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Specification No. 10A

United Kingdom
Civil Aviation Authority

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Flight Data Recorder for Aeroplane Accidents Investigation

Contents

1 Introduction

1.1 Schedule 4, Scale S of the United Kingdom Air Navigation Order 1989, as amended, (Reference (a)) requires that certain categories of aeroplane be equipped with a flight data recorder system of a type approved by the CAA for the purposes of accident investigation.

1.2 Flight data recorder systems installed in aeroplanes in compliance with the Order shall comply with this Specification or such other specifications as the CAA may approve. Alternative specifications shall provide at least an equivalent standard of performance and crash survivability and shall comply with the particular requirements of the Order.

1.3 This Specification No. 10A is based on, and must be used in conjunction with, EUROCAE Minimum Operational Performance Specification (MOPS), No. ED-55 (Reference (b)).

1.4 Where reference is made in this Specification to a cockpit voice recorder system, it shall be understood to mean a system approved by CAA in accordance with either CAA Specification No. 11 (Reference (c)) or EUROCAE Minimum Operational Performance Requirement No. ED-56 (Reference (d)).

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1.5 For the purposes of this Specification, a flight data recorder system may comprise the following equipment:

a) transducers and sensors which provide data for the flight recording function,

b) data acquisition and processing equipment which provide the interface between input sensors, transducers, aeroplane systems and the crash protected recorder,

c) for affected aeroplanes over 27 000 kg MTWA, a non-deployable, crash protected, flight data recorder capable of preserving the information recorded during the last 25 hours of its operation with sufficient memory capacity for at least parameters 1 to 32 of Table A1-1 of EUROCAE MOPS ED-55 e.g. EUROCAE FDR Class AI,

d) for affected aeroplanes over 5700 kg and up to and including 27 000 kg MTWA, a non-deployable, crash protected, flight data recorder capable of preserving the information recorded during the last 25 hours of its operation with sufficient memory capacity for at least parameters 1 to 17 of Table A1-1 of EUROCAE MOPS ED-55 e.g. EUROCAE FDR Class A2,

e) for affected aeroplanes of 5700 kg MTWA or less, either:

i) a non-deployable, crash protected, flight data recorder capable of preserving the information recorded during at least the last 5 hours of its operation with sufficient memory capacity for at least the parameters defined in Table A1-3 of EUROCAE MOPS ED-55, or

ii) a combination of a non-deployable crash protected, flight data recorder capable of preserving the information recorded during the last 30 minutes of its operation (e.g. the cockpit voice recorder with data recorded on one track) together with a 5 hour duration deployable flight data recorder capable of preserving the recording under conditions of its deployment and subsequent landing and having sufficient memory capacity for at least the parameters defined in Table A1-3 of EUROCAE MOPS ED-55, or

iii) a combined cockpit voice recorder/flight data recorder where the flight data recorder element corresponds with that defined in paragraph 1.5 e) i).

NOTE: The design of the cockpit voice recorder erase feature will need to ensure that, when used, the flight data record is not affected.

f) ancillary equipment including, where relevant, underwater locating beacons, radio beacons, crash sensors, deployment mechanisms and batteries dedicated to the flight recorder system.

NOTES: 1) Requirements for Underwater Locating Beacons are given in CM Specification No. 12 (Reference (e)).

2) Requirements for Deployable Radio Beacons are given in CAA Specification No. 16 (Reference (f))

2 Applicability of Technical Specifications

2.1 Where compliance with Schedule 4, Scale P of the Air Navigation Order is required, reference should be made to CM Operational Requirement, Edition 2, December 1972 (Reference (h)).

2.2 Where compliance with Schedule 4, Scales S(i), S(ii) or S(iii) of the Air Navigation Order is required, reference should be made to CM Specification No. 10, Issue 1, May 1974 (Reference (g)).

2.3 Where compliance with Schedule 4, Scales S(iv), S(v) or S(vi) of the Air Navigation Order is required, this Specification No. 10A is applicable.

NOTE: Specification No. 10A is thus applicable to certain categories of aeroplane where the individual Certificate of Airworthiness is issued (whether in the UK or elsewhere) on or after 1 June 1990. However, by virtue of the exemption issued on 1 June 1990, compliance may be delayed until 11 October 1991 subject to the terms of exemption.

2.4 It is not intended that aeroplanes in compliance, prior to 1 June 1990 with the requirements stated in paragraphs 2.1 and 2.2, should be re-investigated. However, when modifications are made to such aeroplanes, it is strongly recommended that consideration be given to full or partial compliance with the additional requirements of Specification No. 10A. In some cases, where significant modifications are made to the aeroplane, e.g. new engines with full authority digital engine control or the introduction of electronic flight displays in lieu of mechanical instruments, the CM may require compliance with this Specification as a Special Condition of approval of the modification.

NOTE: Equivalent requirements for flight recorder systems in helicopters are given in CM Specification No. 18.

3 Requirements

3.1 General

Reference must be made to EUROCAE MOPS ED-55 which gives details of the Operational Requirements to be met together with Equipment and Installation standards and associated guidance material.

3.2 Equipment Approval

3.2.1 The crash protected recorder or the deployable recorder, as the case may be, must be of a type approved by CM. Application for approval will need to be made by the equipment manufacturer using either the Accessory Procedure (UK products) or the Appliance Registration Procedure (non UK products).

3.2.2 With the exception of the equipment defined in 3.2.1, for approval of other items of equipment used in the flight data recorder system e.g. the data acquisition unit, application for approval may be made by the installer using the Component Procedure, or by the equipment manufacturer using either the Accessory Procedure or the Appliance Registration Procedure whichever is applicable.

3.2.3 Flight data recording equipment will be eligible for approval in accordance with this Specification provided that compliance is shown with the equipment standards stated in EUROCAE MOPS ED-55.

NOTES:

1) A recorder using magnetic tape medium, previously approved by CM, or a recorder which is a derivative model of a recorder previously approved by CM, in accordance with the equipment standards stated in CM Specification No. 10, Issue 1, will continue to be acceptable for all installations provided that compliance is shown with the recording capacity and duration requirements for the particular installation.

2) Equipment approval procedures are defined in British Civil Airworthiness Requirements Section A, Issue 1, Chapter A4-8 (Reference (i)), and Section B, Chapter B4-8 (Reference (j)).

3.3 Installation Approval

3.3.1 In showing compliance with the airworthiness requirements applicable to the aeroplane concerned, account must be taken of the operational and installation requirements of EUROCAE MOPS ED-55 and its associated guidance material.

3.3.2 A reference document, applicable to the equipment and its installation in each aeroplane to be approved, shall be compiled and submitted to the CM. The document shall provide details of the conversion data and logic required for translation of the data held in memory to parameters expressed in engineering units.

3.4 **Information to be Recorded**

3.4.1 **Aeroplanes over 27 000 kg MTWA**

Where compliance with Scale S(vi) of Schedule 4 of the Order is required, parameters 1 to 32, as defined in Table A1-1 of EUROCAE MOPS ED-55, shall be recorded. Where spare recording capacity exists and where it can be accomplished with reasonable practicality, the additional recommended parameters of Table A1-5. where relevant, should be recorded.

3.4.2 **Aeroplanes over 5700 kg and up to and including 27 000 kg MTWA**

Where compliance with Scale S(v) of Schedule 4 of the Order is required, parameters 1 to 17 of Table A1-l of EUROCAE MOPS ED-55 shall be recorded. Where spare recording capacity exists and where it can be accomplished with reasonable practicality, the remainder of the parameters of Table A1-1 together with the recommended parameters of Table A1-5, where relevant, should be recorded.

3.4.3 **Aeroplanes of 5700 kg MTWA or less powered by 2 or more turbine engines and certified to carry more than 9 passengers**

Where compliance with Scale S(iv) of Schedule 4 of the Order is required, the parameters of Table A1-3 of EUROCAE MOPS ED-55 shall be recorded. Where spare recording capacity exists and where it can be accomplished with reasonable practicality, the recommended parameters of Table A1-5, where relevant, should be recorded.

NOTES:
1) In accordance with paragraph 2.5.2 of EUROCAE MOPS ED-55, the CM may require additional parameters to be recorded for any novel or unique design or operational characteristic of the aeroplane.
2) The foregoing referenced parameter tables are reproduced in Appendix 1 to this Specification.

3.5 **Maintenance and Calibration**

3.5.1 The maintenance tasks required to ensure the serviceability and continued airworthiness of the flight recorder system shall be established.

3.5.2 An analysis shall be performed to identify those sensors or transducers where either the serviceability or accuracy could be degraded and remain undetected. The maintenance tasks to be performed shall take account of this analysis by requiring appropriate functional and calibration checks at suitable intervals.

3.5.3 Calibration data of flight recorder sensors and transducers shall be retained by the aeroplane operator or, by arrangement, its maintenance organisation.

Appendix 1

Parameter Tables

A1.1 **Recording Format**

A1.1.1 It is important that reference is made to EUROCAE MOPS ED-55 which gives further guidance on parameter processing and recording formats.

A1.1.2 Tables A1.1, A1.3 and A1.5 of EUROCAE MOPS ED-55 give details of the parameters to be recorded as required by paragraph 3.4 of this Specification.

A1.1.3 Table A1.6 of EUROCAE MOPS ED-55 provides an example of a preferred data frame structure based on the use of 12 bit words recorded in a 4 second frame at the rate of 64 words per second. Similarly, Table A1.7 provides a preferred format where the recording rate is 128 words per second. Discrete parameters may be included in discrete words or, where resolution requirements allow, in the least significant bits of variable parameters.

A1.1.4 Table A1.10 of EUROCAE MOPS ED-55 gives details of the accuracy limits required for the pressure altitude parameter.

A1.1.5 The foregoing referenced tables are reproduced in this Appendix.

A1.2 **Parameter Characteristics**

Parameter characteristics are discussed in Annex 1 of EUROCAE MOPS ED-55.

EUROCAE MOPS ED-55 TABLE A1.1 - Parameters to be Recorded - Large Aeroplanes

Serial No.	Parameter	Range	Sampling Interval in seconds	Accuracy Limits (Sensor Input compared to FDR read out)	Minimum Resolution in read out	Remarks
1a or 1b	Time Relative Time Count	24 hours 0 to 4095	4 4	± 0.125% per hour ± 0.125% per hour	1 second	(a) UTC time preferred where available. (b) Counter increments each 4 seconds of system operation.
2	Pressure Altitude	-1000ft to maximum certificated altitude of aircraft + 5000ft	1	±100ft to ±700ft See Table A1.10	5ft	See paragraph A1.5.1 of ED-55.
3	Indicated Airspeed	50kt or minimum value from installed pitot static system to Max VSO Max V_{SO} to 1.2 V_D	1	±5% ±3%	1kt (0.5kt recommended)	See paragraph A1.5.1 of ED-55.
4	Heading	360 degrees	1	±2 degrees	0.5 degrees	
5	Normal Acceleration	-3'g' to +6'g'	0.125	±1% of Maximum range excluding a datum error of ±5%	0.004'g'	The normal acceleration resolution may be rounded from 0.004 to 0.01'g' subject to compliance with paragraph A1.5.2 of ED-55.
6	Pitch Attitude	±75 degrees	0.25	±2 degrees	0.5 degrees	
7	Roll Attitude	±180 degrees	0.5	±2 degrees	0.5 degrees	

EUROCAE MOPS ED-55 TABLE A1.1 - Parameters to be Recorded - Large Aeroplanes

Serial No.	Parameter	Range	Sampling Interval in seconds	Accuracy Limits (Sensor Input compared to FDR read out)	Minimum Resolution in read out	Remarks
8	Manual Radio Transmission Keying	Discrete(s)	1	-	-	Preferably each crew member but one discrete acceptable for all transmissions provided the CVR/FDR system complies with paragraph 4.2.1 of ED-55.
9a	Propulsive thrust/ power on each engine	Full range	Each engine each second	±2%	O.2% of full range	Sufficient parameters e.g. EPR/N_1 or Torque/. N_p as appropriate to the particular engine must be recorded to determine power in both normal and reverse thrust. A margin for possible overspeed should be provided.
9b	Cockpit thrust/ power lever position	Full range	Each lever each second	±2% or sufficient to determine any gated position.	2% of full range	Parameter 9b must be recorded for aeroplanes with non-mechanically linked cockpit - engine controls, otherwise recommended.
10	Trailing edge flap or cockpit control selection	Full range or each discrete position	2	±3° or as pilot's indicator and sufficient to determine each discrete position	0.5% of full range	Flap position and cockpit control, may each be sampled at 4 second intervals so as to give a data point each 2 seconds.

EUROCAE MOPS ED-55 TABLE A1.1 - Parameters to be Recorded - Large Aeroplanes

Serial No.	Parameter	Range	Sampling Interval in seconds	Accuracy Limits (Sensor Input compared to FDR read out)	Minimum Resolution in read out	Remarks
11	Leading edge flap or cockpit control selection	Full range or each discrete position	1	±3° or as pilot's indicator and sufficient to determine each discrete position	0.5% of full range	Left and right sides, or flap and cockpit control, may each be sampled at 2 second intervals so as to give a data point each second.
12	Thrust reverse status	Turbo-jet - stowed, in transit and reverse Turbo-prop - reverse	Each reverser each second	-	-	Turbo-jet - 2 discretes enable the 3 states to be determined. Turbo-prop - 1 discrete.
13	Ground Spoiler position and/or speed brake selection	Full range or each discrete position	0.5	±2% unless higher accuracy uniquely required	0.2% of full range	Sufficient to determine use of the cockpit selector and the subsequent activation and positions of the surfaces.
14	Total or outside air temperature	-50°C to +90° C or available sensor range	2	±2°C	0.3°C	
15	Autopilot/ Autothrottle/ AFCS mode and engagement status	A suitable combination of discretes	1	-	-	Discretes should show which systems are engaged and which primary modes are controlling the flight path and speed of the aircraft.
16	Longitudinal Acceleration (Body axis)	±1'g'	0.25	±1.5% of maximum range excluding a datum error of ±5%	0.004'g'	The acceleration resolution may be rounded from 0.004 to 0.01'g' subject to compliance with paragraph A1.5.2 of ED-55.

EUROCAE MOPS ED-55 TABLE A1.1 - Parameters to be Recorded - Large Aeroplanes

Serial No.	Parameter	Range	Sampling Interval in seconds	Accuracy Limits (Sensor Input compared to FDR read out)	Minimum Resolution in read out	Remarks
17	Lateral Acceleration	±1'g'	0.25	±1.5% of maximum range excluding a datum error of ±5%	0.004'g'	The acceleration resolution may be rounded from 0.004 to 0.01'g' subject to compliance with paragraph A1.5.2 of ED-55.
18	Primary Flight Controls - Control surface positions and/ or* pilot input	Full range		±2° unless higher accuracy uniquely required	0.2% of full range	* For aeroplanes that can demonstrate the capability of deriving either the control input or control movement (one from the other) for all modes of operation and flight regimes, the 'or' applies. For aeroplanes with non-mechanical control systems the 'and'. applies. See paragraph A1.5.3 of ED-55.
18a	pitch axis		0.25			
18b	roll axis		0.25			
18c	yaw axis		0.5			For multiple or split surfaces, a suitable combination of inputs is acceptable in lieu of recording each surface separately.
19	Pitch trim position	Full range	1	±3% unless higher accuracy uniquely required	0.3% of full range	Where dual surfaces are provided it is permissible to record each surface alternately.

EUROCAE MOPS ED-55 TABLE A1.1 - Parameters to be Recorded - Large Aeroplanes

Serial No.	Parameter	Range	Sampling Interval in seconds	Accuracy Limits (Sensor Input compared to FDR read out)	Minimum Resolution in read out	Remarks
20	Radio Altitude	-20ft to +2500ft	1 -	As installed. ±2ft or ±3% whichever is greater below 500ft and ±5% above 500ft recommended.	1ft below 500ft, 1ft + 0.5% of full range above 500ft	For autoland/category 3 operations, each radio altimeter should be recorded, but arranged such that at least one is recorded each second.
21 21a 21b	Vertical beam deviation ILS Glide path MLS Elevation	 ±0.22 DDM or available sensor range as installed 0.9 to +30 degrees	1	As installed. ±3% recommended.	0.3% of full range	See paragraph A1.5.4 of ED-55. For sutoland and category 3 operations, each system should be recorded but arranged such that at least one is recorded each second.
22 22a 22b	Horizontal Beam deviation ILS Localiser MLS Azimuth	 ±0.22 DDM or available sensor range as installed ±62 degrees	1	As installed. ±3% recommended.	0.3% of full range	See parameter 21 remarks.
23	Marker beacon passage	Discrete(s)	1	-	-	A single discrete is acceptable for all markers.
24	Warnings	Discretes	1	-	-	A discrete must be recorded for the master warning. Each 'red' warning (including lavatory smoke), should be recorded when the warning condition cannot be determined from other parameters or from the cockpit voice recorder.

EUROCAE MOPS ED-55 TABLE A1.1 - Parameters to be Recorded - Large Aeroplanes

Serial No.	Parameter	Range	Sampling Interval in seconds	Accuracy Limits (Sensor Input compared to FDR read out)	Minimum Resolution in read out	Remarks
25	Reserved					This parameter serial number is used by ICAO for navigation receiver frequency selection which is included in the recommended list of Table A1.5.
26	Reserved					This parameter serial number is used by ICAO for DME Distance which is included in the recommended parameters of Table A1.5.
27	Landing gear squat switch status or air - ground status	Discrete(s)	1 (0.25 recommended for main gears)	-	-	Discretes should be recorded for the nose and main landing gears.
28	Ground proximity warning system	Discretes	1	-	-	A suitable combination of discretes unless recorder capacity is limited in which case a single discrete for all modes is acceptable.
29	Angle of attack	As installed	0.5	As installed	0.3% of full range	If left and right sensors are available, each may be recorded at 1 second intervals so as to give a data point each half second.
30 30a 30b	Low pressure warning Hydraulic power Pneumatic power	Discrete(s) or available sensor range	2	-	0.5% of full range	Each essential system to be recorded.

EUROCAE MOPS ED-55 TABLE A1.1 - Parameters to be Recorded - Large Aeroplanes

Serial No.	Parameter	Range	Sampling Interval in seconds	Accuracy Limits (Sensor Input compared to FDR read out)	Minimum Resolution in read out	Remarks
31	Groundspeed	As installed	1	Data should be obtained from the most accurate system.	1kt	Additional recommended navigation parameters are given in Table A1.5.
32	Landing gear or gear selector position	Discrete(s)	4	-	-	A suitable combination of discretes should be recorded.

Recording of the parameters listed in Table A1.5, where relevant, will need to be considered in accordance with paragraphs 2.5.2, 3.1.6, 3.1.7 and A1.5.5 of ED-55.

EUROCAE MOPS ED-55 TABLE A1.3 - Parameters to be Recorded - Small Aeroplanes

Serial No.	Parameter	Range	Sampling Interval in seconds	Accuracy Limits (Sensor Input compared to FDR read out)	Minimum Resolution in read out	Remarks
1	Relative Time Count	0 to 4095	4	±0.125% per hour	one second	Counter increments every 4 seconds of system operation.
2	Pressure Altitude	-1000ft to maximum certificated altitude of aircraft +5000ft	1	±100ft to ±700ft See table A1.10	25ft	See paragraph A1.5.1 of ED-55.
3	Indicated Airspeed	50kt to 1.2 VD or range available from installed system	1	±5% or ±l0kts whichever is the greater	2 knots below 175 KIAS otherwise 1% of full range	See paragraph A1.5.1 of ED-55.
4	Heading	360 degrees	1	+5 degrees	1 degree	
5	Normal Acceleration	-3'g' to +6'g'	0.125	±0.2'g' in addition to a maximum offset of ±0.3'g'	0.01'g'	The resolution may be rounded to 0.03'g' subject to compliance with paragraph A1.5.2 of ED-55.
6	Pitch Attitude	100% of usable range	0.25	±2 degrees	0.8 degrees	
7	Roll Attitude	±60 degrees or 100% of usable range whichever is greater	0.5	±2 degrees	0.8 degrees	
8	Manual Radio Transmission Keying	Discrete	1	-	-	Preferably each crew member but one discrete acceptable for all transmissions.

EUROCAE MOPS ED-55 TABLE A1.3 - Parameters to be Recorded - Small Aeroplanes

Serial No.	Parameter	Range	Sampling Interval in seconds	Accuracy Limits (Sensor Input compared to FDR read out)	Minimum Resolution in read out	Remarks
9a	Propulsive thrust/power on each engine	Full range	Each engine each second	±5%.	1% of full range	Sufficient parameters e.g. EPR/NI or Torque/NP as appropriate to the particular engine must be recorded to enable power in both normal and reverse thrust to be determined. A margin for possible overspeed should be provided. Data may be obtained from ,cockpit indicators used for aircraft certification.
9b	Cockpit thrust,/ Power lever position	Full range	Each lever , each second ;	±2% or sufficient to determine .any gated position	±2% of full range	Parameter 9b is required with non-mechanically linked cockpit - engine controls, otherwise recommended.
10	Trailing edge flap or cockpit control selection	Full range or each discrete position	2	±3°	1% of full range	Cockpit control and flap position may each be sampled at 4 second intervals so as to give a data point each 2 seconds.
11	Leading edge flaps or cockpit control selection	Full range or each discrete position	1	±3°	1% of full range	Left and right sides, or cockpit control and flap, may be sampled at 2 second intervals so as to give a data point each second.

EUROCAE MOPS ED-55 TABLE A1.3 - Parameters to be Recorded - Small Aeroplanes

Serial No.	Parameter	Range	Sampling Interval in seconds	Accuracy Limits (Sensor Input compared to FDR read out)	Minimum Resolution in read out	Remarks
12	Thrust reverse status	Turbo-jet - stowed or full reverse Turbo-prop - reverse	Each reverser each second	-	-	
13	Ground Spoiler and/or speed brake selection	Full range or each discrete position	1 -	±2% unless higher accuracy uniquely required.	1% of full range	Sufficient to determine use of the cockpit selector and the subsequent activation and positions of the surfaces.
14	Total or outside air temperature	Sensor range	4	±2 degrees	1 degree	
15	Autopilot/ sutothrottle engagement status	Discrete(s)	1	-	-	Where practicable, discretes should show which primary modes are controlling the flight path and speed of the aircraft.
16	Angle of attack	-20 to +40 degrees or available sensor range	1	±2 degrees	0.8%	This parameter should be recorded if a suitable sensor is available.
17	Longitudinal Acceleration (Body axis)	±1'g'	0.25	±1.5% of full range excluding datum error of ±5%	0.01'g'	

EUROCAE MOPS ED-55 TABLE A1.5 - Additional Recommended Parameters to be Considered

Serial No.	Parameter	Range	Sampling Interval in seconds	Accuracy Limits (Sensor Input compared to FDR read out)	Minimum Resolution in read out	Remarks
1	Navigation Data	As installed		Data should-be obtained from the most accurate system as installed.		Where capacity permits, latitude/longitude resolution should be 0.0002 degrees.
1a	Drift Angle		4		0.1 degree	
1b	Wind Speed		4		1 knot	
1c	Wind Direction		4		1 degree	
1d	Latitude/Longitude		4		0.002 degrees	
2	Metered brake pressure/brake pedal position	As installed	1	As installed		To determine braking effort applied by pilots or by autobrakes.
3	Additional Engine Parameters	As installed	Each Engine Each Second	As installed		The preferred priority is EPR/N_1 Indicated vibration level, N_2, EGT, TLA, fuel flow and fuel cut-off lever position.
4	TCAS	Discrete(s)				The recording of at least the Resolution Advisory is strongly recommended.
4a	Traffic Advisory		1			
4b	Resolution Advisory		1			
4c	Sensitivity level (Crew selected)					
5	Windshear Warning	Discrete	1			

EUROCAE MOPS ED-55 TABLE A1.5 - Additional Recommended Parameters to be Considered

Serial No.	Parameter	Range	Sampling Interval in seconds	Accuracy Limits (Sensor Input compared to FDR read out)	Minimum Resolution in read out	Remarks
6	Selected barometric setting	As installed	64	As installed	1 mb	Where practicable, a sampling interval of 4 seconds is recommended.
6a	Pilot					
6b	First Officer					
7	Selected Altitude	As installed	1	As installed	100 ft	Where capacity is limited a sampling interval of 64 seconds is permissible.
7a	Manual				1	
7b	Automatic					
8	Selected Speed	As installed	1	As installed	1Kt	Where capacity is limited a sampling interval of 64 seconds is permissible.
8a	Manual					
8b	Automatic					
9	Selected Mach	As installed	1	As installed	0.01	Where capacity is limited a sampling interval of 64 seconds is permissible.
9a	Manual					
9b	Automatic					

EUROCAE MOPS ED-55 TABLE A1.5 - Additional Recommended Parameters to be Considered

Serial No.	Parameter	Range	Sampling Interval in seconds	Accuracy Limits (Sensor Input compared to FDR read out)	Minimum Resolution in read out	Remarks
10	Selected Vertical Speed	As installed	1	As installed	100ft/min	Where capacity is limited a sampling interval of 64 seconds is permissible.
10a	Manual					
10b	Automatic					
11	Selected Heading	360 degrees	1	As installed	1 degree	Where capacity is limited a sampling interval of 64 seconds is permissible.
12	Selected Flight Path		1	As installed	1 ft	Where capacity is limited a sampling interval of 64 seconds is permissible.
12a	Course/DSTRK	360 degrees			1 degree	
12b	Path Angle	As installed			0.1 degrees	
13	Selected Decision Height	0-500 ft	64	As installed	1 ft	
14	EFIS Display Format	Discrete(s)	4	-	-	Discretes should show the display system status e.g. off, normal, fail, composite, sector, plan, rose, nav aids, wxr, range, copy.
14a	Pilot					
14b	First Officer					

EUROCAE MOPS ED-55 TABLE A1.5 - Additional Recommended Parameters to be Considered

Serial No.	Parameter	Range	Sampling Interval in seconds	Accuracy Limits (Sensor Input compared to FDR read out)	Minimum Resolution in read out	Remarks
15	Multi-function/ Engine/Alerts Display format	Discrete(s)	4	-	-	Discretes should show the display system status e.g. off, normal, fail and the identity of display pages for emergency procedures, check lists. Information in checklists and procedures need not be recorded.
16	DME 1 and 2 Distance	0-200NM	4	As installed	1NM	A sampling interval of 64 seconds is acceptable where other navigation parameters are recorded.
17	AC Electrical Bus Status	Discrete(s)	4			
18	DC Electrical Bus Status	Discrete(s)	4			
19	Engine Bleed Valve Position	Discrete(s)	4			
20	APU Bleed Valve Position	Discrete(s)	4			
21	Computer Failure	Discrete(s)	4			Critical Flight and Engine Control Systems.
22	Engine Thrust Command	As installed	2	As installed	2% of full range	
23	Engine Thrust Target	As installed	4	As installed	2% of full range	

EUROCAE MOPS ED-55 TABLE A1.5 - Additional Recommended Parameters to be Considered

Serial No.	Parameter	Range	Sampling Interval in seconds	Accuracy Limits (Sensor Input compared to FDR read out)	Minimum Resolution in read out	Remarks
24	Computed Centre of Gravity	As installed	64	As installed	1% of full range	
25	Fuel Quantity in CG Trim Tank	As installed	64	As installed	1% of maximum quantity	
26	Head up Display in use	Discrete(s)	64			
27	Para Visual Display on	Discrete(s)	1			
28	Navigation Receiver Frequency Selection	Sufficient to determine selected frequency	4	As installed	-	An offset value or channel counter would be acceptable. The frequency to be recorded should be that associated with the information displayed to the pilot.
29	Helicopter Health and Usage Monitor System (HUMS)	As installed	-	As installed	-	Principal HUMS parameters as available including Main and Tail Rotor vibration.
30	Event Marker	Discrete	1	-	-	From cockpit switch.

EUROCAE MOPS ED-55 TABLE A1.6 - Sample Data Frame Structure for Aeroplanes Based on Word Rate of 64 Per Second

SF	WD	PARAMETER	WD	PARAMETER	WD	PARAMETER	WD	PARAMETER	WD	PARAMETER	WD	PARAMETER	WD	PARAMETER	WD	PARAMETER
1	1	/	9	/	17	/	25	/	33	/	41	/	49	Sup' frame	57	Sup' frame
2		Synch		Mag/true		LE Flap		/		Lateral		Drift		NAV 1 Frq		FrameCount
3		Workd		Heading		Position		/		Deviation		Angle		LatLg MSP		Long LSP
4		/		/		/		/		/		/		NAV 2 Frq		Time MSP
1	2	/	10	/	18	/	26	/	34	/	42	/	50	Sup' frame	58	/
2		Brakes L/R		Indicated		Pitch		Radio		Vertical		Ground		DME 1		Pressure
3		Pressure		Airspeed		Trim		Altitude		Deviation		Speed		Time LSP		Alt-Fine
4		/		/		/		/		/		/		DME 2		/
1	3	/	11	/	19	P Alt Crs	27	/	35	/	43	/	51	Sup' frame	59	/
2		Angle of		Discretes		TE Flap		Discretes		Angle of		Discretes		OAT		Discretes
3		Attack		1		P Alt Crs		2		Attack		3		Lat LSP		4
4		/		/		TE Flap		/		/		/		OAT		/
1	4	/	12	/	20	/	28	/	36	/	44	/	52	/	60	/
2		Normal		Normal		Normal		Normal		Normal		Normal		Normal		Normal
3		Accel'n		Accel'n		Accel'n		Accel'n		Accel'n		Accel'n		Accel'n		Accel'n
4		/		/		/		/		/		/		/		/
1	5	/	13	/	21	/	29	/	37	/	45	/	53	/	61	/
2		Long		Pitch		Long		Pitch		Long		Pitch		Long		Pitch
3		Accel'n		Attitude		Accel'n		Attitude		Accel'n		Attitude		Accel'n		Attitude
4		/		/		/		/		/		/		/		/
1	6	/	14	/	22	/	30	/	38	/	46	/	54	/	62	/
2		Lateral		Roll		Lateral		Rudder		Lateral		Roll		Lateral		Rudder
3		Accel'n		Attitude		Accel'n		Position		Accel'n		Attitude		Accel'n		Pedals
4		/		/		/		/		/		/		/		/
1	7	/	15	/	23	/	31	/	39	/	47	/	55	/	63	/
2		Elevator		Aileron		Control		Control		Elevator		Aileron		Control		Control
3		Left		Left		Column		Wheel		Right		Right		Column		Wheel
4		/		/		/		/		/		/		/		/
1	8	/	16	/	24	/	32	/	40	/	48	/	56	/	64	/
2		Engine 1		Engine TLA		Engine 3		Other data		Engine 2		Engine TLA		Engine 4		Other data
3		Power		1 & 4		Power		- engines		Power		2 & 3		Power		- engines
4		/		/		/		/		/		/		/		/

SF: Sub-Frame WD: Word

EUROCAE MOPS ED-55 TABLE A1.7 - Sample Data Frame Structure for Aeroplanes Based on Word Rate of 128 Per Second

SF	WD	PARAMETER	WD	PARAMETER	WD	PARAMETER	WD	PARAMETER	WD	PARAMETER	WD	PARAMETER	WD	PARAMETER	WD	PARAMETER
1	1	Sync	17	Oil Temp 1	33	Oil Px 1	49	Oil Qty 1	65		81	Sup' frame 1	97	Sup' frame 2	113	Pres Alt C
2		Sync		Oil Temp 2		Oil Px 2		Oil Qty 2		Reserved		Spare		Nav 1 frq		Frame Count
3		Sync		Oil Temp 3		Oil Px 3		Oil Qty 3		(Sync)		Time MSP		Lat lng MSP		Pres Alt C
4		Sync		Oil Temp 4		Oil Px 4		Oil Qty 4				EFIS Mode		Nav 2 Frq		MFD mode
	2	Time LSP	18	Heading	34	Spare	50	Radio Altitude	66	Spare	82	Drift Angle	98	Latitude LSP	114	Pressure Alt-Fine
	3	Brakes L Pressure	19	Indicated Airspeed	35	Pitch Trim	51	Lateral Deviation	67	Brakes R Pressure	83	Ground Speed	99	Long'tude LSP	115	Outside Air Temp
	4	Spoilers Left	20	Angle of Attack	36	LE Flaps Position	52	Vertical Deviation	68	Spoilers Right	84	Angle of Attack	100	TE Flaps Position	116	Vertical Speed
	5	Normal Accel'n	21	Normal Accel'n	37	Normal Accel'n	53	Normal Accel'n	69	Normal Accel'n	85	Normal Accel'n	101	Normal Accel'n	117	Normal Accel'n
	6	Long Accel'n	22	Pitch Attitude	38	Long Accel'n	54	Pitch Attitude	70	Long Accel'n	86	Pitch Attitude	102	Long Accel'n	118	Pitch Attitude
	7	Lateral Accel'n	23	Roll Attitude	39	Lateral Accel'n	55	Rudder Position	71	Lateral Accel'n	87	Roll Attitude	103	Lateral Accel'n	119	Rudder Pedals
	8	Elevator Left	24	Aileron Left	40	Control Column	56	Control Wheel	72	Elevator Right	88	Aileron Right	104	Control Column	120	Control Wheel
	9	Discretes 1	25	Discretes 2	41	Discretes 3	57	Discretes 4	73	Discretes 5	89	Discretes 6	105	Discretes 7	121	Discretes 8
	10	Engine 1 TLA	26	Engine 4 Command	42	Engine 2 TLA	58	Engine 1 Command	74	Engine 3 TLA	90	Engine 2 Command	106	Engine 4 TLA	122	Engine 3 Command
	11	Engine 1 N1	27	Engine 4 EPR	43	Engine 2 N1	59	Engine 1 EPR	75	Engine 3 N1	91	Engine 2 EPR	107	Engine 4 N1	123	Engine 3 EPR
	12	Engine 1 EGT	28	Engine 4 N2	44	Engine 2 EGT	60	Engine 1 N2	76	Engine 3 EGT	92	Engine 2 N2	108	Engine 4 EGT	124	Engine 3 N2
	13	Engine 1 N3	29	Engine 4 Fuel Flow	45	Engine 2 N3	61	Engine 1 Fuel Flow	77	Engine 3 N3	93	Engine 2 Fuel Flow	109	Engine 4 N3	125	Engine 3 Fuel Flow
	14	Engine 1 Ind Vib	30	Wind Angle	46	Engine 2 Ind Vib	62	DME 1 Distance	78	Engine 3 Ind Vib	94	Fuel Qty Trim Tank	110	Engine 4 Ind Vib	126	Flap Select
	15	Spare	31	Wind Speed	47	Spare	63	DME 2 Distance	79	Spare	95	Computed C of G	111	Spare	127	Spare
	16	Baroset Pilot	32	Altitude Select	48	Speed Select	64	Heading Select	80	Baroset Co pilot	96	Course Select	112	DH Select	128	EPR Target

All Sub-frames per word allocated to same parameter unless different parameter shown for individual sub-frames.
SF: Sub-Frame WD: Word

3.10

EUROCAE MOPS ED-55 TABLE A1.10 - Altitude Record Error Table

Standard	Equivalent Pressure Mercury		Tolerance, Feet Plus or Minus	
Altitude (Feet)	MM	IN.HG	Room Temperature	Low Temperature
-1,000	787.9	31.02	100	150
-500	773.8	30.47	100	___
0	760.0	29.92	100	150
500	746.4	29.39	100	___
1,000	732.9	28.86	100	___
1,500	719.7	28.33	100	___
2,000	706.6	27.82	100	___
3,000	681.1	26.81	125	___
4,000	656.3	25.84	150	210
6,000	609.0	23.98	150	250
8,000	564.4	22.22	150	___
10,000	522.6	20.58	150	___
12,000	483.3	19.03	180	350
14,000	446.4	17.57	210	___
16,000	411.8	16.21	240	___
18,000	379.4	14.94	270	450
20,000	349.1	13.75	300	___
22,000	320.8	12.63	335	___
25,000	281.9	11.10	375	560
30,000	225.6	8.88	450	600
35,000	178.7	7.04	525	730
40,000	140.7	5.54	600	800
50,000	87.3	3.44	700	___

Extract from FAA TSO C51a

APPENDIX 2

Reference Documents

a) UK Air Navigation Order, 1989.

b) EUROCAE Document ED-55, May 1990 : Minimum Operational Performance Specification for Flight Data Recorder System.

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

d) EUROCAE Document ED-56, 1988 : Minimum Operational Performance Requirement for Cockpit Voice Recorder Systems.

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

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

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

h) CAA Operational Requirement, Edition 2, December 1972.

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

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

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

l) FAA Technical Standard Order, TSO C51a : Aircraft Flight Recorders.

m) ICAO Annex 6, Part I: International Commercial Air Transport - Aeroplanes, and Part II: International General Aviation - Aeroplanes.

NOTES: 1) ICAO and CAA documents are obtainable from The Civil Aviation Authority, Printing and Publication Services, Greville House, 37 Gratton Road, Cheltenham GL50 2BN, England.

2) EUROCAE documents are obtainable from EUROCAE, 11 Rue Hamelin, 75783 Paris Cedex 16, France.

3) FAA documents are obtainable from FAA Office Airworthiness, Aircraft Engineering Division, (AIR-100), Independence Avenue, SW., Washington DC, 20591 USA.