Flight Data Recorder Manual for Aviation Accident Investigations

M30 - 003

Issue Nº 1 - 16/09/2009
The Agência de Aviação Civil (AAC) – the Civil Aviation Authority of Cabo Verde, approves this Flight Data Recorder Manual for Aviation Accident Investigations for the use and guidance of safety inspectors designated as accident and incident investigators in the performance of their duties.

It is emphasized that all matters pertaining to an investigator’s duties and responsibilities cannot be covered in this manual. Investigators are expected to use good judgement in matters where specific guidance has not been given. Changes in aviation technology, legislation and within the industry will necessitate changes to requirements.

Comments and recommendations for revision/amendment action to this publication should be forwarded to the Director Flight Safety, Civil Aviation Authority of Cabo Verde:

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FOREWORD

This manual provides general information to assist the investigator-in-charge, group chairmen, and other investigation team staff who may encounter a flight data recorder during the course of an aviation accident investigation. It is intended to provide guidance on the procedures, laws and standard practice surrounding the flight data voice recorder and its recorded information during the course of an investigation.

The Director Flight Safety will be responsible for keeping this manual updated.

The manual’s printing date will be indicated in the centre bottom of each page. While the intent of the manual is to provide guidance for handling a flight data recorder and its recorded information, the manual may not cover all situations, and any questions or concerns may be directed to the Investigator in Charge (IIC) for immediate assistance.

This manual is intended to provide information and guidance to AAC staff who are involved in the flight data recorder portion of an aviation accident investigation.

This handbook has not been adopted by the AAC Board Members, is not regulatory in nature, is not a binding statement of policy, and is not all inclusive.

The recommended procedures are not intended to become obligations of the investigation unit or to create any rights in any of the parties to an investigation. Deviation from the guidance offered in this manual will at times be necessary to meet the specific needs of an investigation. However, such deviations from the guidance offered in this manual shall be within the sole discretion of the appropriate investigation unit staff and shall not be the prerogative of parties to the investigation or other individuals.
1 APPLICABLE RECORDED FLIGHT DATA

1.1. The term “FDR” (flight data recorder) includes digital flight data recorders (DFDRs), solid-state flight data recorders (SSFDRs) and Universal flight data recorders (UFDRs).

1.2. The laws and policies that govern the procedures regarding FDRs and recorded event data are generally applicable to any and all flight data that are recorded on board an aircraft. Any event data that are recovered from an aircraft following an accident or incident are given the same protection and security of an FDR or FDR data.

1.3. Devices that record flight event data include, but are not limited to Quick Access Recorders (QARs), flight test equipment, FADEC, PARs. Furthermore, any magnetic tape or digital memory chips found in the wreckage may contain flight data and shall be secured by the investigation unit staff.

1.4. The protections pertaining to on-board recorders also apply to ground-based recorded flight data (CNS/ATM, AOC, ACARs, etc).

1.5. In the event that recorded media from other event-recording devices is recovered, the investigator-in-charge (IIC) shall immediately be contacted for guidance.

2 FDR DATA: DISCLOSURE AND ACCESS

2.1. FDRs contain highly sensitive material and unauthorized release of information by AAC employees is grounds for disciplinary action.

2.2. The FDR specialist, the IIC are the only staff automatically authorized access to the FDR data. All personnel who obtain information concerning the contents of a FDR recording or written transcript, regardless of reason or source, are bound by Government nondisclosure laws (refer DL X/09, of September 28th).

2.3. The FDR specialist assigned to the accident ordinarily has complete access to the FDR and data at all times. Additionally, any FDR specialist may assist with FDR data, when necessary, with the approval of the IIC.

2.4. Other investigation unit staff is given access to the FDR data in a timely manner to aid in the on-scene portion of the investigation, in coordination with the IIC.
2.5. The FDR specialist shall keep the IIC apprised of information and activities concerning the FDR or FDR data. In particular, any observations that may be significant to the investigation shall be brought to the IIC’s attention.

3 FDR RECOVERY: FROM ON SCENE TO THE FDR LABORATORY

3.1. Upon notification of an accident or incident in which an FDR is installed on the aircraft, the IIC considers whether the FDR might contain information relevant to the investigation (taking into consideration that the FDR can record a minimum of 25 hours of flight information).

3.2. The IIC assigns the FDR to an FDR specialist.

3.3. Preliminary accident information shall be obtained, as soon as possible. Specifically, the following information is required to facilitate data readout:
   - Event description (phase of flight, type of event)
   - KEYS number
   - Aircraft type
   - Flight number
   - Flight itinerary
   - Number of flights after event, if the recorder is not removed immediately.
   - Local altimeter setting at the time of the accident/incident.
   - Elevation of accident/incident site.
   - Location of previous takeoff, runway used, and field elevation.
   - Local altimeter setting at time of takeoff.
   - Time of departure, coordinated universal time (UTC)
   - Time of accident/incident (UTC)
   - Accident site conditions that may have cause damage to the recorder (fire duration, fuel type, etc).

3.4. Recorder information shall be provided to the IIC and the FDR specialist, as soon as possible. This information can be obtained from the airline and/or the airframe manufacturer. Specifically, the following information is required to facilitate data read out:
   - FDR manufacturer/model (Fairchild, Sundstrand, Allied Signal, L3, etc)
   - FDR Part number and Serial Number
   - FDAU (flight data acquisition unit) manufacturer/model and part number
   - Parameters recorded
   - Word(s) and bit location(s) of each parameter
   - Conversion algorithm for each parameter
- Parameter range
- Original owner/upgraded retrofit history
- Airline, recorder maintenance/readout facility contact phone number.

3.5. If there is any visible damage to the underwater locator beacon (ULB or “pinger”), it should be removed prior to shipping. Use caution when handling damaged beacons.

3.6. The FDR unit shall not be tampered with or opened, and the recording medium shall not be removed (i.e., the tape or memory module) until it reaches the recorder laboratory.

3.7. The FDR shall not be read out or downloaded on scene. The IIC shall caution the parties to the investigation that unauthorized readout or download of an FDR, following a reportable accident or incident, may result in loss of party status.

3.8. The FDR must be shipped to the recorder laboratory in a manner that protects it from damage (i.e., inside a cardboard or wooden box, wrapped in either foam or bubble-wrap or in a container filled with foam peanuts).

3.9. If the FDR is recovered in water, it shall immediately be packed in water (fresh, if possible) and not be allowed to dry out. Packaging may be accomplished by sealing the recorder (in water) inside a plastic beverage container with silicon adhesive or a similar sealant.

3.10. If necessary, the FDR shall be packaged appropriately. The FDR may be sent to the recorder laboratory indicated by the IIC on board a commercial airplane. It is advisable that the IIC takes the FDR with his luggage. If this is not possible the IIC needs to coordinate with the laboratory staff to collect the FDR at the arriving flight and await for his arrival before the FDR is unpacked.

3.12. The FDR shall be labeled and identified appropriately, before shipment (including contact name and phone number).

4 CHOICE OF THE FDR READOUT FACILITY AND PARTICIPATION BY THE STATE OF MANUFACTURE (OR DESIGN) AND THE STATE OF THE OPERATOR

4.1 One of the immediate items requiring a decision is where to have the flight recorders read out and analysed. It is essential that the flight recorders be read out as early as possible after an accident. Early identification of problem areas can affect the investigation at the accident site where evidence is sometimes transient. Early identification of problem
areas may also result in urgent safety recommendations which may be necessary to prevent a similar occurrence.

4.2 Not having its own facilities for the playback and analysis of flight recorder information (both voice and data) it will be necessary to request assistance from other States. It is essential, therefore, that the accident investigation unit make timely arrangements to read out the flight recorders at a suitable readout facility.

4.3 The IIC may request assistance from any State that, in its opinion, can best serve the investigation. The manufacturer’s standard replay equipment and playback software, which is typically used by airlines and maintenance facilities, is not considered adequate for investigation purposes. Special recovery and analysis techniques are usually required if the recorders have been damaged.

4.4 Facilities for the read-out of flight recorders should have the following capabilities:
   a) the ability to disassemble and read out recorders that have sustained substantial damage;
   b) the ability to play back the original recording/memory module without the need for the use of a manufacturer’s copy device or the recorder housing that was involved in the accident or incident;
   c) the ability to manually analyse the raw binary waveform from digital tape flight data recorders;
   d) the ability to enhance and filter voice recordings digitally by means of suitable software; and
   e) the capability to graphically analyse data, to derive additional parameters not explicitly recorded, to validate the data by cross-checking and other analytical methods to determine data accuracy and limitations.

4.5 The State of Manufacture (or Design) has airworthiness responsibilities and the expertise normally required to read out and analyse flight recorder information. Since flight recorder information can often reveal airworthiness problems, the State of Manufacture (or Design) must be invited to have a representative present when the flight recorder read-out and analysis are being conducted in a State other than the State of Manufacture (or Design).

4.6 The State of the Operator has regulatory responsibilities regarding the flight operation and can provide insights into operational issues which may be specific to the operator. Since flight recorder information can reveal operational problems, the State of the
Operator must also be invited to have a representative present when the flight recorder read-out and analysis are being conducted.

4.7 The flight data recorder and the cockpit voice recorder should be read out by the same facility, because they contain complementary data which can help validate each recording and aid in determining timing and synchronization. Flight recorders should not be opened or powered up and original recordings should not be copied (particularly not by high-speed copy devices) prior to the read-out because of the risk of damage to the recordings.

4.8 The facility at which the flight recorders are read out for another State should be given an opportunity to comment on the Final Report in order to ensure that the characteristics of the flight recorder analysis have been taken into account.

4.9 The facility at which the flight recorders are read out may require the expertise of the aircraft manufacturer and the operator in order to verify the calibration data and validate the recorded information.

4.10 The IIC may leave the original recordings, or a copy of them, with the read-out facility until the investigation is completed, in order to facilitate the timely resolution of additional requests or clarifications, providing that the facility has adequate security procedures to safeguard the recordings.

5 FDR DATA: NON-SAFTY BOARD FDR DOWNLOAD

5.1 The FDR shall not be read out or downloaded on scene. The IIC shall caution the parties to the investigation that unauthorized readout or download of an FDR, following a reportable accident or incident, may result in loss of party status.

5.2 Under exceptional circumstances, the IIC may approve the owner/operator or a third party vendor to download the data from an undamaged FDR. Ordinarily, such downloads shall be supervised or observed by staff designated by the IIC.

5.3 Downloaded FDR data provided to the IIC shall be provided in a recorder manufacturer format.
6 FDR ARRIVAL AT THE RECORDER LABORATORY

6.1. The FDR’s arrival and initial data download is not ordinarily a group activity.

6.2. The FDR specialist handles and secures the FDR and its original recording medium.

6.3. If the recorder is damaged, the damage is documented and the FDR specialist extracts the recording medium with the use of cutting tools or other special equipment. *NOTE: The IIC shall provide the FDR specialist with the accident site conditions and environment that caused damage to the recorder, if possible.*

6.4. The FDR specialist downloads the original tape or memory from the FDR. The pertinent data are transferred or downloaded from the original medium and are digitally stored.

6.5. The FDR specialist initially checks the recording to determine that information has been recorded.

7 INITIAL FDR READ OUT

7.1. Any critical information that might assist in the field phase of the investigation is relayed to the IIC and other appropriate on-scene investigation unit staff.

7.2. If the recording contains data pertinent to the investigation, the IIC will make a determination as to whether it is necessary to establish an FDR group.

7.3. The data briefing shall be held over a secure landline telephone – not a portable mobile phone – and not routed through any conferencing facility.

7.4. The IIC shall coordinate the distribution of FDR information to parties on scene.

7.5. An electronic file containing preliminary plots and data may be emailed to other investigation unit staff, as determined by the IIC.

8 FDR PRELIMINARY DATA: RELEASE TO THE PARTIES

8.1. If an FDR group is not established, a preliminary set of plots and tabular data shall be provided to the IIC, who coordinates distribution to the party members, as necessary.
8.2. If an FDR group convenes, at the conclusion of the initial FDR group meeting, a preliminary set of plots and tabular data shall be sent to the IIC and may be provided to the group members (hardcopy or electronically).

8.3. Updates and corrections to the preliminary data (plots and corresponding tabular data) may be released to the FDR group members during the course of the investigation. If an FDR group does not convene, updates shall be provided to the IIC for distribution to the party members.

8.4. Release of any additional FDR data (additional data/information not contained in the preliminary plots and corresponding data file) requires the express approval from the IIC.

8.5. Release of ancillary data (FDRs from other aircraft, flight tests, etc), requires the express approval from the IIC.

8.6. FDR parameter conversion information may be proprietary and any release to the parties requires written acknowledgement of responsibility (see attached: Proprietary Information Release).

8.7. A copy of the preliminary data, as released to the parties, shall be retained for archive.

8.8. Animations, reconstructions or graphic simulations are not typically released with FDR data, unless authorized by IIC.

8.9. Preliminary data released to the parties or IIC may contain non-validated data, and shall bear notation to that effect. The final report shall contain finalized and validated data for the parameters and time periods used and deemed pertinent, but not necessarily for every parameter and data point recorded.

8.10. Copies of the waveform or binary data are generally not released, unless authorized by IIC.

**9 FDR PRELIMINARY DATA: INVESTIGATION UNIT STAFF AND OFFICIAL USE**

9.1. An electronic file containing preliminary plots shall be provided to the IIC.

9.2. FDR data (hardcopy or electronic) may be distributed to other group chairman or staff at the request of the IIC. The IIC may distribute data to the party members, as necessary.
to aid in the investigation – group chairman and staff shall not release FDR data to unauthorized individuals.

9.3. FDR data shall not be released to the public, except through the official public report of the accident investigation. Specifically, investigation unit staff, FDR group members, and other individuals with access to the FDR data (including party members) are prohibited from releasing FDR information to unauthorized individuals. However, the IIC may decide to publicly release information regarding FDR activity.

9.4. FDR plots may be overlaid with characterizations of CVR text or other events. Also, other data from the investigation (radar, etc.) may be correlated with FDR data. If applicable, the correlation between CVR events, FDR, and other data shall be coordinated between the CVR, and other pertinent group chairmen.

9.5. Timing and correlation between FDR and other data sources is not a group activity.

9.6. In the course of an investigation, other group chairman may use FDR data, as necessary (to create plots, simulations, etc.). However, it is the responsibility of the group chairman to coordinate with the FDR group chairman to ensure that the data and plots utilized are up-to-date and accurate before finalizing in a report.

9.7. With approval of the investigation authority board, generic FDR data with accident/incident-specific information removed may be released for aviation safety-related interests on a case-by-case basis.

9.9. FDRs contain highly sensitive material, and premature or unauthorized release of information by investigation authority staff is grounds for disciplinary action.

10 PLANNING THE FDR GROUP MEETING
10.1. Not all FDRs that are sent to the recorder laboratory result in the establishment of an FDR group. The IIC determines if a group is necessary.

10.2. The FDR specialist is the group chairman for the FDR portion of the investigation and shall be included in any correspondence and discussions that pertain to all group chairmen participating in the investigation.

10.3. The IIC must appoint FDR group members and to select a tentative date for an FDR group meeting. The group meeting does not necessarily occur immediately after the FDR is sent to the laboratory and may last more than one day.
10.4. The IIC shall notify the party coordinators that an FDR group is convening.

10.5. The IIC must ensure that only parties appropriate to the FDR group are invited. Appropriate parties typically include: The AAC (must be invited), all accredited representatives and typically, the manufacturer, pilot union, and owner/operator. Flight crew cannot participate as group members.

10.6. Party representatives that can provide a technical contribution may be assigned to the FDR group. Typically individuals seated on the FDR group include those familiar with the aircraft systems, aircraft performance, or FDR readouts. The party coordinator is not automatically qualified to be an FDR group member.

10.7. Ordinarily, only one representative per party is seated on the FDR group. Additional party representatives may be seated, at the discretion of the IIC with the FDR group chairman.

10.8. Downloading and transcribing the FDR data can take several hours and the FDR group meeting may not convene immediately after FDR delivery to the laboratory. The IIC finalizes a meeting time and date with the FDR group chairman, and notifies the group members.

10.9. The IIC shall forward the names of the authorized FDR group members to the FDR group chairman prior to the FDR group's arrival.

11 THE FDR GROUP MEETING

11.1. The FDR group chairman shall explain the FDR policies to the group and shall facilitate the group’s effort to process and evaluate the FDR data.

11.2. Specifically with regard to FDR policies, FDR group members are prohibited from releasing FDR information to the public. However, the IIC may decide to publicly release information regarding FDR activity. FDR policy does not prohibit a party from implementing safety-of-flight related adjustments within their organization, as a result of their participation in a FDR group.

11.3. The group members must sign the FDR Group Attendance Sheet and Statement of Party Representatives to the Investigation (see attached). The AAC (the civil aviation authority) signs the attendance sheet but does not sign the party representative form.
11.4. The FDR group chairman, in coordination with IIC, may excuse any member who is disruptive to the process.

11.5. During the course of an investigation it may be necessary to obtain technical assistance from non-party organizations, such as the FDAU (flight data acquisition unit) manufacturer or the FDR manufacturer. The individuals providing technical assistance to the investigation unit shall not ordinarily be made members of the FDR group.

**12 FDR ANIMATIONS**

12.1. Animations are not created for every accident/incident and depend on the recorder laboratory resources and capabilities.

12.2. The production of animations for investigative use or in support of meetings and hearings shall be coordinated and approved through the IIC.

12.3. Animation source files shall not be released.

12.4. Animation videos may be released to the public (including parties to the investigation) when they are placed into the public report.

12.5. The IIC shall coordinate requests from staff and Board Members to review animations, prior to public release.

**13 THE FDR FACTUAL REPORT**

13.1. The FDR factual report typically contains information about the FDR type, operation, damage (with appropriate documentation), data extraction methods, quality and a summary of events.

13.2. If an FDR group convenes, the FDR group members shall have the opportunity to review and comment on the draft factual report.

13.3. The IIC reviews and approves the final factual report.

13.4. CVR transcript–related sections (excluding timing information), or any CVR-related text shall not be distributed to any party coordinators, group members, unauthorized staff, or the general public prior to the public release of the CVR factual report with transcript. However, at times it may be necessary to use paraphrased CVR text with FDR data. The
IIC shall approve any CVR-related paraphrased text that is disseminated prior to the public release of the CVR transcript.

13.5. The FDR report, including plots and data, shall be released to the public at the time the public report is opened. Any plots included in the factual report submitted to the public report shall have an accompanying CSV file containing all data presented in the plots.

14 RELEASE OF THE RECORDER AND ORIGINAL DATA MEDIA

14.1. The IIC shall supply the FDR specialist with the recorder’s return organization and address. Ordinarily with minor accidents and incidents, the owner/operator at the time of the accident or incident is the rightful return organization. However, there are instances when the rightful return organization is less apparent, such as when the insurance company has control of the wreckage, or there are fractional owners, or if the aircraft is leased. If there is uncertainty regarding the proper return organization, the IIC and FDR specialist shall contact the Legal Counsel, who can resolve any issues regarding who shall receive the FDR and original FDR media.

14.2. For tape-based FDRs from which the tape has been removed, the FDR unit may be returned to the owner (or authorized recipient) as soon as the FDR specialist determines that there are no issues related to its operation.

14.3. Although most subsequent data work is accomplished using the downloaded raw data or a digital copy of the original recorded data, the original recorded media may be used in the course of the investigation. The original media is returned to the authorized recipient only after the investigation is complete.

14.4. Typically with a solid-state FDR or a tape-based FDR containing the original tape, the entire FDR is considered “The Original Data” and shall not be released until the investigation is complete or otherwise authorized by the IIC on a case-by-case basis.

14.5. Prior to returning any original FDR recording medium (solid state recorder or the original tape), the FDR specialist shall obtain specific permission from the IIC.

15 INVESTIGATION WITH FOREIGN REPRESENTATIVES

15.1. When the aviation accident investigation authority conducts an investigation that involves a foreign operator/manufacturer, these FDR standard procedures and policies apply, in consultation with the foreign government’s Accredited Representative.
15.2. Coordination between the governments is managed by the IIC and the foreign government’s Accredited Representative.

15.3. The IIC shall clearly identify the participants from the foreign government and their technical advisors to the FDR specialist, in order to avoid unauthorized access to the FDR data.
ATTACHMENT A: STATEMENT OF PARTY REPRESENTATIVES TO INVESTIGATION

Aircraft Identification:

Accident Number ____________________
Registration Number ________________
Make and Model _____________________
Location ___________________________
Date _______________________________

The undersigned hereby acknowledge that they are participating in the above-referenced aircraft accident field investigation (including any component tests and teardowns or simulator testing) on behalf of the party indicated adjacent to their name, for the purpose of providing technical assistance to the investigation unit.

The undersigned further acknowledge that they have read CV-CAR 13.E.245 and agree to abide by provisions of this regulation.

It is understood that a party representative to an investigation may not be a person who also represents claimants or insurers. The placement of a signature hereon constitutes a representation that participation in this investigation is not on behalf of either claimants or insurers and that, while any information obtained may ultimately be used in litigation, participation is not for the purposes of preparing for litigation.

By placing their signatures here on all participants agree that they will neither assert nor permit to be asserted on their behalf, any privilege in litigation, with respect to information or documents obtained during the course of and as a result of participation in this investigation as described above.

It is understood, however, that this form is not intended to prevent the undersigned from participating in litigation arising out of the accident referred to above or to require disclosure of the undersigned’s communications with counsel.

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ATTACHMENT B:  FDR GROUP ATTENDANCE SHEET

FDR Group Attendance Sheet
Meeting Date:_________________ Ref #: __________________
Accident/Incident Date: __________ Location:___________________
Aircraft Registration: _________ Aircraft Type: __________________
Operator/Owner: _________ FDR Type: ___________________

(a) All information concerning the accident or incident obtained by any person or organization participating in the investigation shall be passed to the IIC through appropriate channels before being provided to any individual outside the investigation. Parties to the investigation may relay to their respective organizations information necessary for purposes of prevention or remedial action. However, no information concerning the accident or incident may be released to any person not a party representative to the investigation (including non-party representative employees of the party organization) before initial release by the IIC.

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ATTACHMENT C: PROPRIETARY INFORMATION RELEASE

Proprietary Information Release

Investigation:
Ref # __________ Date of Accident:___________ Aircraft Type:_________________
Aircraft registration#:__________ Operator:__________________ Owner:___________

Investigative activity:
FDR Group ____ Other (specify):_____________________ Activity Date: __________

The following information is being distributed to the undersigned for the express purpose of aiding the Investigation Unit in the investigation.

Description:____________________________________________________________

Format:________________________________ Application:______________________

Owner:___________________________ Contact Information:____________________

By signing this form, the party receiving the information agrees to handle the information as proprietary and accepts responsibility for its protection.

_______________________________________________________________________
Printed Name       Signature          Organization    Date
_______________________________________________________________________
Printed Name       Signature          Organization    Date
_______________________________________________________________________
Printed Name       Signature          Organization    Date
_______________________________________________________________________
Printed Name       Signature          Organization    Date