



Department of Transportation
Federal Aviation Administration
Aircraft Certification Service
Washington, D.C.

TSO-C157a

Effective
Date: 9/9/11

Technical Standard Order

Subject: AIRCRAFT FLIGHT INFORMATION SERVICES-BROADCAST (FIS-B) DATA LINK SYSTEMS AND EQUIPMENT

1. **PURPOSE.** This technical standard order (TSO) is for manufacturers applying for a TSO authorization or letter of design approval (LODA). In it, we, (the Federal Aviation Administration, (FAA)) tell you what minimum performance standards (MPS) your Aircraft Flight Information Services-Broadcast (FIS-B) Data Link Systems and Equipment must first meet for approval and identification with the applicable TSO marking.
2. **APPLICABILITY.** This TSO affects new applications submitted after its effective date.
 - a. All prior revisions to this TSO are no longer effective. Generally, we will not accept applications for the previous revision after the effective date of this TSO. We may do so, however, up to six months after it, if we know that you were working against the prior MPS before the new change became effective.
 - b. Aircraft FIS-B data link systems and equipment approved under a previous TSO authorization may still be manufactured under the provisions of its original approval.
3. **REQUIREMENTS.** New models of FIS-B data link systems and equipment identified and manufactured on or after the effective date of this TSO must meet the MPS qualification and documentation requirements identified in Table 1 of this TSO.

Table 1. Equipment Classes for FIS-B

Equipment Class	Equipment Name	Functionality
1	FIS-B Equipment using Universal Access Transceiver (UAT) and Interoperable with the Surveillance and Broadcast Services (SBS) Provider	RTCA, Inc., Document No. (RTCA/DO)-267A, <i>Minimum Aviation System Performance Standards (MASPS) for Flight Information Services-Broadcast (FIS-B) Data Link</i> , Revision A, dated April 4, 2004, Sections 2 and 3, with amendments per Appendix 1 of this TSO.
2	FIS-B Equipment not Interoperable with the SBS Provider	RTCA/DO-267A Section 2 (except 2.1.4; 2.2.12; and 2.2.13) and Section 3.8.

a. Functionality. This TSO's standards apply to equipment intended to display weather and other non-control flight advisory information to pilots in a manner that will enhance their awareness of the flight conditions.

b. Failure Condition Classifications. Loss or malfunction of the function defined in paragraph **3.a** of this TSO is a minor failure condition. Design the system to at least this failure condition classification.

c. Functional Qualification. Demonstrate the required functional performance under the test conditions specified in RTCA/DO-267A Section 4.

d. Environmental Qualification. Demonstrate the required performance using standard environmental conditions and test procedures appropriate for airborne equipment.

Note: The use of RTCA/DO-160D (with Changes 1 and 2 only, incorporated) or earlier versions is generally not considered appropriate and will require substantiation via the deviation process as discussed in paragraph **3.f** of this TSO.

e. Software Qualification. If the article includes software, develop the software according to RTCA, Inc. document RTCA/DO-178B, *Software Considerations in Airborne Systems and Equipment Certification*, dated December 1, 1992, to the design assurance level consistent with the failure condition classification defined in paragraph **3.b** of this TSO.

Note: The certification liaison process objectives will be considered satisfied after FAA review of the applicable life cycle data.

f. Deviations. We have provisions for using alternate or equivalent means of compliance to the criteria in the MPS of this TSO. If you invoke these provisions, you must show that your

equipment maintains an equivalent level of safety. Apply for a deviation under the provision of 14 CFR § 21.618.

4. MARKING.

a. Mark at least one major component permanently and legibly with all the information in 14 CFR § 45.15(b). The marking must include the serial number.

b. Also, mark the following permanently and legibly, with at least the manufacturer's name, subassembly part number, and the TSO number:

(1) Each component that is easily removable (without hand tools), and

(2) Each subassembly of the article that you determined may be interchangeable.

c. If the article includes software and/or airborne electronic hardware, then the article part numbering scheme must identify the software and airborne electronic hardware configuration. The part numbering scheme can use separate, unique part numbers for software, hardware, and airborne electronic hardware

d. You may use electronic part marking to identify software or electronic hardware components by embedding the identification within the hardware component itself (using software) rather than marking it on the equipment nameplate. If electronic marking is used, it must be readily accessible without the use of special tools or equipment.

5. APPLICATION DATA REQUIREMENTS. You must give the FAA aircraft certification office (ACO) manager responsible for your facility a statement of conformance, as specified in 14 CFR § 21.603(a)(1) and one copy each of the following technical data to support your design and production approval. LODA applicants must submit the same data (excluding paragraph **5.g**) through their civil aviation authority.

a. A Manual(s) containing the following:

(1) Operating instructions and equipment limitations sufficient to describe the equipment's operational capability.

The Operating Manual should state the following:

“FIS-B information is to be used for pilot planning decisions and pilot near-term decisions focused on avoiding areas of inclement weather that are beyond visual range or where poor visibility precludes visual acquisition of inclement weather. FIS-B weather and NAS status information may be used as follows:

(a) To promote pilot awareness of own ship location with respect to reported weather, including hazardous meteorological conditions, NAS status indicators, and enhance pilot planning decisions and pilot near-term decision-making.

(b) To cue the pilot to communicate with the Air Traffic Control controller, Flight Service Station specialist, operator dispatch, or airline operations control center for general and mission critical meteorological information, NAS status conditions, or both.

FIS-B information, including, weather information, NOTAMs, and TFR areas, are intended for the sole purpose of assisting in long- and near-term planning decision making. The system lacks sufficient resolution and updating capability necessary for aerial maneuvering associated with immediate decisions.”

(2) Describe in detail any deviations.

(3) Installation procedures and limitations sufficient to ensure that the aircraft FIS-B data link systems and equipment, when installed according to the installation or operational procedures, still meets this TSO’s requirements. Limitations must identify any unique aspects of the installation. The limitations must include a note with the following statement:

“This article meets the minimum performance and quality control standards required by a technical standard order (TSO). Installation of this article requires separate approval.”

(4) For each unique configuration of software and airborne electronic hardware, reference the following:

- (a) Software part number including revision and design assurance level;
- (b) Airborne electronic hardware part number including revision and design assurance level;
- (c) Functional description; and,
- (d) Failure condition classification.

(5) A summary of the test conditions used for environmental qualifications for each component of the article. For example, a form as described in RTCA/DO-160G, *Environmental Conditions and Test Procedures for Airborne Equipment*, Appendix A.

(6) Schematic drawings, wiring diagrams, and any other documentation necessary for installation of the FIS-B data link systems and equipment.

(7) List of replaceable components, by part number, that makes up the FIS-B data link systems and equipment. Include vendor part number cross-references, when applicable.

b. Instructions covering periodic maintenance, calibration, and repair, for the continued airworthiness of FIS-B data link systems and equipment. Include recommended inspection intervals and service life, as appropriate.

c. If the article includes software: a plan for software aspects of certification (PSAC), software configuration index, and software accomplishment summary.

- d.** Nameplate drawing with the information required by paragraph **4** of this TSO.
- e.** Identify functionality or performance contained in the article not evaluated under paragraph **3** of this TSO (that is, non-TSO functions). Non-TSO functions are accepted in parallel with the TSO authorization. For those non-TSO functions to be accepted, you must declare these functions and include the following information with your TSO application:
 - (1)** Description of the non-TSO function(s), such as performance specifications and software, hardware, and environmental qualification levels. Include a statement confirming that the non-TSO function(s) don't interfere with the article's compliance with the requirements of paragraph **3**.
 - (2)** Installation procedures and limitations sufficient to ensure that the non-TSO function(s) meets the declared functions and performance specification(s) described in paragraph **5.e.(1)**.
 - (3)** Instructions for continued performance applicable to the non-TSO function(s) described in paragraph **5.e.(1)**.
 - (4)** Interface requirements and applicable installation test procedures to ensure compliance with the performance data defined in paragraph **5.e.(1)**.
 - (5)** Test plans, analysis and results, as appropriate, to verify that performance of the hosting TSO article is not affected by the non-TSO function(s).
 - (6)** Test plans, analysis and results, as appropriate, to verify the function and performance of the non-TSO function(s) as described in paragraph **5.e.(1)**.
- f.** The quality system description required by 14 CFR § 21.607, including functional test specifications. The quality system should ensure that you will detect any change to the approved design that could adversely affect compliance with the TSO MPS, and reject the article accordingly. (Not required for LODA applicants.)
- g.** Material and process specifications list.
- h.** List of all drawings and processes (including revision level) that define the article's design.
- i.** Manufacturer's TSO qualification report showing results of testing accomplished according to paragraph **3.c** of this TSO.

6. MANUFACTURER DATA REQUIREMENTS. Besides the data given directly to the responsible ACO, have the following technical data available for review by the responsible ACO:

- a.** Functional qualification specifications for qualifying each production article to ensure compliance with this TSO.

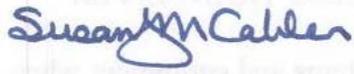
- b. Equipment calibration procedures.
- c. Schematic drawings.
- d. Wiring diagrams.
- e. Material and process specifications.
- f. The results of the environmental qualification tests conducted according to paragraph **3.d** of this TSO.
- g. If the article includes software, the appropriate documentation defined in RTCA/DO-178B including all data supporting the applicable objectives in RTCA/DO-178B *Annex A, Process Objectives and Outputs by Software Level*.
- h. If the article contains non-TSO function(s), you must also make available items **6.a** through **6.g** as they pertain to the non-TSO function(s).

7. FURNISHED DATA REQUIREMENTS.

- a. If furnishing one or more articles manufactured under this TSO to one entity (such as an operator or repair station), provide one copy or on-line access to the data in paragraphs **5.a** and **5.b** of this TSO. Add any other data needed for the proper installation, certification, use, or for continued compliance with the TSO, of the aircraft FIS-B systems and equipment.
- b. If the article contains declared non-TSO function(s), include one copy of the data in paragraphs **5.e.(1)** through **5.e.(4)**.

8. HOW TO GET REFERENCED DOCUMENTS.

- a. Order RTCA documents from RTCA Inc., 1150 18th Street NW, Suite 910, Washington, D.C. 20036. Telephone (202) 833-9339, fax (202) 833-9434. You can also order copies online at www.rtca.org.
- b. Order SAE documents from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001. Telephone (724) 776-4970, fax (724) 776-0790. You can also order copies online at www.sae.org.
- c. Order copies of 14 CFR parts 21 and 45 from the Superintendent of Documents, Government Printing Office, P.O. Box 979050, St. Louis, MO 63197. Telephone (202) 512-1800, fax (202) 512-2250. You can also order copies online at www.access.gpo.gov. Select "Access," then "Online Bookstore." Select "Aviation," then "Code of Federal Regulations."
- d. You can find a current list of technical standard orders and advisory circulars on the FAA Internet website Regulatory and Guidance Library at <http://rgl.faa.gov/>. You will also find the TSO Index of Articles at the same site.

A handwritten signature in blue ink that reads "Susan J. M. Cabler". The signature is written in a cursive style with a large, stylized initial "S".

Susan J. M. Cabler
Assistant Manager, Aircraft Engineering
Division

APPENDIX 1. AMENDMENTS TO THE MINIMUM PERFORMANCE STANDARD FOR EQUIPMENT PROVIDING FIS-B VIA THE UNIVERSAL ACCESS TRANCEIVER

This appendix prescribes addendums to the MPS for aircraft FIS-B systems and equipment when using the Surveillance Broadcast Services system.

1.1 RTCA/DO-267A. The applicable standard is RTCA/DO-267A Sections 2 and 3. We modified it as follows:

1.1.1 Page 19, 3.6.2.3, Reassembly of Linked Application Protocol Data Units (APDU) to Form an FIS-B Product File, Paragraph 3, Sentence 1, reads as follows:

Change from:

...Separate APDU sequences are maintained for each Product and ground station combination for which linked APDUs are transmitted.

To:

... Separate APDU sequences are maintained for each Product and *each Product File ID* or ground station combination for which linked APDUs are transmitted.

1.1.2 Appendix D, Page D-1, Paragraph 2, Sentence 1:

Change from:

...The APDU structure shall begin with an APDU Header consisting of data fields as shown in Table D-1.

To:

... The APDU structure shall begin with an APDU Header consisting of data fields as shown in Table D-1, except the UAT transmission of the APDU header does not include the 16-bit FIS-B APDU ID field.

1.1.3 Appendix D, Page D-1, Table D-1 FIS-B APDU Header Format, replace Header Time rows as follows:

Change From:

Head Time	22 – 37 bits	Section D.4
Time Option Bits	2 bits	
Date (optional)	9 bits (if included)	
Month of Year	4 bits	
Day of month	5 bits	
UTC Time Hours	5 bits	
Time Minutes	6 bits	
Time Seconds (optional)	6 bits (if included)	

To:

Head Time	13 – 22 bits	Section D.4
Time Option Bits	2 bits	
Month of Year (<i>optional</i>)	4 bits (<i>if included</i>)	
Day of month (<i>optional</i>)	5 bits (<i>if included</i>)	
UTC Time Hours	5 bits	
Time Minutes	6 bits	
Time Seconds (<i>optional</i>)	6 bits (<i>if included</i>)	

1.1.4 Appendix D, Page D-1, amend the Segmentation Data Block entries and add a new Product File ID entry in Table D-1 to read as follows:

Change from:

Field	Number of Bits	Document Section
Product File Length	12 bits	
Number	12 bits	
Zero Padding Bits	0-7 bits to force octet-alignment	Section D.6

To:

Field	Number of Bits	Document Section
<i>Product File ID</i>	<i>10</i>	<i>TSO-C157a, Appendix 1, Paragraph 1.1.9</i>
<i>Product File Length</i>	<i>9</i>	<i>Section D.5.1</i>
<i>APDU Number</i>	<i>9</i>	<i>Section D.5.2</i>
Zero Padding Bits	0-7 bits to force octet-alignment	Section D.6

1.1.5 Appendix D, Page D-3, Table D-2 Format of the FIS-B Product Descriptor, reads as follows:

Change from:

Geographic Locator (region) (<i>optional</i>)	20 bits (if present)	Section D.2.4
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To :

Geographic Locator (region) (<i>optional</i>)	20 bits (if present)	Section D.2.4
<i>Latitude</i>	<i>7 bits</i>	<i>Section D.2.4</i>
<i>Longitude</i>	<i>8 bits</i>	<i>Section D.2.4</i>
<i>Extent</i>	<i>5 bits</i>	<i>Section D.2.4</i>

1.1.6 Appendix D, Page D-15, Figure D-3, Block Reference Indicator Format, reads as follows:

Change from:

Byte #	Bit Number							
	7	6	5	4	3	2	1	0
0	Element Identifier	N/S	Spare		Block Number (MSb)			
1	Block Number							
2	Block Number (LSb)							

To:

Byte #	Bit Number							
	7	6	5	4	3	2	1	0
0	Element Identifier	N/S	Scale		Block Number (MSb)			
1	Block Number							
2	Block Number (LSb)							

1.1.7 Appendix D, Page D-15, Section 2.3.5.2.2 The Block Reference Indicator, after the “Hemisphere N/S” paragraph add new paragraph to read as follows:

“Scale: an encoded multiplier applied to the base size of the GBR block in both latitude and longitude dimensions. Values represented by the Scale encoding are either system or product specific. Any mathematical calculations that are needed to reduce a high-resolution product down to a lower-resolution ‘scaled’ product are left for the implementer to separately describe/document.”

1.1.8 Appendix D, Page D-21, D.5, Segmentation Data Block, Sentence 5, reads as follows:

Change from:

...The Segmentation Data Block (if present) shall consist of two components, the Product File Length field and the APDU Number field.

To:

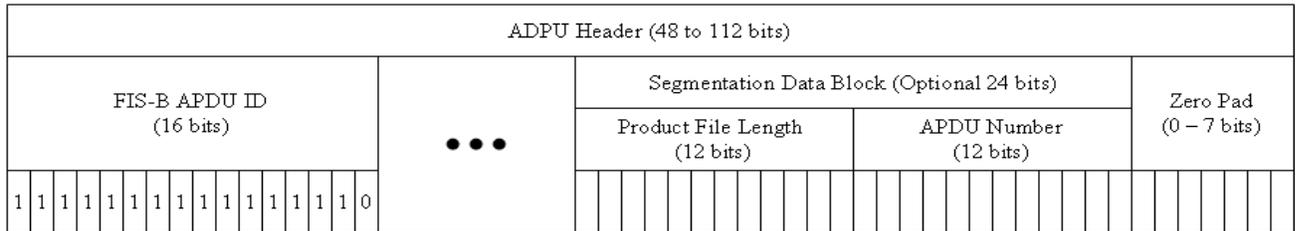
...The Segmentation Data Block (if present) shall consist of *three* components, the Product File *ID* field, Product File Length field and the APDU Number field.

1.1.9 Appendix D, Page D-21, supplement section D.5 with the following:

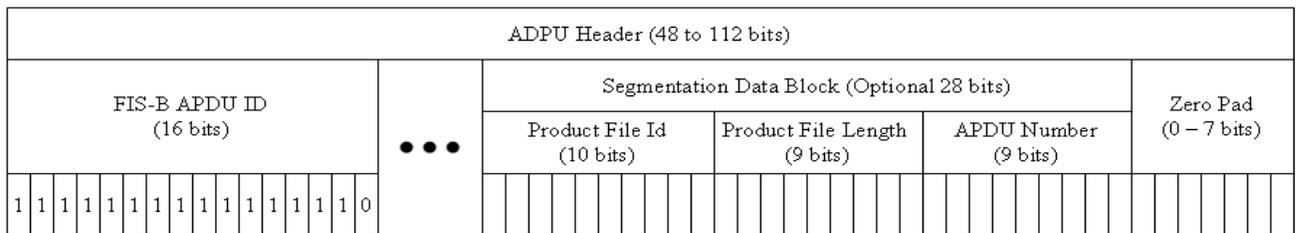
The Product File ID Field contains a reference number to associate segmented APDUs with the appropriate Product File. Such a reference is necessary when broadcasting the same APDU segments for a Product File from multiple radio stations.

1.1.10 Appendix D, Page D-23, Figure D-9 APDU Header Layouts, amend the optional Segmentation Data Block fields to read as follows:

Change from:



To:



1.1.11 Appendix D, Page D-23, Figure D-9 APDU Header Layouts, amend the APDU Header Time field text to read as follows:

Change from:

APDU Header Time (13 or 28 bits)

To:

APDU Header Time (13, 19, or 22 bits)

1.1.12 Appendix D, Page D-23, Figure D-9, APDU Header Layouts, add note to Option Flags table to read as follows:

“Note: A given APDU shall not have Time Flag #1 and Time Flag #2 set to one (1) within the same APDU Header.”

1.1.13 Appendix K, Page K-1, the last entry in Table K-1, reads as follows:

Change from:

The last entry in Table K-1 shows the encoding of the CC (Change Cipher) character as “011111.”

To:

The last entry in Table K-1 shows the encoding of the ”|” character as “011111.”

1.1.14 Appendix K, Page K-1, new note at the bottom of the table, reads as follows:

“| = The change cipher character is not used by FIS-B (per MASPS), so there is no expected impact on legacy users.”