



Government of Bermuda DCA Airworthiness Management Flight Data Recorders *Module 9*

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Requirements Prior to TC/STC

Maintenance of Flight Data Recorders – as well as Cockpit Voice Recorders – is not easy!

- *Obscure European Requirements*
- *Complexity of operating requirements e.g. mandatory parameters*
- *Mix of TC Requirements and Operating Rules*



Requirements Prior to TC/STC

At the time of certification the TC/STC applicant will be expected to demonstrate to the regulatory authority of State of Operation that they have complied with the following:

- A flight data recorder system has been installed in accordance with the agreed aircraft certification basis, taking account of the applicable operational rules.
- Evidence has been provided that demonstrates the installed FDR system meets the appropriate operational rules, including accuracy, resolution and sampling rates



Requirements of State of Operation

FDR is not equipment required for continuing safe flight and landing – *Hence Probably not addressed by MPD*

FDR, Cockpit Voice Recorders (CVR) and Emergency Locator Transmitter (ELT) are ICAO standards, essentially related to ICAO Annex 13

State of Operation is required to implement Regulations to require carriage of equipment



Requirements of State of Operation

FDR, CVR are required by ICAO Annex
6 to be 'Inspected'

➤ *Prior to first flight of day*

➤ *Annually*

*State is required to set Regulations to
require Inspections*



Requirements of State of Operation

Annual Inspection of FDR/CVR – ICAO Annex 6 Part 1 Attachment D



Requirements of State of Operation

ATTACHMENT D. FLIGHT RECORDERS

Supplementary to Chapter 6, 6.3

Introduction

The material in this Attachment concerns flight recorders intended for installation in aeroplanes engaged in international air navigation. Flight recorders comprise two systems — a flight data recorder and a cockpit voice recorder. Flight data recorders are classified as Type I, Type II and Type IIA depending upon the number of parameters to be recorded and the duration required for retention of the recorded information.

1. Flight data recorder (FDR)

1.1 General requirements

1.1.1 The FDR is to record continuously during flight time.

1.1.2 The FDR container is to:

- a) be painted a distinctive orange or yellow colour;
- b) carry reflective material to facilitate its location; and
- c) have securely attached an automatically activated underwater locating device.

1.1.3 The FDR is to be installed so that:

- a) the probability of damage to the recording is minimized. To meet this requirement it should be located as far aft as practicable. In the case of pressurized aeroplanes it should be located in the vicinity of the rear pressure bulkhead;
- b) it receives its electrical power from a bus that provides the maximum reliability for operation of the FDR without jeopardizing service to essential or emergency loads; and
- c) there is an aural or visual means for pre-flight checking that the FDR is operating properly.

1.2 Parameters to be recorded

1.2.1 *Type I FDR.* This FDR will be capable of recording, as appropriate to the aeroplane, at least the 32 parameters in Table D-1. However, other parameters may be substituted with due regard to the aeroplane type and the characteristics of the recording equipment.

1.2.2 *Types II and IIA FDRs.* These FDRs will be capable of recording, as appropriate to the aeroplane, at least the first 15 parameters in Table D-1. However, other parameters may be substituted with due regard to the aeroplane type and the characteristics of the recording equipment.

1.3 Additional information

1.3.1 A Type IIA FDR, in addition to a 30-minute recording duration, is to retain sufficient information from the preceding take-off for calibration purposes.

1.3.2 The measurement range, recording interval and accuracy of parameters on installed equipment is usually verified by methods approved by the appropriate certifying authority.

1.3.3 The manufacturer usually provides the national certifying authority with the following information in respect of the FDR:

- a) manufacturer's operating instructions, equipment limitations and installation procedures;
- b) parameter origin or source and equations which relate counts to units of measurement; and
- c) manufacturer's test reports.

1.3.4 Documentation concerning parameter allocation, conversion equations, periodic calibration and other serviceability/maintenance information should be maintained by the operator. The documentation must be sufficient to ensure that accident investigation authorities have the necessary information to read out the data in engineering units.

2. Cockpit voice recorder (CVR)

2.1 General requirements

2.1.1 The CVR is to be designed so that it will record at least the following:

- a) voice communication transmitted from or received in the aeroplane by radio;
- b) aural environment on the flight deck;



Requirements of State of Operation

Annual Inspection Requirements

- *Ensure operation correct for nominal duration*
- *Quality to ensure bit error rate is within limits and nature and distribution of errors*
- *Complete flight examined in engineering units to evaluate validity – include sensors*
- *Read out facility requires necessary software to accurately convert engineering units/status of discretetes*
- *Annual replay of CVR – include test signals from each airplane source*
- *Sample of in-flight recording of CVR*



Requirements of State of Operation

FDR, CVR, ELT not required for TC basis – Part 25

- *Partitioning of systems difficult – FDR Data Acquisition Unit sensors – could be part of integral airplane systems*
- *Maintenance analysis – MSG 3 - will not lead to ICAO annex 6 inspection requirements*
- *MRB/MPD will not address ICAO Annex 6*



Requirements of State of Operation

State of Operation will be required to implement National Regulations to meet ICAO annex 6.1 Attachment D Inspection standards

Operator Maintenance Programmes and CAW management procedures must be developed



Inspection of FDR requires

- *Dedicated Test Equipment*
- *Software*
- *Support from operator*
- *Sample flight details*
- *Airplane specific data*
- *Trained personnel*
- *Identification of Mandatory Parameters*



The flight data recorder system includes appropriately approved equipment as required by the applicable operational requirements.

- The information necessary to enable test centre to effectively conduct a readout of the FDR content is provided. As a minimum this shall include a data frame layout document together with any necessary conversion data to enable translation into engineering units.
- The information necessary to enable operators to perform scheduled tasks that demonstrate continued compliance with the certification requirements is provided. This information is expected to address the constituent parts of the FDR system



- Prior to CofA issue the operator / applicant will be expected to provide evidence that, for the individual aircraft to be certificated, the requirements in the previous slides have been met.
- The operator is also expected to demonstrate that all of the TC/STC holder's scheduled tasks referenced in slide 5 have been incorporated into their Approved Maintenance Programme



The regulatory authority will expect the operator/applicant to provide a compliance statement that demonstrates the following:

- *A Data Frame Layout Document (DFL) is available for the FDR system*
- *Conversion Data (to enable translation of FDR data to engineering units) is available for the FDR system.*
- *Procedures are in place (CAME) to provide the DFL and Conversion Data to the appropriate readout facility*



- The Approved Maintenance Programme includes the TC/STC holder's list of scheduled tasks.
- The FDR Readout from a representative flight, conducted immediately prior to C of A issue, has been evaluated to ensure that the FDR system is functioning correctly.



On-going Serviceability Assessment

- The aircraft operator/owner is responsible for ensuring the continued serviceability of the FDR system and retaining the relevant records required by the operational rules
- Detection of FDR recording anomalies may be achieved in one of two ways:
 - Analysis of recorded data.
 - A combination of scheduled maintenance tasks and analysis of recorded data.



Various stages to replaying an FDR and analysing its content, not all of which are performed solely by the readout facility or the operator. Each stage has responsibilities associated with them.

- Performing/Selecting a Representative Flight - *operator*
- Providing FDR Data, Representative Flight Details, DFL's and Conversion Data - *operator*
- Establishing Limitations of the Readout - *operator*
- Establishing Revision and Applicability of DFL's and Conversion Data - *operator*
- Replaying the FDR – *test centre*
- Reporting the FDR Readout Results – *test centre*
- Assessing the FDR Readout Results – *test centre/operator*
- Retention and Configuration Control of FDR Readout Results - *operator*



The following slides illustrate the procedures necessary in the MCM



Performing/Selecting a Representative Flight

Responsibility : This is the responsibility of the aircraft operator/ owner.

Purpose : The purpose of performing a specific FDR test flight or recording the details of a representative commercial flight is to gain a FDR recording of a flight that can be used to assess the functionality of an FDR



The appropriate selection of a representative flight and recorded flight details can greatly increase the FDR serviceability information that can be established during FDR readout analysis

- Details of a representative flight should include a take off, climb, cruise, descent, approach to landing and landing, together with general details of the flight profile, could be expanded to include:
 - Pre-departure checks, Flight duration, altitude reached, flight control settings, power settings, flight



Providing FDR Data, Representative Flight Details, DFLs and Conversion Data

Responsibility: This is the responsibility of the aircraft operator/owner.

Purpose: The purpose of providing the FDR data and the appropriate supporting data to the readout facility is to enable the generation of the most accurate possible readout of the FDR's content



On-going Serviceability Assessment

- The accuracy and assessment of an FDR readout is dependent on the provision a DFL and associated conversion data. This in conjunction with details of a representative flight enables a meaningful assessment of FDR system functionality to be carried out



Establishing Limitations of the Readout

Responsibility: The responsibility of assessing the supporting information provided with the FDR data and determining how much information can be provided about the FDR system lies with the test house or operator performing the readout

Purpose: This task should be performed prior to the readout, and its purpose is to establish a clear understanding of the limitations that the



- Several readout facilities have commented that their ‘customers’ have assumed that the presentation of a readout report implies that the overall FDR system is serviceable, even when content of the report is incomplete or implies that there may be faults within the system.
- Numbers of accidents and incidents reveal that FDR/CVR systems are not fully functional

Especially in Mandatory parameters which may vary from State to State



Establishing Revision and Applicability of DFLs and Conversion Data

Responsibility: It is the responsibility of the operator to provide along with their work request the details of the appropriate DFL and conversion data together with their current revision status.

Purpose: The purpose of establishing the revision status and applicability of Data Frame Layouts (DFLs) and Conversion data prior to



Replaying the FDR

Responsibility: This is the responsibility of the replay organisation responsible for performing the readout

Purpose: The purpose of replaying the FDR is to generate a report on the FDR's content for subsequent review and analysis



Reporting the FDR Readout Results

Responsibility: This is the responsibility of the replay organisation responsible for performing the readout

Purpose: The purpose of generating a readout report is to provide the customer with documented evidence of the content of their recorder, together with any anomalies the replay house has identified.



Assessing the FDR Readout Results

Responsibility: This is the responsibility of the aircraft operator/owner

Purpose: The purpose of this assessment is to determine the actual serviceability of the FDR system and to assist in the scheduling of any necessary maintenance work



Retention & Configuration Control of FDR Readout Results

Responsibility: This is the responsibility of the FDR readout facility and the aircraft operator/owner.

(i) The owner/operator is required to retain the record of a representative flight conducted during the previous twelve months.

*The readout facility is required to retain readout records/test reports in manner and for a period acceptable to the CAA of **State of Operation & DCA Bermuda.***

Purpose: The purpose of this is to ensure that both the aircraft operator/owner AND the replay house can accurately determine the last recorded status of the FDR system