2: FIS-B Product Update Intervals.....	C-2
Table F-1: CRL Availability by Product Name .....	F-1
Table G-1: Transmission Time Slot Definition for the UAT Ground Segment.....	G-1
Table G-2: UAT Channel Rotation Adjustment for Leap Second.....	G-3
Table K-1: FIS-B Equipment Class to Requirement Number Mapping .....	K-1
Table L-1: Sample Number of Uplink Messages Received Over 10-Seconds .....	L-1

---

# 1 PURPOSE AND SCOPE

## 1.1 Introduction

This document contains Minimum Operational Performance Standards (MOPS) for Flight Information Services – Broadcast (FIS-B) system with Universal Access Transceiver (UAT). These standards specify system characteristics that should be useful to designers, manufacturers, installers and users of the equipment.

Compliance with these standards is recommended as one means of assuring that the equipment will perform its intended function(s) satisfactorily under all conditions normally encountered in routine aeronautical operation. Any regulatory application of this document is the sole responsibility of appropriate governmental agencies.

This document considers an equipment configuration consisting of the airborne processing and cockpit display of aeronautical and meteorological data known as FIS-B provided by the Federal Aviation Administration (FAA).<sup>1</sup> Functions or components that refer to equipment capabilities that exceed the stated minimum requirements are identified as optional features.

Section 1 of this document provides information needed to understand the rationale for equipment characteristics and requirements stated in the remaining sections. It describes typical equipment operations and operation goals, as envisioned by the members of Special Committee 206 (SC-206), and establishes the basis for the standards stated in Section 2. Definitions and assumptions essential to proper understanding of this document are also provided in this section.

Section 2 contains the minimum performance standards for the equipment. These standards specify the required performance under standard environmental conditions. Also included are recommended bench test procedures necessary to demonstrate equipment compliance with the stated minimum requirements.

Section 3 describes the performance required of installed equipment. Tests for the installed equipment are included when performance cannot be adequately determined through bench testing.

Section 4 contains a description of the relationship between the aircraft characteristics and the FIS-B equipment conforming to this MOPS.

Section 5 lists the members of SC-206 who developed the document.

APPENDIX A, a normative appendix, provides formatting and encoding details of FIS-B Uplink Products, including the UAT Ground Uplink Message formatting, the Application

---

<sup>1</sup> The FIS-B service is part of the FAA's Surveillance and Broadcast Services System (SBSS).