



Advisory Circular (AC)

Flight Data Recorder Installation Calibration And Correlation Procedures

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this Advisory Circular (AC) material is applicable to the approval of all initial and follow-on installations of Flight Data Recorder (FDR) systems and may be considered one means but not the only means of demonstrating compliance with the calibration and correlation requirements of AWM 551.100. Proper functioning of a newly installed flight data recorder system should be established by a series of ground and flight tests, the objectives of which are to ascertain that all parameters are recorded within the required accuracy limits over their entire operating range.

1.2 Guidance Applicability

This document is applicable to all Transport Canada personnel, delegates and industry.

1.3 Description of Changes

This document, formerly AMA No. 551.100, is reissued as an AC. With the exception of minor editorial changes, the content is unaltered.

1.4 Termination

This document does not have a terminating action. It will however, be reviewed periodically for suitability of content.

2.0 REFERENCES

2.1 Reference Documents

It is intended that the following reference materials be used in conjunction with this document:

- (a) Part VI Subpart 25 of the Canadian Aviation Regulations (CAR) — *Aircraft Equipment and Maintenance Standard*;
- (b) Chapter 551 of the Airworthiness Manual (AWM) — *Aircraft Equipment and Installation*; and
- (c) Transport Canada Publication TP 13140E — *Flight Recorder Configuration Standard*.

2.2 Cancelled Document

As of the effective date of this document, AMA No. 551.100 dated 1 December 1998 is cancelled.

3.0 DEFINITIONS

The following definitions are applicable to this AC:

Calibration: The application of a measured input of known accuracy to a physical dimension of unverified accuracy, to detect and define any variation from its performance standards. Calibration includes adjustment and recording of corrected measurements and recording of measurements, which require no adjustment.

Correlation: The process of comparing data recorded by the FDR against the actual corresponding data derived from flight instruments and control surface position indicators during specified portion(s) of a flight profile or during ground checks which are conducted for that purpose.

Analog Data: Data transferred between Line Replaceable Units (LRU) via a varying voltage on dedicated circuits.

Digital Data: Data transferred between LRUs via digital data buses such as ARINC 429.

Test: A means of demonstrating compliance, using a test aircraft in a configuration representative of the configuration to be certified, in a ground and/or flight environment.

Simulation: The use of a laboratory-installed system of avionic components and LRUs ("rig") representative of the aircraft in which the FDR system is to be certified. The rig may be controlled by a computer-based system including analog and discrete inputs, to create specific operating conditions, such as 90° pitch up, or other conditions that cannot be tested in flight or are difficult to test on the aircraft. The rig should be configured such that the computer or analog inputs to the system drive the instruments and displays in a way representative of the aircraft. All LRUs and avionic components installed in the rig should be either of production standard or representative of the final production configuration.

Stimulation: The use of test equipment, traceable to a known standard, to induce aircraft systems to produce a specific result.

4.0 GENERAL

FDR operational standards are stated in CAR 625.33, which specifies parameters, ranges, accuracies, sampling intervals and resolutions.

5.0 INSTALLATION TESTS

Installation tests should comprise ground and/or flight tests and will vary in extent dependent upon whether the installation is classed as initial or follow-on.

The following guidance information is based upon EUROCAE ED-55 requirements. Generally, each parameter should be tested over its entire range of operation, the number of test points being dependent on the data source and how the source (data) is processed. The minimum number of test points is defined below. Required test points for a given parameter may be obtained by simulation, stimulation, ground test, flight test or a combination of these methods.

(a) Initial FDR System Installation.

(i) **Ground Tests** - The following tests should be performed for an initial FDR system certification.

- 1) Insert definitive Documentary Data through the Flight Data Entry Panel, if installed, (or equivalent device, e.g. flight-deck clock suitably configured and wired or an event marker switch) to identify commencement of tests.
- 2) With the FDR system operating, perform a calibration check of all parameters and discretetes. All sensors or transducers should be exercised over their effective range and all discretetes exercised through their "off"/"on" states. Specific test points should be recorded to enable replay to confirm values.
- 3) Sensors which may not be practical to exercise for the purpose of calibration tests (e.g. fuel flow, torque, EPR) may be stimulated by appropriate test equipment.
- 4) Where the output of a sensor is indicated on flight-deck instruments and/or displays, the correlation between the indicated value and the predetermined calibration point should be established.
- 5) Where a sensor output does not provide a flight-deck indication or where it results in an indication with resolution too low for correlation, (eg position of flight control surfaces, spoilers, airbrakes) angle-measuring devices such as inclinometers should be used to set predetermined test points required for calibration.
- 6) A minimum of five test points should be verified for each non-linear parameter and three test points should be verified for each linear parameter. Test points should include upper, transition and lower values (e.g. left, zero and right lateral deviation) and should confirm test points denoting to, from, north, south, east, west, plus, minus, etc. For

parameters derived from flight-deck controls having discrete detent positions (e.g. throttles, flaps), each detented position should be tested.

- 7) Upon completion of ground test calibration and correlation testing, the FDR should be removed from the aircraft for data analysis. Alternatively, a suitable copy tape or download of the recording(s) should be obtained from the FDR in situ for subsequent playback assessment.
- 8) To facilitate the assessment of all recorded data, the block of time allocated to ground testing may be suitably time-marked on the FDR such that the identification and assessment of the ground test data may be made later during the flight test data playback assessment [see "Flight Tests", paragraph (ii)(6)].

- (ii) **Flight Tests** - The flight test should be performed as the last test and while it should be of minimal duration, should nevertheless be of sufficient length to determine if there has been any degradation of the recorded data when compared with the ground correlation and calibration data.

The certification flight test of the initial FDR installation should include specific test points of all parameters and should cover a range of altitudes including maximum certificated altitude of the aircraft. The test schedule should include the following where practical with all test points registered by means of a suitable event marker:

- 1) Instrument and/or electronic display readings and recordings made at intervals during the flight for the purpose of determining data correlation of the required parameters.
- 2) Unless conducted through the ground test segment, functioning of the equipment and systems in all modes and over their full ranges to generate the various discretely and variable parameters to be recorded.
- 3) Unless conducted through ground testing, electrical power switching to demonstrate FDR system tolerance to transients and power interruptions.
- 4) Operation of radio transmitters and electrical equipment (e.g. pumps, solenoids, motors, fans) to demonstrate FDR system immunity to electromagnetic interference.
- 5) Implementation of a flight profile to demonstrate FDR system tolerance to vibration and acceleration.
- 6) At completion of testing, the FDR should be removed from the aircraft for playback assessment. Alternatively, a suitable copy tape or download of the recording(s) should be obtained from the FDR in situ for subsequent playback assessment.

- (b) Follow-on FDR System Installations.

- (i) **Ground Tests** - The following tests should be performed for certification of follow-on installations of an FDR system.

- 1) Insert definitive Documentary Data through the Flight Data Entry Panel, if installed, (or equivalent device, e.g. flight-deck clock suitably configured and wired or an event marker switch) to identify commencement of tests.
- 2) With the FDR system operating, perform a check of each parameter to obtain sufficient calibration and correlation data to demonstrate that the system performance conforms to that of the initial installation. It is acceptable to monitor and record a reduced number of parameter test points. For data derived from a digital bus, a minimum of two test points

is required. For data derived from analog sources, a minimum of three test points is required, typically to record extreme values and transition points and test points denoting to, from, north, south, east, west, plus, minus, etc.

(ii) **Flight Tests** - Flight testing is not required for follow-on FDR installations.

(c) **Additional Parameters and/or Discretes** - If new parameters or discrete signals are added to an existing FDR system, recertification testing is required. If the existing system can accommodate the change(s) without modification to FDR system components (e.g. if Flight Data Acquisition Unit (FDAU) software changes are not required), confirmation of satisfactory performance should be established by means of ground and flight testing of the additional FDR system inputs only, followed by a suitable playback assessment. If the new parameters or discretes are derived from existing aircraft systems and require additional wiring or modifications to existing cable assemblies, an EMI program should be conducted.

Where significant architectural and/or software changes result from the requirement to augment the list of parameters and/or discrete inputs to an FDR system, a full recertification of the system will be necessary with testing of all parameters and discretes required as for an initial installation as described in 5. (a) (i) and (ii).

(d) **Documentation** - A report prepared to comply with AWM 551.100(d)(4)(i)(A) should describe the FDR system installation and the equipment installed and should contain a record of the results of all ground and flight tests, including calibrations and correlations. A copy of the actual ground and flight test data should be retained by the installer.

For each follow-on installation, a copy of all ground calibration and correlation data should be retained by the installer.

Any processing time delays between the FDR acquisition system input and FDR recording output should be documented. ED-55 Annexe A refers.

To aid in the playback and analysis of the recorded data, the following information should also be documented:

- Bits per FDR Word
- FDR Words per Subframe
- Seconds per Subframe
- Parameter Name
- Subframe Number (location of parameter)
- Parameter Word Number
- Bits (comprising Word)
- Superframe Cycle Counter Name (if applicable)
- Superframe Cycle Numbers (if applicable)
- Signed Value
- Raw Data Range
- Polynomial Coefficients
- Tabular data
- Predefined Equation
- Conversion Description
- Units (e.g. degrees, radians, feet, knots, G)
- Sign Convention
- Discrete Interpretation

Note:

Guidelines for documentation of flight recorder configurations are contained in the "Flight Recorder Configuration Standard", Transport Canada Publication TP 13140E.

6.0 HEADQUARTERS CONTACT

For more information please contact:

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