

CERTIFICATION OF FLIGHT RECORDERS MAINTENANCE ORGANIZATIONS

1.0 PURPOSE

- 1.1 This Advisory Circular (AC) provides guidance to operators that are required to provide a maintenance program for Flight Recorder Systems; and maintenance organizations who wish to carry out analysis of the data download.

2.0 REFERENCE

- 2.1 Civil Aviation (Instruments and Equipment) Regulation, 2018
- 2.2 Civil Aviation (Air Operators Certification and Administration) Regulation, 2018
- 2.3 Civil Aviation (Approved Maintenance Organization) Regulation, 2018
- 2.4 Advisory Circular No. CAA-AC-AWS009C (Aircraft Maintenance Program Development)
- 2.5 Advisory Circular No. CAA-AC-GEN002B (Approval of Technical Manuals)
- 2.6 Advisory Circular CAA-AC-GEN-003B: Five Phase Certification and Approval Process
- 2.7 UK CAA Specification 10A

3.0 GENERAL

- 3.1 Part II of the Civil Aviation (Instruments and Equipment) Regulation, requires that every aircraft shall be fitted and equipped with instruments and equipment, including special equipment as may be specified according to the use and circumstances under which the flight is to be conducted.
- 3.2 The practice of routinely analyzing recorded data from flight recorders is a proactive means of monitoring aircraft operations to identify safety hazards and mitigate the potential risks. Information from flight recorders can assist to:
- a) detect exceedances or other related events;
 - b) routine data measurements;
 - c) incident investigations; and
 - d) continued airworthiness investigations.
- 3.3 “Flight Recorder” means any type of recorder installed in the aircraft for the purpose of complementing accident/incident investigation.

- 3.4 Flight recorders shall not be switched off during flight time.
- 3.5 Flight recorders shall be constructed, located and installed so as to provide maximum practical protection for the recordings in order that the recorded information may be preserved, recovered and transcribed. Flight recorders shall meet the prescribed crashworthiness and fire protection specifications.
- 3.6 “Flight Data Analysis” means a process of analyzing recorded flight data in order to improve the safety of flight operations.
- 3.7 Non-deployable flight recorder containers shall:
- a) be painted a distinctive orange or yellow colour;
 - b) carry reflective material to facilitate their location; and
 - c) have securely attached an automatically activated underwater locating device. For aeroplanes used for commercial operation such device shall be operating at a frequency of 37.5 kHz. At the earliest practicable date but not later than 1 January 2018, this device shall operate for a minimum of 90 days.
- 3.8 Automatic deployable flight recorder containers shall:
- a) be painted a distinctive orange colour, however the surface visible from outside the aircraft may be of another colour;
 - b) carry reflective material to facilitate their location; and
 - c) have an integrated automatically activated ELT.
- Note. — Current industry practice is to phase out yellow flight recorder containers at the end of the service life of the flight recorder.*
- Note3 - The need for removal of the flight recorder records from the aircraft will be determined by the Authority with due regard to the seriousness of an occurrence and the circumstances, including the impact on the operation.*
- Note- Procedure for inspection of flight recorder systems are given in Appendix-I.*
- 3.9 The flight recorder systems shall be installed so that:
- a) the probability of damage to the recordings is minimized;
 - b) they receive electrical power from a bus that provides the maximum reliability for operation of the flight recorder systems without jeopardizing service to essential or emergency loads;
 - c) there is an aural or visual means for pre-flight checking that the flight recorder systems are operating properly; and
 - d) if the flight recorder systems have a bulk erasure device, the installation shall be designed to prevent operation of the device during flight time or crash impact.
- 3.10 The flight recorder systems when tested by methods approved by the Authority shall be demonstrated to be suitable for the environmental extremes over which they are designed to operate.

4.0 FLIGHT RECORDER COMPOSITION

- 4.1 Crash protected flight recorders comprise one or more of the following systems: a flight data recorder (FDR), a cockpit voice recorder (CVR), an airborne image recorder (AIR) and/or a data link recorder (DLR). Image and data link information may be recorded on either the CVR or FDR.

- 4.2 Lightweight flight recorders comprise one or more of the following systems: an aircraft data recording system (ADRS), a cockpit audio recording system (CARS), an airborne image recording system (AIRS) and/or a data link recording system (DLRS).

Note 1- For aeroplanes / helicopters for which the application for type certification is submitted before 1 January 2016, specifications applicable to flight recorders may be found in EUROCAE ED-112, ED-56A, ED-55, Minimum Operational Performance Specifications (MOPS), or earlier equivalent documents.

Note 2- For aeroplanes / helicopters for which the application for type certification is submitted on or after 1 January 2016, specifications applicable to flight recorders may be found in EUROCAE ED-112A, Minimum Operational Performance Specification (MOPS), or equivalent documents.

Note 3 - Specifications applicable to lightweight flight recorders may be found in EUROCAE ED 155, Minimum Operational Performance Specification (MOPS), or equivalent documents.

5.0 FLIGHT DATA RECORDER

- 5.1 A person shall not fly an aircraft unless it is equipped with an FDR capable of retaining the information recorded during at least the last twenty-five hours of the operation, except for the Type IIA flight data recorders which shall be capable of retaining the information recorded during at least the last thirty minutes of its operation.
- 5.2 A person shall not fly an aircraft unless it is equipped with an FDR which shall record the information specified in the Table set out in the First Schedule to Civil Aviation (Instruments and Equipment) Regulations.
- 5.3 The FDR shall start to record prior to the aircraft moving under its own power and record continuously until the termination of the flight when the aeroplane is no longer capable of moving under its own power.
- 5.4 Aircraft FDRs are classified by type, depending upon the number of parameters and the duration required for the retention of the recorded information, as follows:
- a) Type IA FDRs shall record 78 parameters required to determine accurately the aeroplane flight path, speed, attitude, engine power, configuration and operation. Type IA FDRs shall be capable of retaining the information recorded during at least the last 25 hours of their operation.
 - b) Type I FDRs shall record 32 parameters required to determine accurately the aeroplane flight path, speed, attitude, engine power, configuration and operation. Type I FDRs shall be capable of retaining the information recorded during at least the last 25 hours of their operation.
 - c) Type II FDRs shall record the parameters required to determine accurately the airplane flight path, speed, attitude, engine power and configuration of lift and drag devices. Type II FDRs shall be capable of recording 15 parameters in the aeroplane used for General Aviation and 16 parameters (including longitudinal acceleration) for commercial operation, respectively. Type II FDRs shall be capable of retaining the information recorded during at least the last 25 hours of their operation.
 - d) Type IVA FDRs shall record 48 parameters required to determine accurately the helicopter flight path, speed, attitude, engine power, operation and configuration. Type IVA FDRs shall be capable of retaining the information recorded during at least the last 10 hours of their operation.
 - e) Type IV FDRs shall record 30 parameters required to determine accurately the helicopter flight

path, speed, attitude, engine power and operation. Type IV FDRs shall be capable of retaining the information recorded during at least the last 10 hours of their operation.

- f) Type V FDRs shall record 15 parameters required to determine accurately the helicopter flight path, speed, attitude and engine power. Type V FDRs shall be capable of retaining the information recorded during at least the last 10 hours of their operation.

Note 1- Parameters to be recorded by Type IA, I and II are listed in Table-1 of Appendix-I.

- 5.5 The use of engraving metal foil FDRs shall be discontinued.
- 5.6 The use of analogue FDRs using frequency modulation (FM) shall be discontinued.
- 5.7 Type IA, I and II FDRs shall be capable of retaining the information recorded during at least the last 25 hours of their operation.
- 5.8 Types IVA, IV and V FDRs shall be capable of retaining the information recorded during at least the last 10 hours of their operation.

6.0 AEROPLANES-COMMERCIAL AIR TRANSPORT

- 6.1 All turbine-engined aeroplanes, for which the individual certificate of airworthiness was first issued before 1 January 1987, with a maximum certificated take-off mass of over 5700kg shall be equipped with an FDR which shall record time, altitude, airspeed, normal acceleration and heading.
- 6.2 All turbine-engined aeroplane for which the individual certificate of airworthiness was first issued before 1 January 1987, with a maximum certificated take-off mass of over 27000kg that are of types of which the prototype was certificated by the appropriate national authority after 30 September 1969 should be equipped with an FDR which should record, in addition to time, altitude, airspeed, normal acceleration and heading, such additional parameters necessary to meet the objective of determining:
 - a) the attitude of the aeroplane in achieving its flight path; and
 - b) the basic forces acting upon the aero plane resulting in the achieved flight path and the origin of such basic forces.
- 6.3 All turbine-engined aeroplanes, for which the individual certificate of airworthiness was first issued on or after 1 January 1987 but before 1 January 1989, with a maximum certificated take-off mass of over 27000kg that are of types of which the prototype was certificated by the appropriate national authority after 30 September 1969 shall be equipped with a Type II FDR.
- 6.4 All turbine-engined aeroplanes, for which the individual certificate of airworthiness was first issued on or after 1 January 1987 but before 1 January 1989, with a maximum certificated take-off mass of over 5700kg, except those in 6.3, shall be equipped with FDR which shall record time, altitude, airspeed, normal acceleration and heading. These FDRs may record such additional parameters as are necessary to determine pitch attitude, roll attitude, radio transmission keying and power on each engine.
- 6.5 All aeroplanes of a maximum certificated take-off mass of over 27000kg for which the individual certificate of airworthiness is first issued on or after 1 January 1989 shall be equipped with a Type I FDR.
- 6.6 All aeroplanes of a maximum certificated take-off mass of over 5 700 kg, up to and including 27 000

kg, for which the individual certificate of airworthiness is first issued on or after 1 January 1989, should be equipped with a Type II FDR.

- 6.7 All aeroplanes of a maximum certificated take-off mass of over 5 700 kg for which the individual certificate of airworthiness is first issued on or after 1 January 2005 shall be equipped with a Type IA FDR.
- 6.8 All multi-engined turbine powered aeroplanes of a maximum certificated take-off mass of 5700kg or less for which the individual Certificate of airworthiness is first issued on or after 1 January 1990, should be equipped with a Type II FDR.
- 6.9 All turbine-engined aeroplanes of a maximum certificated take-off mass of 5700kg or less for which the application for type certification is submitted on or after 1 January 2016 shall be equipped with:
- a) Type II FDR; or
 - b) a class C AIR or AIRS capable of recording flight path and speed parameters displayed to the pilot(s); or
 - c) an ADRS capable of recording the essential parameters defined in Table-4 of Appendix-I.

Note: "The application for type certification is submitted refers to the date of application of the original "Type Certificate" for the aeroplane type, not the date of certification of particular aeroplane variants or derivative models.

- 6.10 All turbine-engined aeroplanes of a maximum certificated take-off mass of 5700kg or less for which the individual certificate of airworthiness is first issued on or after 1 January 2016 should be equipped with:
- a) A Type II FDR; or
 - b) a class C AIR or AIRS capable of recording flight path and speed parameters displayed to the pilot(s); or
 - c) an ADRS capable of recording the essential parameters defined in Table-4 of Appendix-I
- 6.11 All aeroplanes which are required to record normal acceleration, lateral acceleration and longitudinal acceleration for which the application for type certification is submitted on or after 1 January 2016 and which are required to be fitted with an FDR shall record those parameters at a maximum sampling and recording interval of 0.0625 seconds.
- 6.12 All aeroplanes which are required to record pilot input and/or control surface position of primary controls (pitch, roll, yaw) for which the application for type certification is submitted on or after 1 January 2016 and which are required to be fitted with an FDR shall record those parameters at a maximum sampling and recording interval of 0.125 seconds.

Note- For aero planes with control systems in which movement of a control surface will back drive the pilot's control, "or" applies. For aeroplanes with control systems in which movement of a control surface will not back drive the pilot's control, "and" applies. In aeroplanes with independent moveable surfaces, each surface needs to be recorded separately. In aeroplanes with independent pilot input on primary controls, each pilot input on primary controls needs to be recorded separately.

7.0 AEROPLANE - GENERAL AVIATION

- 7.1 All aeroplanes of a maximum certificated take-off mass of over 27000 kg for which the individual certificate of airworthiness is first issued on or after 1 January 1989 shall be equipped with a Type I FDR.

- 7.2 All aeroplanes of a maximum certificated take-off mass of over 5700 kg, up to and including 27000 kg, for which the individual certificate of airworthiness is first issued on or after 1 January 1989, shall be equipped with a Type II FDR.
- 7.3 All aeroplanes of a maximum certificated take-off mass of over 5700 kg for which the individual certificate of airworthiness is first issued on or after 1 January 2005 shall be equipped with a Type IA FDR.
- 7.4 All multi-engined turbine powered aeroplanes of a maximum certificated take-off mass of 5700kg or less for which the individual certificate of airworthiness is first issued on or after 1 January 1990, should be equipped with a Type II FDR.
- 7.5 All turbine-engined aeroplanes with a seating configuration of more than five passenger seats and a maximum certificated take-off mass of 5700 kg or less for which the individual certificate of airworthiness is first issued on or after 1 January 2016 should be equipped with:
- a) a Type II FDR; or
 - b) a Class C AIR or AIRS capable of recording flight path and speed parameters displayed to the pilot(s); or
 - c) an ADRS capable of recording the essential parameters defined in Table-4 of Appendix-I.

Note-- AIR or AIRS classification is defined in Para 11.2-11.4.

- 7.6 All aeroplanes for which the application for type certification is submitted on or after 1 January 2016 and which are required to be fitted with an FDR, shall record the following parameters at a maximum recording interval of 0.125 seconds:
- a) Pilot input and/or control surface position
 - b) primary controls (pitch, roll, yaw)

Note-1 - For aeroplanes with control systems in which movement of a control surface will back drive the pilot's control, "or" applies. For aeroplanes with control systems in which movement of a control surface will not back drive the pilot's control, "and" applies. In aeroplanes with independent moveable surfaces, each surface needs to be recorded separately. In aeroplanes with independent pilot input on primary controls, each pilot input on primary controls needs to be recorded separately.

Note 2- The application for type certification is submitted refers to the date of application of the original "Type Certificate" for the aero plane type, not the date of certification of particular aeroplane variants or derivative models.

8.0 HELICOPTERS-COMMERCIAL AIR TRANSPORT & GENERAL AVIATION

- 8.1 All helicopters of a maximum certificated take-off mass of over 7000kg or having a passenger seating configuration of more than nineteen, for which the individual certificate of airworthiness is first issued on or after 1 January 1989 shall be equipped with a Type IV FDR.
- 8.2 All helicopters of a maximum certificated take-off mass of over 3175 kg, up to and including 7000kg, for which the individual certificate of airworthiness is first issued on or after 1 January 1989, shall be equipped with a Type V FDR.
- 8.3 All helicopters of a maximum certificated take-off mass of over 3175kg for which the individual certificate of airworthiness is first issued on or after 1 January 2005 shall be equipped with a Type IVA FDR.

- 8.4 All multi-engined turbine powered helicopters of a maximum certificated take-off mass of 3175 kg or less for which the individual certificate of airworthiness is first issued on or after 1 January 1990 should be equipped with a Type V FDR.
- 8.5 All turbine-engined helicopters of a maximum certificated take-off mass of over 2250 kg, up to and including 3175 kg for which the application for type certification is submitted on or after 1 January 2018 shall be equipped with:
- a) Type IV A FDR; or
 - b) Class C AIR capable of recording flight path and speed parameters displayed to the pilot(s); or
 - c) ADRS capable of recording the essential parameters defined in Table- 5 of Appendix-I.

Note-1- "The application for "type certification is submitted" refers to the date of application of the original "Type Certificate" for the helicopter type, not the date of certification of particular helicopter variants or derivative models.

- 8.6 All helicopters of a maximum certificated take-off mass of 3175 kg or less for which the individual certificate of airworthiness is first issued on or after 1 January 2018 should be equipped with:
- a) Type IV A FDR; or
 - b) Class C AIR capable of recording flight path and speed parameters displayed to the pilot (s); or
 - c) ADRS capable of recording the essential parameters defined in Table-5 of Appendix- I.
- 8.7 A person shall not fly a helicopter of a maximum certificated take-off mass of over—
- a) 2,730 kg shall be equipped with a Type V FDR to record the parameters required to determine accurately the helicopter flight path, speed, attitude and engine power.
- 8.8 An operator shall ensure, to the extent possible, in the event the helicopter becomes involved in an accident or incident, the preservation of all related flight recorder records, and if necessary the associated flight recorders, and their retention in safe custody pending their disposition in accordance with Civil Aviation (Instruments and Equipment) Regulations.

9.0 COMBINATION RECORDERS

- 9.1 Combination recorders (FDR/CVR) may be used to meet the flight recorder equipage requirements.
- 9.2 All airplanes of a maximum certificated take-off mass of over 5700kg for which the application for type certification is submitted on or after 1 January 2016 and which are required to be equipped with both a CVR and an FDR, shall be equipped with two combination recorders (FDR/CVR). One recorder shall be located as close to the cockpit as practicable and the other recorder located as far aft as practicable.
- 9.3 All aeroplanes of a maximum certificated take-off mass of over 15000kg for which the application for type certification is submitted to on or after 1 January 2016 and which are required to be equipped with both a CVR and an FDR, shall be equipped with two combination recorders (FDR/CVR). One recorder shall be located as close to the cockpit as practicable and the other recorder located as far aft as practicable.
- 9.4 All aeroplanes of a maximum certificated take-off mass over 5700kg, required to be equipped with an FDR and a CVR, may alternatively be equipped with two combination recorders (FDR/CVR).
- 9.5 5.5 All multi-engined turbine-powered aeroplanes of a maximum certificated take-off mass of 5700kg or less, required to be equipped with an FDR and a CVR, may alternatively be equipped with one combination recorder (FDR/CVR).

- 9.6 Means shall be provided for an accurate time correlation between the recorder systems recordings.
- 9.7 The manufacturer shall provide the appropriate certificating authority with the following information in respect of the flight recorder systems:
- 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.

2.0 AUTOMATIC DEPLOYABLE FLIGHT RECORDER (ADFR)

3.0 The following requirements shall apply to an ADFR:

- a) deployment shall take place when the aeroplane structure has been significantly deformed;
- b) deployment shall take place when an aeroplane sinks in water;
- c) ADFR shall not be capable of manual deployment;
- d) the ADFR shall be able to float on water;
- e) the ADFR deployment shall not compromise the safe continuation of the flight;
- f) the ADFR deployment shall not significantly reduce the chance of survival of the recorder and of successful transmission by its ELT;
- g) the ADFR deployment shall not release more than one piece;
- h) an alert shall be made to the flight crew when the ADFR is no longer captive to the aircraft;
- i) the flight crew shall have no means to disable ADFR deployment when the aircraft is airborne;
- j) the ADFR shall contain an integrated ELT, which shall activate automatically during the deployment sequence. Such ELT may be of a type that is activated in-flight and provides information from which a position can be determined; and
- k) the integrated ELT of an ADFR shall satisfy the same requirements as an ELT required to be installed on an aeroplane. The integrated ELT shall at least have the same performance as the fixed ELT to maximize detection of the transmitted signal.

10.0 DATA LINK RECORDERS

- 10.1 All aeroplanes and helicopters for which the individual certificate of airworthiness are first issued on or after 1 January 2016, which utilize any of the data link communications applications listed in para 6.4 are required to carry a CVR, shall record on a flight recorder the data link communications messages.
- 10.2 All aeroplanes and helicopter which are modified on or after 1 January 2016 to install and utilize any of the data link communications applications are required to carry a CVR shall record on a flight recorder the data link communications messages.

Note 1 - Data link communications are currently conducted by either ATN-based or FANS 1/A-equipped aircraft.

Note 2 -A Class B AIR (Airborne Image Recorder) could be a means for recording data link communications applications messages to and from the aeroplanes/helicopters where it is not practical or is prohibitively expensive to record those data link communications applications messages on FDR or CVR.

- 10.3 The minimum recording duration shall be equal to the duration of the CVR.
- 10.4 Data link recording shall be able to be correlated to the recorded cockpit audio.

10.5 Where the aircraft/helicopter flight path is authorized or controlled through the use of data link messages, all data link messages, both uplinks (to the aircraft/helicopter) and downlinks (from the aircraft/helicopter), shall be recorded on the aircraft/helicopter. As far as practicable, the time the messages were displayed to the flight crew and the time of the responses shall be recorded.

10.6 Messages applying to the applications listed below shall be recorded. Applications without the asterisk (*) are mandatory applications which shall be recorded regardless of the system complexity. Applications with an (*) shall be recorded only as far as is practicable given the architecture of the system.

- Data link initiation capability
- Controller–pilot data link communications
- Data link – flight information services
- Automatic dependent surveillance – contract
- Automatic dependent surveillance – broadcast*
- Aeronautical operational control*.

Note- 1- Sufficient information to derive the content of the data link communications message and the time the messages were displayed to the flight crew is needed to determine an accurate sequence of events on board the aircraft/helicopter.

Note-2- Descriptions of the applications for Data Link Recorders are contained in Table-3 of Appendix-I.

11.0 AIRBORNE IMAGE RECORDER (AIR) AND AIRBORNE IMAGE RECORDING SYSTEM (AIRS)

11.1 The AIR or AIRS must start to record prior to the aeroplane/ helicopter moving under its own power and record continuously until the termination of the flight when the aeroplane/ helicopter is no longer capable of moving under its own power. In addition, depending on the availability of electrical power, the AIR or AIRS must start to record as early as possible during the cockpit checks prior to engine start at the beginning of the flight until the cockpit checks immediately following engine shutdown at the end of the flight.

11.2 A Class “A” AIR or AIRS captures the general cockpit area in order to provide data supplemental to conventional flight recorders.

11.3 A Class “B” AIR or AIRS captures data link message displays.

11.4 A Class “C” AIR or AIRS captures instruments and control panels.

Note 1- There are no provisions for Class “A” AIRs or AIRS in this CAR.

Note-2- A Class C AIR or AIRS may be considered as a means for recording flight data where it is not practical or is prohibitively expensive to record on an FDR or an ADRS or where an FDR is not required.

Note-3- To respect crew privacy, the cockpit area view may be designed as far as practical to exclude the head and shoulders of crew members whilst seated in their normal operating position.

12.0 AIRCRAFT DATA RECORDING SYSTEMS (ADRS)

12.1 Additional information: the measurement range, recording interval and accuracy of parameters on

installed equipment is usually verified by methods approved by the Authority.

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

13.0 FLIGHT RECORDER ELECTRONIC DOCUMENTATION

- 13.1 It is recommended that the documentation requirement concerning FDR and ADRS parameters provided by operators to accident investigation authorities should be in electronic format and take account of industry specifications.

Note-- Industry specification for documentation concerning flight recorder parameters may be found in the ARINC 647A, Flight Recorder Electronic Documentation, or equivalent document.

14.0 FLIGHT RECORDER RECORDS

- 14.1 The pilot in-command, and/or owner/operator, shall ensure, to the extent possible, in the event the aeroplane/helicopter becomes involved in an accident or incident, the preservation of all related flight recorder records and, if necessary, the associated flight recorders, and their retention in safe custody pending their disposition in accordance with civil aviation requirements.

15.0 COCKPIT VOICE RECORDER AND COCKPIT AUDIO RECORDING SYSTEM

- 15.1 The objective is to record the aural environment on the flight deck during flight time.
- 15.2 All CVRs shall be capable of retaining the information recorded during at least the last thirty minutes of their operation.
- 15.3 From 1st January 2016, all CVRs shall be capable of retaining the information recorded during at least the last two hours of their operation.
- 15.4 An Air Operator Certificate (AOC) holder shall not operate an aeroplane of a maximum certificated takeoff mass of 5, 700kg unless the aeroplane is equipped with a CVR.
- 15.5 All turbine-engine aeroplanes of a maximum certificated take-off mass of over 5 700 kg for which the application for type certification is submitted to a Contracting State on or after 1 January 2016 and required to be operated by more than one pilot shall be equipped with a CVR.
- 15.6 A turbine – engine aeroplane of a maximum certificated takeoff mass of 27, 000kg or above, that is, of a type of which the prototype was certificated by the appropriate Authority before the 30th September, 1969.
- 15.7 “Prototype” means an aircraft in respect of which an application has been made for a C of A and the design of which has previously been investigated in connection with any such application;
- 15.8 All aeroplanes of a maximum certificated take-off mass of over 5 700 kg, up to and including 27 000 kg, for which the individual certificate of airworthiness is first issued on or after 1 January 1987, should be equipped with a CVR.

15.9 All helicopters for which the individual certificate of airworthiness is first issued after the 1st January, 2005, which utilize data link communications and are required to carry a CVR, shall record on a flight recorder all data link communications to and from the helicopter. The minimum recording duration shall be equal to the duration of the CVR and shall be correlated to the recorded cockpit audio.

15.10 From the 1st January 2007, all helicopters which utilize data link communications and are required to carry a CVR, shall record on a flight recorder, all data link communications to and from the helicopter. The minimum recording duration shall be equal to the duration of the CVR and shall be correlated to the recorded cockpit audio.

15.11 A CVR container shall—

- 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.

15.12 The CVR and CARS shall start to record prior to the aeroplane moving under its own power and record continuously until the termination of the flight when the aeroplane is no longer capable of moving under its own power. In addition, depending on the availability of electrical power, the CVR and CARS shall start to record as early as possible during the cockpit checks prior to engine start at the beginning of the flight until the cockpit checks immediately following engine shutdown at the end of the flight.

15.13 The preferred channel allocation shall be as follows:

Channel 1 — co-pilot headphones and live boom microphone

Channel 2 — pilot headphones and live boom microphone

Channel 3 — area microphone

Channel 4 — time reference plus the third and fourth crew members' headphone and live microphone, if applicable.

Note 1 — Channel 1 is located closest to the base of the recording head.

Note 2 — The preferred channel allocation presumes use of current conventional magnetic tape transport mechanisms and is specified because the outer edges of the tape have a higher risk of damage than the middle. It is not intended to preclude use of alternative recording media where such constraints may not apply.

15.14 The CVR shall record on four separate channels, or more, at least the following:

- a) voice communication transmitted from or received in the aeroplane by radio;
- b) aural environment on the flight deck;
- c) voice communication of flight crew members on the flight deck using the aeroplane's interphone system, if installed;
- d) voice or audio signals identifying navigation or approach aids introduced in the headset or speaker; and
- e) digital communications with ATS, unless recorded by the FDR.

15.15 The CARS shall record on two separate channels, or more, at least the following:

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

- c) voice communication of flight crew members on the flight deck using the aeroplane's interphone system, if installed.

15.16 Prior to the first flight of the day, the built-in test features for the flight recorders and flight data acquisition unit (FDAU), when installed, shall be monitored by manual and/or automatic checks.

15.17 To assess the serviceability of the CVR system checks and functional tests are recommended as follows:

- a) Confirm the proper recording on each voice channel of all the required audio inputs as follow:
 - i) all voice communications transmitted from or received by the aircraft communications equipment
 - ii) all conversation on the flight deck;
 - iii) voice communications of flight crew-members on the flight deck, using the aircraft's interphone system;
 - iv) voice or audio signals identifying navigation aids introduced into the aircraft audio system;
 - v) audio signals from alerting or warning devices on the flight deck, both fully integrated with the aircraft audio system and non-integrated;
 - vi) general flight deck sounds, monitor the Cockpit Area Microphone (CAM) to ensure that it satisfactorily picks up all cockpit sounds;
 - vii) voice communications of flight crew-members using the passenger address system; and
 - viii) ensure that the "Hot Microphone" facility is operational for each boom microphone station that the aircraft is equipped with.
- a) For each channel ensure that the quality of reproduction has not deteriorated below an optimal audible level.

Note: For solid state devices, this may require the removal of the CVR from the aircraft and a bench check carried out to verify the integrity of the reproduction)

Note 1: The quality of reproduction of some cockpit voice recorders can be affected by ground operation of auxiliary power units and ground power units.

Note 2: Some phone jacks in cockpit voice recorder cockpit monitors are not wired for operation.

- b) In installations incorporating crash sensors ("G" switches) in the cockpit voice recorder power feed, check the operation of these switches in accordance with the manufacturer's procedures. (This may necessitate removal from the aircraft and checking in a workshop).
- c) Confirm the proper functioning of the bulk erase inhibit logic.
- d) Confirm the correct operation of the CVR failure annunciator where fitted.
- e) Confirm that the self-test indicator functions correctly. The aircraft flight manual will provide details if the Aircraft Maintenance Manual or STC does not specify the correct indications.

15.18 Underwater Locator Device (ULD) Maintenance program should specify:

- a) Life limits on the battery.
- b) Cleaning of the switches (contacts).
- c) Periodic checking of the device in accordance with the manufacturer's requirements.

1.7.1 The System of Maintenance should follow the aircraft manufacturer's recommendations, however

where the aircraft manufacturer's program is deficient or specifies the use of the component manufacturer's repair and overhaul limits, Overhaul (when required), and Retirement of heat absorption material must be considered.

15.19 A person shall not fly an aeroplane unless the aeroplane is equipped with a CVR installed as required and designed to record at least the following voice communication transmitted from or received in the aircraft by radio —

- a) aural environment on the flight cockpit;
- b) voice communication of flight crewmembers in the cockpit using aircraft's interphone system;
- c) voice or audio signals identifying navigation or approach aids introduced in the headset or speaker;
- d) voice communication of flight crewmembers using passenger address system, if installed; and
- e) digital communications with ATS, unless recorded by the flight data recorder.



Kenya Civil Aviation Authority

APPENDIX- I

1.0 GENERAL

- 1.1 The flight recorder systems shall be installed so that:
 - a) the probability of damage to the recordings is minimized;
 - b) they receive electrical power from a bus that provides the maximum reliability for operation of the flight recorder systems without jeopardizing service to essential or emergency loads;
 - c) there is an aural or visual means for pre-flight checking that the flight recorder systems are operating properly; and
 - d) if the flight recorder systems have a bulk erasure device, the same shall be deactivated.
- 1.2 Operational checks and evaluations of recordings from the flight recorder systems shall be conducted to ensure the continued serviceability of the recorders.
- 1.3 The flight recorder systems, when tested by methods approved by the Authority, shall be demonstrated to be suitable for the environmental extremes over which they are designed to operate.
- 1.4 Means shall be provided for an accurate time correlation between the flight recorder systems recordings.
- 1.5 The manufacturer shall provide the appropriate certificating authority with the following information in respect of the flight recording systems:
 - a) manufacturer's operating instructions, equipment limitations and installation
 - b) procedures;
 - c) parameter origin or source and equations which relate counts to units of measurement; and
 - d) manufacturer's test reports.
- 1.5.1 When parameters of altitude and airspeed are provided by sensors that are dedicated to the FDR system, there shall be a recalibration performed as recommended by the sensor manufacturer, or at least every two years.
- 1.6 Annual inspections shall be carried out as follows:
 - a) an analysis of the recorded data from the flight recorders shall ensure that the recorder operates correctly for the nominal duration of the recording;
 - b) the analysis of the FDR shall evaluate the quality of the recorded data to determine if the bit error rate (including those errors introduced by recorder, the acquisition unit, the source of the data on the helicopter and by the tools used to extract the data from the recorder) is within acceptable limits and to determine the nature and distribution of the errors;
 - c) a complete flight from the FDR shall be examined in engineering units to evaluate the validity of all recorded parameters. Particular attention shall be given to parameters from sensors dedicated to the FDR. Parameters taken from the aircraft's electrical bus system need not be checked if their serviceability can be detected by other aircraft systems;
 - d) the readout facility shall have the necessary software to accurately convert the recorded values to engineering units and to determine the status of discrete signals;
 - e) an annual examination of the recorded signal on the CVR shall be carried out by replay of the CVR recording. While installed in the aircraft, the CVR shall record test signals from each aircraft source and from relevant external sources to ensure that all required signals meet intelligibility standards;
 - f) where practicable, during the annual examination, a sample of in-flight recordings of the CVR shall be examined for evidence that the intelligibility of the signal is acceptable; and
 - g) an annual examination of the recorded images on the AIR shall be carried out by replay of the AIR recording. While installed in the aircraft, the AIR shall record test images from each aircraft source and from relevant external sources to ensure that all required images meet recording quality standards.
- 1.6.1 Flight recorder system shall be considered unserviceable if there is a significant period of poor quality data, unintelligible signals, or if one or more of the mandatory parameters is not recorded correctly.
- 1.6.2 A report of the annual inspection shall be made available on request to the authority for monitoring purposes.

2.0 PARAMETERS TO BE RECORDED

2.1 Aeroplane

2.1.1 Flight data recorders for aeroplanes shall be classified as Type I, Type IA and Type II depending upon the number of parameters to be recorded.

2.1.2 The parameters that satisfy the requirements for FDRs are listed in the paragraphs below. The number of parameters to be recorded shall depend on aero plane complexity. The parameters without an asterisk (*) are mandatory parameters which shall be recorded regardless of aeroplane complexity. In addition, the parameters designated by an asterisk (*) shall be recorded if an information data source for the parameter is used by aeroplane systems or the flight crew to operate the aeroplane. However, other parameters may be substituted with due regard to the aeroplane type and the characteristics of the recording equipment.

2.1.3 The following parameters shall satisfy the requirements for flight path and speed:

- Pressure altitude
- Indicated airspeed or calibrated airspeed
- Air-ground status and each landing gear air-ground sensor when practicable
- Total or outside air temperature — Heading (primary flight crew reference)
- Normal acceleration
- Lateral acceleration
- Longitudinal acceleration (body axis)
- Time or relative time count
- Navigation data*: drift angle, wind speed, wind direction, latitude/longitude
- Groundspeed*
- Radio altitude*

2.1.4 The following parameters shall satisfy the requirements for attitude:

- Pitch attitude
- Roll attitude
- Yaw or sideslip angle*
- Angle of attack*

2.1.5 The following parameters shall satisfy the requirements for engine power:

- Engine thrust/power: propulsive thrust/power on each engine, cockpit thrust/power lever position
- Thrust reverse status*
- Engine thrust command*
- Engine thrust target*
- Engine bleed valve position*
- Additional engine parameters*: EPR, N1, indicated vibration level, N2, EGT, TLA, fuel flow, fuel cut-off lever position, N3

2.1.6 The following parameters shall satisfy the requirements for configuration:

- Pitch trim surface position
- Flaps*: trailing edge flap position, cockpit control selection
- Slats*: leading edge flap (slat) position, cockpit control selection
- Landing gear*: landing gear, gear selector position
- Yaw trim surface position*
- Roll trim surface position*
- Cockpit trim control input position pitch*
- Cockpit trim control input position roll*
- Cockpit trim control input position yaw*
- Ground spoiler and speed brake*: Ground spoiler position, ground spoiler selection, speed brake position, speed brake selection
- De-icing and/or anti-icing systems selection*
- Hydraulic pressure (each system) *

- Fuel quantity in CG trim tank *
- AC electrical bus status*
- DC electrical bus status*
- APU bleed valve position*
- Computed centre of gravity*

2.1.7 The following parameters shall satisfy the requirements for operation:

- Warnings
- Primary flight control surface and primary flight control pilot input: pitch axis, roll axis, yaw axis
- Marker beacon passage
- Each navigation receiver frequency selection
- Manual radio transmission keying and CVR/FDR synchronization reference
- Autopilot/auto throttle/AFCS mode and engagement status*
- Selected barometric setting*: pilot, first officer
- Selected altitude (all pilot selectable modes of operation) *
- Selected speed (all pilot selectable modes of operation) *
- Selected Mach (all pilot selectable modes of operation) *
- Selected vertical speed (all pilot selectable modes of operation) *
- Selected heading (all pilot selectable modes of operation) *
- Selected flight path (all pilot selectable modes of operation) *: course/DSTRK, path angle
- Selected decision height*
- EFIS display format*: pilot, first officer
- Multi-function/engine/alerts display format*
- GPWS/TAWS/GCAS status*: selection of terrain display mode including pop-up display status, terrain alerts, both cautions and warnings, and advisories, on/off switch position
- Low pressure warning*: hydraulic pressure, pneumatic pressure
- Computer failure*
- Loss of cabin pressure*
- TCAS/ACAS (traffic alert and collision avoidance system/airborne collision avoidance system) *
- Ice detection*
- Engine warning each engine vibration*
- Engine warning each engine over temperature*
- Engine warning each engine oil pressure low*
- Engine warning each engine over speed*
- Wind shear warning*
- Operational stall protection, stick shaker and pusher activation*
- All cockpit flight control input forces*: control wheel, control column, rudder pedal cockpit input forces
- Vertical deviation*: ILS glide path, MLS elevation, GNSS approach path
- Horizontal deviation*: ILS localizer, MLS azimuth, GNSS approach path
- DME 1 and 2 distances*
- Primary navigation system reference*: GNSS, INS, VOR/DME, MLS, Loran C, ILS
- Brakes*: left and right brake pressure, left and right brake pedal position
- Date*
- Event marker*
- Head up display in use*
- Para visual display on*

Note— It is not intended that aeroplanes issued with an individual certificate of airworthiness before 1 January 2016 be modified to meet the range, sampling, accuracy or resolution guidance detailed in this Appendix.

- 2.1.8 Type IA FDR: This FDR shall be capable of recording, as appropriate to the aeroplane, at least the 78 parameters as given in Table-1 of Appendix-I.
- 2.1.9 Type I FDR: This FDR shall be capable of recording, as appropriate to the aeroplane, at least the first 32 parameters as given in Table-1 of Appendix-I.
- 2.1.10 Types II: This FDR shall be capable of recording, as appropriate to the aeroplane, at least the first 15 parameters when used for General aviation and 16 parameters (including longitudinal acceleration) for commercial operation respectively as given in Table-1 of Appendix-I.
- 2.1.11 The parameters that satisfy the requirements for flight path and speed as displayed to the pilot(s) are listed below. The parameters without an (*) are mandatory parameters which shall be recorded. In addition, the parameters designated by an (*) shall be recorded if an information source for the parameter is displayed to the pilot and is practicable to record:
- Pressure altitude
 - Indicated airspeed or calibrated airspeed
 - Heading (primary flight crew reference)
 - Pitch attitude
 - Roll attitude
 - Engine thrust/power
 - Landing-gear status*
 - Total or outside air temperature*
 - Time*
 - Navigation data*: drift angle, wind speed, wind direction, latitude/longitude
 - Radio altitude*
- 2.1.12 The measurement range, recording interval and accuracy of parameters on installed equipment shall be verified by methods approved by the appropriate certificating authority.
- 2.1.13 Documentation concerning parameter allocation, conversion equations, periodic calibration and other serviceability/maintenance information shall be maintained by the operator. The documentation needs to be sufficient to ensure that accident investigation authorities have the necessary information to read out the data in engineering units.

2.2 Helicopters

- 2.2.1 Flight data recorders for helicopters shall be classified as Type IVA, IV and V depending upon the number of parameters to be recorded.
- 2.2.2 The parameters that satisfy the requirements for Types IVA, IV and V FDRs, are listed in the paragraphs below. The number of parameters to be recorded shall depend on helicopter complexity. The parameters without an asterisk (*) are mandatory parameters which shall be recorded regardless of helicopter complexity. In addition, the parameters designated by an asterisk (*) shall be recorded if an information data source for the parameter is used by helicopter systems or the flight crew to operate the helicopter. However, other parameters may be substituted with due regard to the helicopter type and the characteristics of the recording equipment.
- 2.2.3 The following parameters shall satisfy the requirements for flight path and speed:
- Pressure altitude
 - Indicated airspeed
 - Outside air temperature
 - Heading
 - Normal acceleration
 - Lateral acceleration
 - Longitudinal acceleration (body axis)
 - Time or relative time count

- Navigation data*: drift angle, wind speed, wind direction, latitude/longitude
- Radio altitude*.

2.2.4 The following parameters shall satisfy the requirements for attitude:

- Pitch attitude
- Roll attitude
- Yaw rate.

2.2.5 The following parameters shall satisfy the requirements for engine power:

- Power on each engine: free power turbine speed (Nf), engine torque, engine gas generator speed (Ng), cockpit power control position
- Rotor: main rotor speed, rotor brake
- Main gearbox oil pressure*
- Gearbox oil temperature*: main gearbox oil temperature, intermediate gearbox oil temperature, tail rotor gearbox oil temperature
- Engine exhaust gas temperature (T4) *
- Turbine inlet temperature (TIT)*.

2.2.6 The following parameters shall satisfy the requirements for operation:

- Hydraulics low pressure
- Warnings
- Primary flight controls
- pilot input and/or control output position: collective pitch, longitudinal cyclic pitch, lateral cyclic pitch, tail rotor pedal, controllable stabilator, hydraulic selection
- Marker beacon passage
- Each navigation receiver frequency selection
- AFCS mode and engagement status*
- Stability augmentation system engagement*
- Indicated sling load force*
- Vertical deviation*: ILS glide path, MLS elevation, GNSS approach path
- Horizontal deviation*: ILS localizer, MLS azimuth, GNSS approach path
- DME 1 and 2 distances* — Altitude rate* — Ice detector liquid water content*
- Helicopter health and usage monitor system (HUMS)*: engine data, chip detectors, channel timing, exceedance discrete, broadband average engine vibration

2.2.7 The following parameters shall satisfy the requirements for configuration:

- Landing gear or gear selector position*
- Fuel contents*
- Ice detector liquid water content*.

2.2.8 Type IVA FDR: This FDR shall be capable of recording, as appropriate to the helicopter, at least the 48 parameters in as given in Table-2 of Appendix-I.

2.2.9 Type IV FDR: This FDR shall be capable of recording, as appropriate to the helicopter, at least the first 30 parameters as given in Table-2 of Appendix-I.

2.2.10 Type V FDR: This FDR shall be capable of recording, as appropriate to the helicopter, at least the first 15 parameters as given in Table-2 of Appendix-I.

2.2.11 If further recording capacity is available, recording of the following additional information shall be considered:

- a) additional operational information from electronic displays, such as electronic flight instrument systems (EFIS), electronic centralized aircraft monitor (ECAM) and engine indication and crew alerting system (EICAS); and
- b) additional engine parameters (EPR, N1, fuel flow, etc.).

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

2.2.13 Documentation concerning parameter allocation, conversion equations, periodic calibration and other

serviceability/maintenance information shall be maintained by the operator/owner. The documentation shall be sufficient to ensure that accident investigation authorities have the necessary information to read out the data in engineering units

3.0 RECORDING INTERVAL

- 3.1 The flight recorders shall start to record prior to the aeroplane/helicopter moving under its own power and record continuously until the termination of the flight when the aeroplane/helicopter is no longer capable of moving under its own power.

4.0 INSPECTION OF FLIGHT RECORDER SYSTEM

- 4.1 Prior to the first flight of the day, the built-in test features for the flight recorders and flight data acquisition unit (FDAU), when installed, shall be monitored by manual and/or automatic checks.
- 4.2 FDR systems or ADRS and AIR systems or AIRS shall have recording system inspection intervals of one year; subject to the approval from the appropriate regulatory authority, this period may be extended to two years provided these systems have demonstrated a high integrity of serviceability and self-monitoring. DLR systems or DLRS shall have recording system inspection intervals of two years; subject to the approval from the appropriate regulatory authority, this period may be extended to four years provided these systems have demonstrated high integrity of serviceability and self-monitoring.
- 4.3 Recording system inspections shall be carried out as follows:
- a) an analysis of the recorded data from the flight recorders shall ensure that the recorder operates correctly for the nominal duration of the recording;
 - b) the analysis of the FDR or the ADRS shall evaluate the quality of the recorded data to determine if the bit error rate (including those errors introduced by recorder, the acquisition unit, the source of the data on the aeroplane/helicopter and by the tools used to extract the data from the recorder) is within acceptable limits and to determine the nature and distribution of the errors;
 - c) a complete flight from the FDR or the ADRS shall be examined in engineering units to evaluate the validity of all recorded parameters. Particular attention shall be given to parameters from sensors dedicated to the FDR or the ADRS. Parameters taken from the aircraft's electrical bus system need not be checked if their serviceability can be detected by other aircraft systems;
 - d) the readout facility shall have the necessary software to accurately convert the recorded values to engineering units and to determine the status of discrete signals;
 - e) an examination of the recorded images on the AIR or AIRS shall be carried out by replay of the AIR or AIRS recording. While installed in the aircraft, the AIR or AIRS shall record test images from each aircraft source and from relevant external sources to ensure that all required images meet recording quality standards.
- 4.4 A flight recorder system shall be considered unserviceable if there is a significant period of poor quality data, unintelligible signals, or if one or more of the mandatory parameters is not recorded correctly.
- 4.5 A report of the recording system shall be made available on request to DGCA for monitoring purposes.

5.0 CALIBRATION OF FLIGHT RECORDER SYSTEMS

- a) For those parameters which have sensors dedicated only to the FDR and are not checked by other means, recalibration shall be carried out at least every five years or in accordance with the recommendations of the sensor manufacturer to determine any discrepancies in the engineering conversion routines for the mandatory parameters and to ensure that parameters are being recorded within the calibration tolerances; and
- b) when the parameters of altitude and airspeed are provided by sensors that are dedicated to the FDR system, there shall be a recalibration performed as recommended by the sensor manufacturer, or at least every two years.

APPENDIX 1

Table 1

PARAMETER GUIDANCE FOR FLIGHT DATA RECORDERS (FDR) – AEROPLANES

Serial number	Parameter	Measurement range	Maximum sampling and Recording interval (seconds)	Accuracy limits (sensor input compared to FDR read-out)	Recording resolution
1.	Time (UTC when available, otherwise relative time count or GPS time sync)	24 hours	4	±0.125% per hour	1 second
2.	Pressure-altitude	–300 m (–1000 ft) to maximum certificated altitude of aircraft +1500 m (+5000 ft)	1	±30 m to ±200 m (±100 ft to ±700 ft)	1.5 m (5 ft)
3.	Indicated airspeed or calibrated airspeed	95 km/h (50 kt) to max V _{SO} (Note 1) V _{SO} to 1.2 V _D (Note 2)	1	±5% ±3%	1 kt (0.5 kt recommended)
4.	Heading (primary flight crew reference)	360°	1	±2°	0.5°
5.	Normal acceleration (Note 3)	–3 g to +6 g	0.125	±1% of maximum range excluding datum error of ±5%	0.004 g
6.	Pitch attitude	±75° or usable range whichever is greater	0.25	±2°	0.5°
7.	Roll attitude Radio transmission keying	±180° On-off (one	0.25	±2°	0.5°
8.	Radio transmission keying	On off (one discrete)	1	-	-
9.	Power on each engine (Note 4)	Full range	1 (per engine)	±2%	0.2% of full range or the resolution required to operate the aircraft
10.	Trailing edge flap and cockpit control selection	Full range or each discrete position			0.5% of full range or the resolution required to operate the aircraft
11.	Leading edge flap and cockpit control selection	Full range or each discrete position	2	±5% or as pilot's indicator	0.5% of full range or the resolution required to operate the aircraft
12.	Thrust Reverser	Position Stowed, In transit and reverse	1 (per engine)	-	-
13.	Ground spoilers/speed brake selection	Full range or each discrete position	1	±2% unless higher accuracy	±2% of full range

				uniquely required	
14.	Outside air temperature	Sensor range	2	±2°C	0.3°C
15.	Autopilot/Autothrottle/AFC Mode and Engagement status	A suitable combination of discreet	1	-	-
Note: – For General Aviation Aeroplane the preceding 15 parameters satisfy the requirements for a Type II FDR.					
16.	Longitudinal acceleration (Note3)	±1g	0.25	±0.015g excluding a datum error of ±0.005g	0.04g
Note: – For Commercial Air transport Aeroplane the preceding 16 parameters satisfy the requirements for a Type II FDR.					
17.	Lateral Acceleration Note 3	±1g	0.25	±0.015g excluding a datum error of ±0.005g	0.04g
18.	Pilot input and/or control surface position – primary controls (pitch, roll, yaw) note 5 and 6	Full range	0.25	±2% unless higher accuracy uniquely required	0.2% of full range or as installed
19.	Pitch trim position	Full range	1	±3% unless higher accuracy uniquely required	0.3% of full range or as installed
20.	Radio altitude	- 6m to 750m (120feet to 2500 feet)	1	±0.6 m (±2 ft) or ±3% whichever is greater below 150m (500 ft) and ±5% above 150m (500ft)	±0.3 m (1 ft) below 150m (500 ft). 0.3m (1ft+0.5% of full range above 150m (500ft))
21.	Vertical beam deviation (ILS/GPS/GLS glide path, MLS elevation, IRNAV/IAN vertical deviation)	Signal range	1	±3%	0.3% of full range
22.	Horizontal beam deviation (ILS/GPS/GLS localizer, MLS azimuth, IRNAV/IAN lateral deviation)	Signal range	1	±3%	0.3% of full range
23.	Marker beacon passage	Discreet	1	-	-
24.	Master Warning	Discreet	1	-	-
25.	Each NAV receiver frequency selection (Note 7)	Full range	4	As installed	
26.	DME 1 and 2 Distance	0-370 km	4	As installed	1852m (1NM)
	(Notes 7 and 8)	(0-200NM)			
27.	Air/Ground status	Discreet	1	-	-
28.	GPWS (Ground Proximity Warning Systems)	Discreet	1	-	-
29.	Angle of Attack	Full range	0.5	As installed	0.3% of full range
30.	Hydraulics, each system (Low pressure)	Discreet	2		0.5% of full range
31.	Navigation data (latitude/ longitude, ground speed and drift angle) (Note 9)	As installed	1	As installed	-
32.	Landing gear and gear selector position	Discreet	4	As installed	-
Note: – The preceding 32 parameters satisfy the requirements for a Type I FDR.					

33.	Ground speed	As installed	1	Data should be obtained from the most accurate system	1kt
34.	Brakes (left and right brake pressure, left and right brake pedal position)	(Maximum metered brake range, discrete or full range)	1	±5%	2% of full range
35.	Additional engine parameters (EPR, N1, indicated vibration level, N2, EGT, fuel flow, fuel cut-off lever position, N3)	As installed	Each engine each second	As installed	2% of full range
36.	TCAS/ACAS (traffic alert and collision avoidance system)	Discrete	1	As installed	-
37.	Wind shear warning	Discrete	1	As installed	-
38.	Selected barometric setting (pilot, co-pilot)	As installed	64	As installed	0.1 mb (0.01 in-Hg)
39.	Selected altitude (all pilot selectable modes of operation)	As installed	1	As installed	Sufficient to determine crew selection
40.	Selected flight path (all pilot selectable modes of operation)(course/DSTRK, path angle, final approach path (IRNAV/IAN))	As installed	1	As installed	Sufficient to determine crew selection
41.	Selected Mach (all pilot selectable modes of operation)	As installed	1	As installed	Sufficient to determine crew selection
42.	Selected vertical speed (all pilot selectable modes of operation)	As installed	1	As installed	Sufficient to determine crew selection
43.	Selected heading (all pilot selectable modes of operation)	As installed	1	As installed	Sufficient to determine crew selection
44.	Selected flight path (all pilot selectable modes of operation)(course/DSTRK, path angle, final approach path (IRNAV/IAN))	-	1	As installed	-
45.	Selected Decision Height	As installed	64	As installed	Sufficient to determine crew selection
46.	EFIS display format (pilot, co-pilot)	Discrete (s)	4	As installed	-
47.	Multi-function/engine/ alerts display format	Discrete (s)	4	As installed	-
48.	AC electrical bus status	Discrete (s)	4	As installed	-
49.	DC electrical bus status	Discrete (s)	4	As installed	-
50.	Engine bleed valve position	Discrete (s)	4	As installed	-
51.	APU bleed valve position	Discrete (s)	4	As installed	-
52.	Computer Failure	Discrete (s)	4	As installed	-
53.	Engine thrust command	As installed	2	As installed	-
54.	Engine thrust target	As installed	4	As installed	-
55.	Computed centre of gravity	As installed	64	As installed	-

56.	Fuel quantity in CG trim tank	As installed	64	As installed	-
57.	Head up display in use	As installed	4	As installed	-
58.	Para visual display on/off	As installed	1	As installed	-
59.	Operational stall protection, stick shaker and pusher activation	As installed	1	As installed	-
60.	Primary navigation system Reference (GNSS, INS, VOR/DME, MLS, Loran C, Localizer, glide slope)	As installed	1	As installed	-
61.	Ice detection	As installed	4	As installed	-
62.	Engine warning each engine vibration	As installed	1	As installed	-
63.	Engine warning each engine over temperature	As installed	1	As installed	-
64.	Engine warning each engine oil pressure low	As installed	1	As installed	-
65.	Engine warning each engine over speed	As installed	1	As installed	-
66.	Yaw Trim Surface Position	Full range	2	±3% unless higher accuracy uniquely required	0.3% of full range
67.	Roll Trim Surface Position	Full range	2	±3% unless higher accuracy uniquely required	0.3% of full range
68.	Yaw or sideslip angle	Full range	1	±5%	0.5°
69.	De-icing and/or anti-icing systems selection	Discreet (s)	4	-	-
70.	Hydraulic pressure (each system)	Full range	2	±5%	100psi
71.	Loss of cabin pressure	Discreet (s)	1	-	-
72.	Cockpit trim control input position, Pitch	Full range	1	±5%	0.2% of full range or as installed
73.	Cockpit trim control input position, Roll	Full range	1	±5%	0.2% of full range or as installed
74.	Cockpit trim control input position, Yaw	Full range	1	±5%	0.2% of full range or as installed
75.	All cockpit flight control input forces (control wheel, control column, rudder pedal)	Full range (±311 N (±70 lbf), ± 378 N (±85 lbf), ± 734 N (±165 lbf))	1	±5%	0.2% of full range or as installed
76.	Event marker	Discreet	1	-	-

77.	Date	365 days	4	-	-
78.	ANP or EPE or EPU	As installed	4	As installed	

Note: – The preceding 78 parameters satisfy the requirements for a Type IA FDR

Notes—

1. V_{SO} stalling speed or minimum steady flight speed in the landing configuration is in Section “Abbreviations and Symbols”.
2. V_D design diving speed.
3. Refer to 6.10 and 7.6 for increased recording requirements.
4. Record sufficient inputs to determine power.
5. For aeroplanes with control systems in which movement of a control surface will back drive the pilot's control, “or” applies. For aeroplanes with control systems in which movement of a control surface will not back drive the pilot's control, “and” applies. In aeroplanes with split surfaces, a suitable combination of inputs is acceptable in lieu of recording each surface separately.
6. Refer to 6.9 for increased recording requirements.
7. If signal available in digital form.
8. Recording of latitude and longitude from INS or other navigation system is a preferred alternative.
9. If signals readily available.

If further recording capacity is available, recording of the following additional information should be considered:

- a) operational information from electronic display systems, such as electronic flight instrument systems (EFIS), electronic centralized aircraft monitor (ECAM) and engine indication and crew alerting system (EICAS).
Use the following order of priority:
 - i) parameters selected by the flight crew relating to the desired flight path, e.g. barometric pressure setting, selected altitude, selected airspeed, decision height, and autoflight system engagement and mode indications if not recorded from another source;
 - ii) display system selection/status, e.g. SECTOR, PLAN, ROSE, NAV, WXR, COMPOSITE, COPY, ETC.;
 - iii) warnings and alerts;
 - iv) the identity of displayed pages for emergency procedures and checklists; and
- b) retardation information including brake application for use in the investigation of landing overruns and rejected take-offs.

Table 2

PARAMETER GUIDANCE FOR FLIGHT DATA RECORDERS (FDR) – HELICOPTERS

Serial number	Parameter	Measurement range	Maximum sampling and Recording interval (seconds)	Accuracy limits (sensor input compared to FDR read-out)	Recording resolution
1.	Time (UTC when available, otherwise elapse time)	24 hours	4	±0.125% per hour	1 second
2.	Pressure-altitude	–300 m (–1000 ft) to maximum certified altitude of aircraft +1500 m (+5000 ft)	1	±30 m to ±200 m (±100 ft to ±700 ft)	1.5 m (5 ft)
3.	Indicated airspeed	As the installed pilot display measuring system	1	±5%	1 kt
4.	Heading	360°	1	±2°	0.5°
5.	Normal acceleration	–3 g to +6 g	0.125	±0.09g excluding a datum error of ±0.045g	0.004 g
6.	Pitch attitude	±75° or 100% of usable range whichever is greater	0.5	±2°	0.5°
7.	Roll attitude	±180°	0.5	±2°	0.5°
8.	Radio transmission keying	On - off (one discrete)	1	-	-
9.	Power on each engine	Full range	1 (per engine)	±2%	0.1% of full range
10.	Main Rotor: Main Rotor Speed Rotor Brake	50-130% Discrete	0.51 -	±2% -	0.5% of full range -
11.	Pilot input control surface – primary (collective pitch, and/or position controls longitudinal cyclic pitch, lateral cyclic pitch, tail rotor pedal)	Full range	0.5 (0.25 recommended)	±2% unless higher accuracy uniquely required	0.5% of operating range
12.	Hydraulics, each system (low pressure and selection)	Discrete	1	-	-
13.	Outside Air Temperature	Sensor range	2	±2°C	0.3°C
14.	Autopilot/Autothrottle/AFC Mode and Engagement status	A suitable combination of discrete	1	-	-
15.	Stability Augmentation System Engagement	Discrete	1	-	-
Note: – The preceding 15 parameters satisfy the requirements for a Type V FDR.					
16.	Main Gearbox oil pressure	As installed	1	As installed	1°C
17.	Main Gearbox oil pressure temperature	As installed	2	As installed	0.04g
18.	Yaw rate	±400°/second	0.25	±1.5% maximum range excluding datum error of ±5%	±2°/s
19.	Sling load force	1-200% of certified load	0.5	±3% of maximum range	0.5% of max certified load

20.	Longitudinal acceleration	$\pm 1g$	0.25	$\pm 0.015 g$ excluding a datum error of $\pm 0.05 g$	0.004g
21.	Lateral acceleration	$\pm 1g$	0.25	$\pm 0.015 g$ excluding a datum error of $\pm 0.05 g$	0.004g
22.	Radial altitude	-6 m to 750 m (-20 ft to 2500 ft)	1	$\pm 0.6 m (\pm 2 ft)$ or $\pm 3\%$ whichever is greater below 150m (500 ft) and $\pm 5\%$ above 150m (500 ft)	0.3 m (1 ft) below 150m (500ft), 0.3m (1 ft) + 0.5% of full range above 150m (500ft)
23.	Vertical Beam Deviation	Signal range	1	$\pm 3\%$	0.3%
24.	Horizontal Beam Deviation	Signal range	1	$\pm 3\%$	0.3%
25.	Marker Beacon Passage	Discreet	1	-	-
26.	Master Warnings	Discreet(s)	1	-	-
27.	Each NAV receiver frequency selection	Sufficient to determine selected frequency	4	As installed	-
28.	DME 1 and 2 distances	0-370km (0-200NM)	4	As installed	152m (1NM)
29.	Navigation data (Latitude/longitude, ground speed, drift angle, windspeed, wind direction)	As installed	2	As installed	As installed
30.	Landing gear and gear selector position	Discreet	4	-	-
Note: – The preceding 30 parameters satisfy the requirements for a Type IV FDR.					
31.	Engine exhaust gas temperature (T4)	As installed	1	As installed	-
32.	Turbine inlet temperature (TIT/ITT)	As installed	1	As installed	-
33.	Fuel content	As installed	4	As installed	-
34.	Altitude rate	As installed	1	As installed	-
35.	Ice detection	As installed	4	As installed	-
36.	Helicopter health and usage monitor system	As installed		As installed	-
37.	Engine control mode	Discreet	1	As installed	-
38.	Selected barometric setting (pilot and co-pilot)	As installed	64 (4 recommended)	As installed	0.1 mb (0.01 in-Hg)
39.	Selected altitude (all pilot selectable modes of operation)	As installed	1	As installed	Sufficient to determine crew selection
40.	Selected speed (all pilot selectable modes of operation)	As installed	1	As installed	Sufficient to determine crew selection

41.	Selected Mach (all pilot selectable modes of operation)	As installed	1	As installed	Sufficient to determine crew selection
42.	Selected vertical speed (all pilot selectable modes of operation)	As installed	1	As installed	Sufficient to determine crew selection
43.	Selected heading (all pilot selectable modes of operation)	As installed	1	As installed	Sufficient to determine crew selection
44.	Selected flight path (all pilot selectable modes of operation)	As installed	1	As installed	Sufficient to determine crew selection
45.	Selected Decision Height	As installed	4	As installed	Sufficient to determine crew selection
46.	EFIS display format (pilot and co-pilot)	Discreet	4	-	-
47.	Multi-function/engine/ alerts display format	Discreet	4	-	-
48.	Event marker	Discreet	1	-	-
<i>Note – The preceding 48 parameters satisfy the requirements for a Type IVA FDR.</i>					

Table 3

DESCRIPTION OF APPLICATIONS FOR DATA LINK RECORDERS (Aeroplanes & Helicopters)

Item	Application Type	Application Description	Recording Content
1.	Data link Initiation	This includes any applications used to logon to or initiate data link service. In FANS-1/A and ATN, these are ATS Facilities Notification (AFN) and Context Management (CM) respectively.	C
2.	Controller/Pilot Communication	This includes any application used to exchange requests, clearances, instructions and reports between the flight crew and controllers on the ground. In FANS-1/A and ATN, this includes the CPDLC application. It also includes applications used for the exchange of oceanic (OCL) and departure clearances (DCL) as well as data link delivery of taxi clearances.	C
3.	Addressed Surveillance	This includes any surveillance application in which the ground sets up contracts for delivery of surveillance data. In FANS-1/A and ATN, this includes the Automatic Dependent Surveillance (ADS-C) application. Where parametric data are reported within the message they shall be recorded unless data from the same source are recorded on the FDR.	C
4.	Flight Information	This includes any service used for delivery of flight information to specific aircraft. This includes, for example, D-METAR, DATIS, D-NOTAM and other textual data link services.	C
5.	Aircraft Broadcast Surveillance	This includes Elementary and Enhanced Surveillance Systems, as well as ADS-B output data. Where parametric data sent by the helicopter are reported within the message they shall be recorded unless data from the same source are recorded on the FDR.	M*
6.	Aeronautical Operational Control Data	This includes any application transmitting or receiving data used for AOC purposes (per the ICAO definition of AOC).	M*

Key:

C: Complete contents recorded.

M: Information that enables correlation to any associated records stored separately from the helicopter.

*: Applications that are to be recorded only as far as is practicable given the architecture of the system.

Table 4

PARAMETER GUIDANCE FOR AIRCRAFT DATA RECORDING SYSTEM (ADRS)-AEROPLANES

S/No	Parameter name	Parameter category	Minimum recording range	Maximum recording interval in seconds	Minimum recording accuracy	Minimum recording resolution	Remarks
1.	Heading (Magnetic or True)	R*	±180 degrees	1	±2 degrees	0.5 degree	* If not available, record rates
2.	Pitch attitude	E*	±90 degrees	0.25	±2 degrees	0.5 degree	*If not available, record rates
3.	Roll attitude	E*	±180 degrees	0.25	±2 degrees	0.5 degree	*If not available, record rates
4.	Yaw rate	E*	±300 degrees/S	0.25	±1% + drift of 360 degree/hour	2 degree/s	* Essential if no heading is available
5.	Pitch rate	E*	±300 degrees/S	0.25	±1% + drift of 360 degree/hour	2 degree/s	* Essential if no pitch attitude is available
6.	Roll rate	E*	±300 degrees/s	0.25	±1% + drift of 360 degree/hour	2 degree/s	* Essential if no roll attitude is available
7.	Positioning system: latitude/longitude	E	Latitude: ±90 degrees/S Longitude: ±180 degrees/s	2 (1 if available)	As installed (0.00015degree recommended)	0.00005 degrees	
8.	Positioning system estimated error	E*	Available range	2 (1 if available)	As installed	As installed	If available
9.	Positioning system: altitude	E	-300m (-1000ft) to Maximum certificated altitude of aeroplane +1500m(5000ft)	2 (1 if available)	As installed {±15m (±50ft) recommended}	1.5m (5ft)	
10.	Positioning system: time*	E	24 hours	1	±0.5 second	0.1 second	UTC time preferred where available
11.	Positioning system: ground speed	E	0-1000kt	2 (1 if available)	As installed (±5kt recommended)	1kt	
12.	Positioning system: ground channel	E	0-360°	2 (1 if available)	As installed (±2 degrees recommended)	0.5 degrees	
13.	Normal Acceleration	E	13g-6g (*)	0.25 (0.125 if available)	As installed (±0.09g excluding a datum error of ±0.45g recommended)	0.004g	
14.	Longitudinal	E	±1g (*)	0.25 (0.125	As installed	0.004g	

	Acceleration			if available)	(±0.0015 g excluding a datum error of ±0.05 g recommended)		
15	Lateral Acceleration	E	±1g (*)	0.25 (0.125 if available)	As installed (±0.0015 g excluding a datum error of ±0.05 g recommended)	0.004g	
16	External static pressure (or pressure altitude)	R	34.4mb (3.44 in-Hg) to 310.2mb (31.02in- Hg) or available sensor range	1	As installed (±1 mb (0.1 in-Hg) or ±30 m (±100 ft) to ±210 m (±700ft) recommended)	0.1 mb (0.01-Hg) or 1.5m (5ft)	
17	Outside air temperature (or total air temperature)	R	-50° to +90°C or available sensor range	2	As installed (±2°C recommended)	1°C	
18	Indicated air speed	R	As the installed pilot display measuring system or available sensor range	1	As installed (±3% recommended)	1kt (0.5kt recommended)	
19	Engine RPM	R	Full range including over speed condition	Each engine each second	As installed	0.2% of full range	
20	Engine Oil Pressure	R	Full range	Each engine each second	As installed (5% of full range recommended)	2% of full range	
21	Engine Oil Temperature	R	Full range	Each engine each second	As installed (5% of full range recommended)	2% of full range	
22	Fuel flow oil pressure	R	Full range	Each engine each second	As installed	2% of full range	
23	Manifold pressure	R	Full range	Each engine each second	As installed	0.2% of full range	
24	Engine thrust/power/torque parameters required to determine propulsive thrust/power*	R	Full range	Each engine each second	As installed	0.1% of full range	*sufficient parameters e.g. EPR/N1 as appropriate to the particular engine shall be recorded to determine power in both

							normal and reverse thrust. A Margin for possible over speed should be provided.
25.	Engine gas speed generator (Ng)	R	0-150%	Each engine each second	As installed	0.2% of full range	
26.	Free power turbine speed (Nf)	R	0-150%	Each engine each second	As installed	0.2% of full range	
27.	Coolant temperature	R	Full range	1	As installed (±5% recommended)	1°C	
28.	Main voltage	R	Full range	Each engine each second	As installed	1 volt	
29.	Cylinder head temperature	R	Full range	Each cylinder each second	As installed	2% of full range	
30.	Flap position	R	Full range of each discrete position	2	As installed	0.5°	
31.	Primary flight control surface position	R	Full range	0.25	As installed	0.2% of full range	
32.	Fuel quantity	R	Full range	4	As installed	1% of full range	
33.	Exhaust gas temperature	R	Full range	Each engine each second	As installed	2% of full range	
34.	Emergency voltage	R	Full range	Each engine each second	As installed	1 volt	
35.	Trim surface position	R	Full range of each discrete position	1	As installed	0.3% of full range	
36.	Landing gear position	R	each discrete position	Each gear every 2 seconds	As installed		*Where available, record up-and-locked and down-and-locked position
37.	Novel/unique aircraft features	R	As required	As required	As required	As required	

Key:

E: Essential parameters

R: Recommended parameters

Table 5

PARAMETER GUIDANCE FOR AIRCRAFT DATA RECORDING SYSTEM (ADRS)– HELICOPTERS

S/No	Parameter name	Parameter category	Minimum recording range	Maximum recording interval in seconds	Minimum recording accuracy	Minimum recording resolution	Remarks
1.	Heading (Magnetic or True)	R*	±180 degrees	1	±2 degrees	0.5 degree	*If not available, record rates
2.	Pitch attitude	E*	±90 degrees	0.25	±2 degrees	0.5 degree	*If not available, record rates
3.	Roll attitude	E*	±180 degrees	0.25	±2 degrees	0.5 degree	*If not available, record rates
4.	Yaw rate	E*	±300 degrees/S	0.25	±1% + drift of 360 degree/hour	2 degree/s	* Essential if no heading is available
5.	Pitch rate	E*	±300 degrees/S	0.25	±1% + drift of 360 degree/hour	2 degree/s	* Essential if no pitch attitude is available
6.	Roll rate	E*	±300 degrees/s	0.25	±1% + drift of 360 degree/hour	2 degree/s	* Essential if no roll attitude is available
7.	Positioning system: latitude/longitude	E	Latitude: ±90 degrees Longitude: ±180 degrees	2 (1 if available)	As installed (0.00015degree recommended)	0.00005 degrees	
8.	Positioning system estimated error	E*	Available range	2 (1 if available)	As installed	As installed	*If available
9.	Positioning system: altitude	E	-300m (-1 000ft) to Maximum certificated altitude of aeroplane +1 500m(5000ft)	2 (1 if available)	As installed {±15m (±50ft) recommended}	1.5m (5ft)	
10.	Positioning system: time*	E	24 hours	1	±0.5 second	0.1 second	*UTC time preferred where available
11.	Positioning system: ground speed	E	0-1000kt	2 (1 if available)	As installed (±5kt recommended)	1kt	
12.	Positioning system: track	E	0-360°	2 (1 if available)	As installed (±2 degrees recommended)	0.5 degrees	
13.	Normal Acceleration	E	-3g-6g (*)	0.25 (0.125 if available)	As installed (±0.09g excluding a datum error of ±0.45g recommended)	0.004g	

14.	Longitudinal Acceleration	E	±1g (*)	0.25 (0.125 if available)	As installed (±0.0015 g excluding a datum error of ±0.05 g recommended)	0.004g	
15.	Lateral Acceleration	E	±1g (*)	0.25 (0.125 if available)	As installed (±0.0015 g excluding a datum error of ±0.05 g recommended)	0.004g	
16.	External static pressure (or pressure altitude)	R	34.4mb (3.44 in-Hg) to 310.2mb (31.02in- Hg) or available sensor range	1	As installed (±1 mb (0.1 in-Hg) or ±30 m (±100 ft) to ±210 m (±700ft) recommended)	0.1 hPA (0.03-in-Hg) or 1.5m (5ft)	
17.	Outside air temperature (or total air temperature)	R	-50° to +90°C or available sensor range	2	As installed (±2°C recommended)	1°C	
18.	Indicated air speed	R	As the installed pilot display measuring system or available sensor range	1	As installed (±3% recommended)	1kt (0.5kt recommended)	
19.	Main Rotor Speed (Nr)	R	Full range including over speed condition	Each engine each second	As installed	0.3% of full range	
20.	Engine RPM (*)	R	Full range	Each engine each second	As installed (5% of full range recommended)	0.2% of full range	*For piston engine helicopters
21.	Engine Oil Pressure	R	Full range	Each engine each second	As installed (5% of full range recommended)	2% of full range	
22.	Engine Oil Temperature	R	Full range	Each engine each second	As installed	2% of full range	
23.	Fuel flow or pressure	R	Full range	Each engine each second	As installed	2% of full range	
24.	Manifold pressure (*)	R	Full range	Each engine each second	As installed	2% of full range	*For piston engine helicopters
25.	Engine thrust/power/torque parameters required to determine propulsive thrust/power*	R	0-150%	Each engine each second	As installed	0.1% of full range	*sufficient parameters e.g. EPR/N1 or torque Npas to the particular engine

							shall be recorded to determine power. A Margin for possible over speed should be provided. Only for turbine engine helicopter.
26	Engine gas speed generator (Ng)	R	0-150%	Each engine each second	As installed	0.2% of full range	*Only for turbine engine helicopters
27	Free power turbine speed (Nf)		Full range	1	As installed (±5% recommended)	0.2% of full range	*only for piston engine helicopters
28	Collective pitch		Full range	Each engine each second	As installed	0.1% of full range	
29	Coolant temperature	R	Full range	Each cylinder each second	As installed	1°C	*only for piston engine helicopters
30	Main voltage	R	Full range or each discrete position	2	As installed	1 volt	
31	Cylinder head temperature	R	Full range	0.25	As installed	2% of full range	*only for piston engine helicopters
32	Fuel quantity	R	Full range	4	As installed	0.1% of full range	
33	Exhaust gas temperature	R	Full range	Each engine each second	As installed	2% of full range	
34	Emergency voltage	R	Full range	Each engine each second	As installed	1 volt	
35	Trim surface position	R	Full range or each discrete position	1	As installed	0.3% of full range	
36	Landing gear position	R	each discrete position*	Each gear every 2 seconds	As installed		*Where available, record up-and-locked and down-and-locked position
37	Novel/unique aircraft features	R	As required	As required	As required	As required	