Specification No. 23

United Kingdom
Civil Aviation Authority

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State Emergency Services Helicopter Flight Recorder Standards

Note: References to EU regulations in this document are to those regulations as retained and amended in UK domestic law under the European Union (Withdrawal) Act 2018. Similarly, references to EASA Certification Specifications (CS) that have been retained by the CAA are prefixed with 'UK'.

1 Introduction

1.1 Helicopters conducting Public Transport operations in support of the UK police forces or the Maritime Coastguard Agency are regarded as conducting State activities and are not covered by Regulation (EU) 2018/1139 (the Basic Regulation). Therefore, such aircraft must comply with the equipment requirements of the Air Navigation Order 2016 (ANO) (as amended), article 119 and Schedule 6. Scale SS of Schedule 6 requires that certain categories of helicopter be equipped with flight recorder systems of types approved by the Civil Aviation Authority (CAA) for the purposes of accident investigation.

1.2 Flight recorder systems installed in a helicopter in accordance with the ANO need to comply with published CAA Specifications (see References) or such other specification as the CAA may approve. Alternative specifications shall provide at least an equivalent standard of performance and crash survivability and meet with the particular requirements of the ANO.

1.3 Following the accident to police helicopter EC135, G-SPAO in 2013, the Air Accident Investigation Branch (AAIB) made several Safety Recommendations (SR) concerning the provisioning and installation of crashworthy flight recording equipment for helicopters conducting State Public Transport operations including the police and Search and Rescue (SAR). In response to this the CAA issued Safety Directive (SD) 2016/006 in December 2016, which mandated revisions to the flight recorder (FR) requirements for such helicopter operations in the UK. This directive was replaced by SD 2018/002 in May 2018 and this again by SD 2020/001 in February 2020 and the requirements will be incorporated into the ANO in due course.

1.4 The main revision to the FR systems that are required to be installed, over the standing levels of equipment, is the introduction of **airborne image recorders** meeting EUROCAE Minimum Operating Performance Specification (MOPS) ED-112A or ED-155 standards, or an equivalent standard acceptable to the CAA.

1.5 A specification note, to summarise the revised flight recorder requirements and to provide additional information that applicants/operators may need in meeting the revised equipment specifications, was originally circulated to operators of police and SAR helicopters. That specification note was superseded by this CAA Specification No 23 in June 2018.

1.6 This version of the specification (Issue 5) revises references to several European Technical Standard Orders (ETSO) introduced at Amendment 16 of UK CS-ETSO. Where an ETSO has been identified with significant differences in the MOPS to the corresponding FAA TSO it has been moved to Index 2 of UK CS-ETSO and the number prefixed with '2C'. Additionally, a requirement to check for interference with other operational equipment has been introduced, following some experience during installation, and a correction made to a MMEL item reference.

2 Revised Flight Recorder Installation Requirements for State Emergency Services Aircraft

2.1 The ANO and SD requirements for FRs, which include the new image recorder equipment, for helicopters engaged in State police and SAR operations are summarised in the following paragraphs. (Refer to explanation of terms at the end of the document).

2.2 Helicopters operating under a Police Air Operators Certificate with a MTOM greater than 2,730 kg but not more than 3,175 kg and first issued with an individual Certificate of Airworthiness before 1 January 2019:

a) For helicopters in this category without a previously installed FDR and/or CVR:

i. Install a CARS compliant with ED-155 or its equivalent; and

ii. Install a Class C AIRS[1] compliant with ED-155 or its equivalent as an alternative means of meeting the ANO FDR requirement.

b) For helicopters in this category with a previously installed FDR and CVR in compliance with ANO 2016:

i. Install a Class A AIRS[2] compliant with ED-155 or its equivalent.

c) Compliance for both a) and b) will be required by 1 August 2021.

2.3 Helicopters operating under a Police Air Operators Certificate with a MTOM above 3,175 kg and first issued with an individual Certificate of Airworthiness before 1 January 2019:

a) Install a Class A AIR[3] compliant with ED-112A or its equivalent.

b) Compliance with a) will be required by the 1 August 2021.

2.4 Helicopters operating under a Police Air Operators Certificate with a MTOM greater than 2,730 kg but not more 3,175 kg and first issued with an individual Certificate of Airworthiness on or after 1 January 2019:

a) Install an ADRS, CARS and Class A AIRS all compliant with ED-155 or its equivalent.

2.5 Helicopters operating under a Police Air Operators Certificate with a MTOM above 3,175 kg and first issued with an individual Certificate of Airworthiness on or after 1 January 2019:

a) Install an FDR, CVR and Class A AIR all compliant with ED-112A or its equivalent.

2.6 State SAR helicopters, under contract with the MCA, with a MTOM above 3,175 kg and first issued with an individual Certificate of Airworthiness before 1 January 2019:

a) Install a Class A AIR, compliant with ED-112A or its equivalent.

b) Compliance with a) will be required by the 1 August 2021.

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1 Class C Airborne Image Recording System (AIRS) provides a means for recording flight data where it is not practical or prohibitively expensive to record on an FDR, or where an FDR is not required. Refer to ED-155 III-1.3.3.c.ii.

2 Class A AIRS is used when it is required to capture data supplemental to conventional flight recorders. For example, to capture cockpit Human Factors issues, movements etc. Refer to ED-155 III-1.3.3.c.i.

3 Class A Airborne Image Recorder (AIR), refer to ED-112A Table III-3.1: Required Image Quality.

2.7 State SAR helicopters, under contract with the MCA, with a MTOM above 3175 kg and first issued with an individual Certificate of Airworthiness on or after 1 January 2019:

a) Install a Class A AIR, compliant with ED-112A or its equivalent.

2.8 In all cases, the image recordings are required to be protected to prevent misuse in accordance with the SD and in a similar fashion to the protection afforded to CVR recordings.

3 Modification and Installation Means of Compliance

3.1 In addition to the certification requirements related to the installation of the flight recorder system(s) and equipment on a helicopter, the following additional equipment and aircraft level aspects shall be observed.

3.1.1 Equipment Level Requirements

AIR (annotated Cockpit Image Recorder (CIR) in the UK CS-ETSO):

The equipment shall comply with UK ETSO-2C176a[4] (Aircraft Cockpit Image Recorder Systems).

The failure condition classification as detailed in the UK ETSO paragraph 3.2.1 has been determined to be minor or major depending on whether the recorder type is a Single CIR, CIR function in a deployable recorder or CIR function in a combined recorder[5].

CARS, ADRS and AIRS:

The equipment shall comply with UK ETSO-2C197 (Information Collection and Monitoring Systems).

The failure condition classification as detailed in the UK ETSO paragraph 3.1.1 has been determined to be minor.

3.1.2 Aircraft Level Requirements

AIR:

The FR system shall comply with following requirements in relation to Equipment Installation and Installed Performance as set out in ED-112A:

Chapter 2-5, Common Design Specification

Chapter 3-4, Deployable Recorders (if operationally selected)

Chapter 5-6, Recorder Independent Power Supply (RIPS) (if operationally selected)

Chapter III-6, for equipment installation and ground and flight test procedures

Annex III-A, Post Flight Evaluation of Recordings

Annex III-B, Maintenance Practices

[4] ETSO-2C176a has replaced C176a and relates directly to EUROCAE ED-112A MOPS.
[5] The failure classification is driven by the accident investigation need.

CARS, ADRS and AIRS:

The FR system shall comply with following requirements in relation to Equipment Installation and Installed Performance as set out in ED-155:

Chapter 2-5, Common Design Specification

Chapter 3-5, Deployable Recorders (if operationally selected)

The following requirements specific to CARS:

Chapter I-2.1.7, Quality and Reliability of Recording

Chapter I-6 for equipment installation and ground and flight test procedures

Annex I-A Post Flight Evaluation of Recordings

Annex I-B Maintenance Practices

The following requirements specific to ADRS:

Chapter II-2.1.7, Data to Be Recorded

Chapter II-2.1.9, Quality and Reliability of Recording

Chapter II-2.1.12, Data Sampling, Recording and Retrieval Characteristics

Chapter II-6, for equipment installation, initial installation, calibration and correlation, ground and flight test procedures and follow-on installations

Annex II-A Required Documentation

Annex II-B Definition of Parameters to Be Recorded

Annex II-C Maintenance Practices

The following requirements specific to AIRS:

Chapter III-2.2, Camera Specifications

Chapter III-6, for specific installation aspects and ground and flight test procedures

Annex III-A Maintenance Practices

3.2 Combination Recorders combining various elements of the FR requirements are acceptable but must meet the relevant specifications for the individual requirements.

3.3 A Class C AIR or AIRS should record views of the forward instrument panel and be capable of covering at least the flight path and speed parameters displayed to the pilot(s):

Coverage Area:	Forward Instrument Panel
Purpose:	To determine the following: Status of instrument displays and display modes (blank screen, partial display, automatic display mode changes, etc.);
Resolution:	Sufficient to: Determine instrument display status and operational mode of the displays. Determine parameter values whose recording requirements are only be met by image recording.
Parameters:	At least the following parameters should be recorded: 1) Time 2) Pressure Altitude 3) Indicated airspeed 4) Attitude and Slip 5) Heading

6) Vertical speed
7) Main rotor speed
8) Power on each engine
9) Radio Altitude (if displayed on panel)
10) Outside air temperature (if displayed on panel)

3.4 Flight recorder systems, when tested by methods approved by the appropriate certificating authority, must be demonstrated to be suitable for the environmental extremes over which they are designed to operate.

3.5 The manufacturer/operator must provide the CAA 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;

c) manufacturer's test reports; and

d) MMEL and MEL factors;

i. In devising their MEL, operators should align the entry for rectification interval of AIR or AIRS with requirements for flight recorders performing similar functions, as detailed in CS-MMEL items 23-71-1 for CVR, 31-31-1 for FDR or 31-31-2 for combination recorders.

3.6 Bulk Erase Function

3.6.1 For Class A AIR or AIRS, provision shall be made for a pilot-operated post-flight bulk erase function. Where a Class C AIR or AIRS is used instead of an FDR/ADRS to capture parametric data from instrument displays, a facility to bulk erase that captured parametric data shall not be provided. After use of a bulk erase function, the recording shall be modified so that it cannot be retrieved using any normal replay or copying techniques *but would not prevent accident investigation authorities access to such recordings by specialized replay or copying techniques*.

3.6.2 The installation shall be designed to prevent activation during flight and minimize the probability of inadvertent activation of a bulk erase function during an accident.

3.7 FRs compliant with ED-112A are to meet the ANO Schedule 6, Scale SS(6) requirement to have a means of location through either an automatically activated underwater sonar location device operating at a frequency of 37.5 kHz and for a minimum of 90 days or, for deployable units, an emergency locator radio transmitter (ELT).

3.8 FRs compliant with ED-155 are not required to be fitted with location devices but instead it is recommended that the applicant consider fitting a fuselage mounted underwater sonar location device particularly if the role of the helicopter is likely to include flight over water for more than 10 minutes in any one flight.

3.9 The FR systems shall be installed so that 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.

3.10 The FRs shall start to record prior to the helicopter moving under its own power and record continuously until the termination of the flight when the helicopter is no longer capable of moving under its own power.

3.11 Means shall be provided for an accurate time correlation between the flight recorder systems functions.

3.12 Current specifications do not specifically address the operation of image recording cameras within a Night Vision System (NVIS) cockpit environment. However, the applicant should ensure that the principles required under the MOPS are met for all lighting conditions. Camera issues should be discussed with the CAA as necessary.

3.13 During installation, compatibility must be ensured with all operational equipment, including portable electronic devices (PED), likely to be installed or used by the operator when conducting police or SAR activities.

3.14 Experience from the AAIB provides that the camera installation should ensure that:

a) The mounting is able to handle the vibrations so that the captured images do not suffer from rippling as the camera is vibrated during a scan of the sensor.

- If as the image is scanned from the sensor the direction of the camera is changing, then a compression wave of distortion in the direction of the scan may result.
- This could be problematic if the objective is to read text (e.g. fuel figures) or measure/compare the relative lengths of coloured bars (e.g. pictorial fuel indication) and the geometry of camera distance, resolution, vibration etc. denies this.

b) For a Class C image recorder, the contrast control (in normal, NVIS, or any other mode) should ignore any external view; allow it to white-out or black-out externals if the objective is to capture the contents of the displays.

c) Resolution should be sufficient to support reading what is intended to be read under worst case vibration and lighting/contrast conditions.

d) Colour differentiation. If the colour of a caption or text can change to infer different levels of urgency then it is also important that they are clearly and consistently distinguishable across the spectrum of different lighting conditions.

4 Summary

4.1 The Flight Recorder requirements for police and State SAR helicopters are as detailed in the ANO and current SD. The information in this Specification is intended to aid operators in meeting the necessary equipment standards but close liaison with the CAA is encouraged at an early stage to ensure that the appropriate interpretation and compliance is achieved.

Annex A

Explanation of Terms

Flight Recorders and Associated Requirements

A flight recorder is any type of recorder installed in an aircraft for the purpose of assisting an accident or incident investigation. Flight recorders are crash protected, designed and built to international standards and comprise one or more of the following systems:

- Flight Data Recorder (FDR)
- Cockpit Voice Recorder (CVR)
- Data Link Recorder (DLR)
- Airborne Image Recorder (AIR) - may also be referred to as Cockpit Image Recorder (CIR)

The recognised Minimum Operational Performance Standards (MOPS) for these systems are EUROCAE ED-112, ED-112A, ED-55 and ED-56A or equivalent documents.

Technology improvements have resulted in smaller and lighter systems with enhanced capabilities. Accordingly, lightweight flight recorders are now available, which are designed and built to less demanding international standards for aircraft of lower complexity, while offering a level of protected data at more appropriate cost. Such systems have some equivalency to those detailed above, but are termed:

- Cockpit Audio Recording System (CARS)
- Aircraft Data Recording System (ADRS)
- Airborne Image Recording System (AIRS)
- Data Link Recording System (DLRS)

The recognised Minimum Operational Performance Standards (MOPS) for these systems are EUROCAE ED-155 or equivalent documents.

Reference Documents

a) UK Air Navigation Order 2016.

b) EUROCAE Document ED-56A, November 1997: Minimum Operational Performance Requirement for Cockpit Voice Recorder Systems. (Superseded by ED-112).

c) EUROCAE Document ED-55, September 1998: Minimum Operational Performance Specification for Flight Data Recorder System. (Superseded by ED-112).

d) EUROCAE Document ED-112, March 2003: Minimum Operational Performance Specification for Crash Protected Airborne Recorder Systems.

e) EUROCAE Document ED-112A, September 2013: Minimum Operational Performance Specification for Crash Protected Airborne Recorder Systems.

f) EUROCAE Document ED-155, July 2009: Minimum Operational Performance Specification for Lightweight Flight Recording Systems.

g) CAP 562, Leaflet 34-30 Radio Altimeters and AVADs for Helicopters.

h) CAP 731, Issue 3, March 2011: Approval, Operational Serviceability and Readout of Flight Data Recorder Systems and Cockpit Voice Recorders.

i) CAP 762, Version 1, November 2006: The Effectiveness of Image Recorder Systems in Accident Investigations.

j) CAA Specification No. 10, Issue 1, May 1974: Flight Data Recorder Systems.

k) CAA Specification No. 10A, Issue 1, June 1990: Flight Data Recorder for Aeroplane Accidents Investigation.

l) CAA Specification No. 11, Issue 3, August 1983: Cockpit Voice Recorder Systems.

m) CAA Specification No. 12, Issue 1, May 1974: Underwater Locating Devices.

n) CAA Specification No. 16, Issue 1, November 1985: Automatically Deployable Emergency Locator Transmitters for Helicopters.

o) CAA Specification No. 18, Issue 1, June 1990: Flight Data Recorder for Helicopter Accidents Investigation.

p) British Civil Airworthiness Requirements, Section A, Issue 1 (CAP 553), Chapter A4-8, Design Approval of Aircraft Components, Equipment and Accessories.

q) British Civil Airworthiness Requirements, Section B, Issue 1 (CAP 554), Chapter B4-8, Design Approval of Aircraft Components, Equipment and Accessories.

r) FAA Docket No. 25530, July 11, 1988: Cockpit Voice Recorders and Flight Recorders; Final Rule.

s) UK ETSO-2C123c Cockpit Voice Recorder Systems.

t) UK ETSO-2C124c Flight Data Recorder Systems.

u) UK ETSO-C155b Recorder Independent Power Supply.

v) UK ETSO-2C176a Aircraft Cockpit Image Recorder Systems.

w) UK ETSO-2C197 A1 Information Collection and Monitoring Systems.

x) FAA Technical Standard Order, TSO C51a: Aircraft Flight Recorder.

y) UK CS-MMEL.