



## **Flight Data Recorder Systems**

### **Contents**

- 1 Introduction**
- 2 Applicability**
- 3 System Requirements**
  - 3.1 Definition
  - 3.2 General Flight Data Recorder System Requirements
    - 3.2.1 Objectives
    - 3.2.2 Parameters to be Recorded
  - 3.3 Accuracy
    - 3.3.1 Long-term Accuracy
    - 3.3.2 Repeatability
  - 3.4 Resolution
  - 3.5 Relative Timings
  - 3.6 Reliability
  - 3.7 Data Monitor
  - 3.8 Crash Protected Recorder
    - 3.8.1 Record Duration
    - 3.8.2 Identification
    - 3.8.3 Crash Protection Requirements
      - a) General
      - b) Fire Test
      - c) Test Procedures
  - 3.9 Declarations
    - 3.9.1 General
  - 3.10 Vibration Tests (Flight Data Recorder)

---

The latest version of this document is available in electronic format at [www.caa.co.uk](http://www.caa.co.uk), where you may also register for e-mail notification of amendments.

Printed copy is available from: TSO, PO Box 29, Norwich NR3 1GN [www.tso.co.uk/bookshop](http://www.tso.co.uk/bookshop)  
Telephone: 0870 600 5522 e-mail: [book.orders@tso.co.uk](mailto:book.orders@tso.co.uk) Fax orders: 0870 600 5533

- 3.11 Normal Acceleration Transducer Performance
- 3.12 Declarations
  - 3.12.1 Equipment
  - 3.12.2 Systems

#### **4 Installation Requirements**

- 4.1 General
- 4.2 Electrical Supply
- 4.3 Operation and Termination
- 4.4 Synchronisation of Flight Data Recorders
- 4.5 Normal Acceleration Transducer
- 4.6 Airspeed and Altitude Data Sources
- 4.7 Location
- 4.8 System Accuracy

#### **5 Accident Investigation Requirements**

- 5.1 General
- 5.2 Read-out Requirements

#### **6 Requirements for Reliability and Maintenance**

- 6.1 Reliability Requirements
  - 6.1.1 Investigation Data Standard
  - 6.1.2 Achievement of Reliability Requirement
- 6.2 Calibration
- 6.3 Overhaul
- 6.4 Record Retention

Table 1 System Accuracy

## **1 Introduction**

- 1.1 The Air Navigation Order 1972, as amended, requires that certain categories of aeroplanes be equipped with a flight recording system (comprising a flight data recorder system and a cockpit voice recorder system) approved for the purpose by the Civil Aviation Authority.
- 1.2 Flight data recorder systems installed in aeroplanes in compliance with the Order shall comply with this Specification or with such other Specification as the Civil Aviation Authority may approve. Alternative installations submitted for approval shall have at least an equivalent standard of performance and shall comply with the particular requirements of the Order.
- 1.3 Cockpit Voice Recorder Systems will be subject to compliance with Civil Aviation Authority (Airworthiness Division) Specification No. 11.

## **2 Applicability**

This Specification prescribes the minimum performance standards, the installation requirements and requirements for general accident investigations and maintenance applicable to flight data recorder systems and components installed in conventional sub-sonic aeroplanes in accordance with the provisions of the Air Navigation Order 1972, as amended, Schedule 5, paragraph 4 (6), Scale S.

## **3 System Requirements**

### **3.1 Definition**

For the purpose of this Specification the equipment to be approved shall be that which is necessary to a flight data recorder system capable of recording by reference to a time scale, data from which the information required in ANO Schedule 5, paragraph 4 (6), Scale S can be established.

The flight data recorder system will normally include the following items of equipment:

- a) One or more units necessary for data acquisition and processing;
- b) A control panel on which system status is displayed;
- c) A crash protected recorder;
- d) Where information is not already available from existing sources transducers to provide a source of data.

### **3.2 General Flight Data Recorder System Requirements**

The primary purpose of the flight data recorder system is the achievement of the three particular objectives of paragraphs 3.2.1 a) to c). The fourth objective of 3.2.1 d) is a general one and it can only be achieved to a degree consistent with the number of parameters recorded. Where the recorded data is the same as that which is also presented to the pilots but is obtained from a different source, calibrations shall be available such that the information presented to the pilots in normal, flight conditions can be deduced.

#### **3.2.1 Objectives**

The objective in the selection of parameters is that the following information, required for accident investigation purposes shall be obtainable either directly or by deduction from the system:

- a) the flight path of the aeroplane;
- b) the attitude of the aeroplane in achieving that flight path;

- c) the basic forces acting upon the aeroplane and resulting in the achieved flight path (e.g. lift; drag; thrust; control forces); and
- d) the general origin of the basic forces and influences (e.g. navigational information; aeroplane system status information).

### 3.2.2 Parameters to be Recorded

The recording requirements for conventional sub-sonic aeroplanes shall, in relation to the list in Table 1 be as follows:

- |    |                                                                                       |   |                                                         |
|----|---------------------------------------------------------------------------------------|---|---------------------------------------------------------|
| a) | Aeroplanes having a total maximum weight authorised of between 5700 kg and 11399 kg.  | - | Either a voice recorder or parameters 1 to 9 inclusive. |
| b) | Aeroplanes having a total maximum weight authorised of between 11400 kg and 26999 kg. | - | A voice recorder and parameters 1 to 10 inclusive.      |
| c) | Aeroplanes having a total maximum weight authorised of 27000 kg and over.             | - | A voice recorder and parameters 1 to 26 inclusive.      |

65

- NOTES:**
- 1) It is not intended that the parameter lists resulting from the application of the requirements of 3.2.2 should, in any installation, require more recorder capacity than is provided by a 64 words per second system.
  - 2) The parameter requirements for non-conventional sub-sonic and for super-sonic aeroplanes will be the subject of consultation between the manufacturers, intending operators and the Civil Aviation Authority.

## 3.3 Accuracy

### 3.3.1 Long-term Accuracy

The required parameter accuracy is quoted in Table 1 and is, in each case, the RSS (root sum squared) value, measured between the absolute value of the parameter (unless otherwise stated) and the final numerical presentation after read-out.

### 3.3.2 Repeatability

For any parameter within the range of Table 1 the flight data recorder system (as defined in 3.1) should have a repeatability over a period of one minute in normal flight conditions at least five times better than the parameter accuracy quoted in Table 1.

## 3.4 Resolution

The resolution of the flight data recorder system over its operating range shall not be less than the short term repeatability specified in 3.3.2.

## 3.5 Relative Timings

Readings shall be recorded such that relative timings of different parameters can be deduced to within 0.25 seconds.

### 3.6 Reliability

3.6.1 The flight data recorder system shall be designed with the objective of attaining a mean time between failures consistent with the requirements of 6, and the manufacture(s) shall recommend in the Maintenance Manual the read-out periods, calibration procedures and overhaul periods necessary to comply with and maintain these standards in service.

3.6.2 In order to achieve compliance with 3.6.1, the design objective for the digital data processing unit and the recorder shall be that not more than one word in  $10^4$  will be misread under the environmental and operating conditions to which the equipment may be subjected in service. As the loss of data synchronism will in the worst case result in the loss of all data for at least one complete data word frame, the probability of its occurrences shall be not greater than one word frame in  $10^3$  word frames. If parity check is provided then 10 words shown to be spurious by such a parity check may be debited as one misread word. As certain digital words may present greater problems in data reconstruction this standard shall be attained at all points in the flight data recorder scale.

### 3.7 Data Monitor

3.7.1 The flight data recorder system shall include a means of monitoring that valid data is being recorded, and shall, present this information on the system control panel which shall be accessible to the flight crew for the preflight check.

3.7.2 An analysis of the monitor to show compliance with 3.7.1 shall be provided by the manufacturer.

### 3.8 Crash Protected Recorder

3.8.1 **Record Duration** The record duration shall be at least 25 hours.

3.8.2 **Identification** The crash protected recorder shall be provided with means to facilitate its identification in conditions following a crash including fire. This may be achieved by the recorder being coloured fluorescent orange or international orange and carrying the following warning in relief in black letters at least one inch high:-

Flight recorder	-	do not open
Enregistreur de vol	-	ne pas ouvrir

**NOTE:** Where this method is not appropriate alternative means should be discussed with the Civil Aviation Authority.

### 3.8.3 Crash Protection Requirements

a) The warning required by 3.8.2 shall remain legible and the record shall be capable of analysis by normal playback techniques after a flight recorder(s) has been subjected to the following sequence of tests:

- i) Impact, penetration, crush, fire and fluids, excepting sea water.
- ii) Impact, penetration, crush and sea water.

b) At the start of the fire tests the recorder shall be at its normal maximum internal working temperature, and shall be allowed to cool naturally after the test.

#### c) Test Procedures

- i) **Impact** The recorder shall be subjected to half sine wave impact shocks applied to each of the three axes in the most critical direction, and having a peak acceleration of 1,000 'g' for at least 5 milliseconds.

- ii) **Penetration Resistance** The recorder shall be subjected to an impact force produced by a 226 kg (500lb) steel bar which is dropped from a height of 3m (10 ft) on to the weakest face of the recorder in the most critical plane. The point of contact of the bar shall have an area no greater than 32mm<sup>2</sup> (0.05 in<sup>2</sup>). The longitudinal axis of the bar shall be vertical at the time of impact.
- iii) **Static Crush** The recorder shall be subjected to a static crush force of 22.25 kN (5,000 lbf) applied continuously but not simultaneously to each of the three axes in the most critical direction, for a period of 5 minutes.
- iv) **Fire** At least 50% of the outside area of the recorder shall be subjected to flames of at least 1100°C for a period of 30 minutes.
- v) **Fluids (excepting seawater)** The recording medium shall be immersed for 24 hours in each of the following fluids:
  - Aircraft fuel - J.P.1 (Kerosene) J.P.4
  - Lubricating Oil - D.Eng. RD2487
  - Hydraulic Fluid - DTD 585,  
Phosphate ester based fluid
  - Fire Extinguishing Fluids - Water glycol + 62% water,  
CO<sub>2</sub> foam, methyl bromide,  
freon 12, standard foam liquid,  
dry powder, CTC, BTM, BCF.
- vi) **Sea Water** The recorder or the recording medium shall be immersed in sea water for 30 days.

**NOTE:** Where the recording medium is immersed in sea water the recorder need not be subjected to the tests specified in 3.8.3 a) ii).

### 3.9 **Declarations**

- 3.9.1 **General** All the items of equipment which comprise the flight data recorder system shall be designed in accordance with BCAR Sections D, J and R as appropriate and constructed in accordance with the relevant requirements of BS 3G100 Part 1.

Tests shall be carried out to prove compliance with the environmental test requirements of BS 3G100, Part 2 or other Approved Specification, and with the electrical requirements of BS 3G100, Part 3.

- 3.10 **Vibration Tests (Flight Data Recorder)** In addition to the requirements of 3.9, it shall be shown either by test or analysis that the recorder will continue to function without loss of data when subjected to vibration conditions corresponding to  $\pm 1$  'g' at 1 Hz for periods of not less than 10 seconds in each of the three major axes.

The recorder shall be tested under the same mounting conditions as declared for the vibration tests called up in 3.9.

- 3.11 **Normal Acceleration Transducer Performance** The damping factor shall be not less than 0.7 of critical damping and the total error in following a single triangular acceleration pulse of 0.5 second duration or greater, shall be no more than 10% of the acceleration. The output/input ratio shall not vary by more than  $\pm 3$ dB when the transducer is subjected to a sinusoidal 'g' input within the range of 0 to 4 Hz. Above 4 Hz the output signal shall decrease at no less than 6 dB per octave.

**NOTE:** It is recommended that at least some of the attenuation is provided in the mechanical design of the transducer, in order to avoid saturation due to noise or high frequency inputs. Attenuation wholly provided by electrical filtering is unlikely to be acceptable.

### 3.12 **Declarations**

3.12.1 **Equipment** The Applicant for Approval of an item of equipment shall produce a Declaration of Design and Performance in accordance with the requirements of BS 3G100, Part 1. The CAA if satisfied will approve the item in relation to this Declaration. The Declaration shall in addition to that required by BS 3G100, Part 1, contain the following information:

- a) A statement of the relevant parts of this Specification with which the design complies;
- b) For transducers a statement showing compliance with 3.3 and 3.4 of this Specification;
- c) Any other specification which has a bearing on the design, and the degree of compliance;
- d) Any limitation(s) in the use of the equipment in relation to a flight data recorder system (e.g. mounting attitudes, location, input-output characteristics, interface requirements, etc.).

3.12.2 **Systems** The Applicant for Approval of the flight data recorder system shall produce a Declaration of Design and Performance. The CAA if satisfied will approve the system in relation to this Declaration.

The Declaration shall contain, in addition to the information required by BS 3G100, Part 1, Appendix A, the following:

- a) A list of the equipments (including Approval Numbers if any) which are necessary to the system;
- b) A statement of system accuracy (referred to in Table 1) throughout the environmental range over which the equipments are declared. (A calibration report should be included with the relevant test reports);
- c) A statement of the degree of compliance with the requirements of this Specification (with the relevant test reports);
- d) Confirmation of the availability of read-out facilities capable of complying with the requirements of paragraph 2 of this Specification;
- e) Maintenance procedures necessary to maintain system reliability to the requirements of paragraph 6.

## **4 Installation Requirements**

### 4.1 **General**

4.1.1 The flight data recorder system shall be of an approved type and shall be installed in accordance with the appropriate provisions of British Civil Airworthiness Requirements Sections D and J.

The system shall be so installed that in normal working conditions it shall be operating under the environmental conditions to which the items of equipment comprising the system have been declared.

4.1.2 Where the system is connected to mandatory instruments or data sources used for controlling or indicating the flight path of the aeroplane, compliance shall be shown with Chapter D4-1, paragraph 6.

**NOTE:** Provision of suitable isolation between the instruments or data sources and the flight data recorder system would be an acceptable means of compliance.

#### 4.2 **Electrical Supply**

The electrical supply to the flight data recorder system shall be of the highest practicable reliability, but need not be taken from the aeroplane's emergency source of supply.

#### 4.3 **Operation and Termination**

4.3.1 Operation shall be automatically initiated prior to the aeroplane starting to move under its own power, and shall cease at the end of the flight when the aeroplane is no longer capable of moving under its own power.

4.3.2 An automatic means shall be provided to inhibit operation when ground or auxiliary power only is being supplied to the aeroplane.

**NOTE:** Override facilities may be provided for ground test purposes.

#### 4.4 **Synchronisation of Flight Data and Voice Recorders**

Where aeroplanes are required to carry both flight data and voice recorders, the pilot's "Press to Transmit" action shall be recorded as an event mark on the flight data recorder, in order to correlate data and voice recordings.

#### 4.5 **Normal Acceleration Transducer**

The normal accelerometer shall be rigidly attached and located along the longitudinal axis within the permitted centre-of-gravity range of the aeroplane in a manner such that the performance will not be significantly affected by structural modes or vibrations.

#### 4.6 **Airspeed and Altitude Data Sources**

It is permissible to obtain airspeed and altitude data from either of the pilot's instrument systems. Where the data is obtained from a separate source, this source shall have equivalent integrity and accuracy. Position error information consistent with that required for the pilot's instrument systems shall be provided by the Applicant for Approval.

**NOTE:** In these circumstances both dimensional and non-dimensional free-air position error correction curves will have to be provided. Data in ground effect for the normal take-off and landing configurations and conditions should also be added. Limits of applicability (e.g. sideslip; reverse thrust; stall proximity) will have to be specified.

#### 4.7 **Location**

4.7.1 In-so-far as it is practicable, the recorder shall be installed as far to the rear of the aeroplane as possible, consistent with reasonable maintenance access, in a position to minimise the probability of damage from crash impact and subsequent fire.

4.7.2 The recorder shall remain attached to the local structure under normal, longitudinal, and transverse accelerations of 15 'g'.

4.7.3 Where the vibration of the airframe exceeds the limits to which the equipment has been tested at the location in which the recorder is installed, additional vibration testing within the vibration spectrum of that location shall be undertaken to ensure that the recorder will continue to function within its performance specification. In such circumstances the attachments and mounting attitude shall be designed to bring the recorder environment within the declared limits of the equipment.

#### 4.8 **System Accuracy**

The flight data recorder system shall comply with the accuracy requirements of Table 1. A record shall be provided of an input to output calibration of the system throughout the typical operating range of the required parameters. A read-out of a typical flight shall be



provided whose data shall be correlated with that of the pilot instruments, e.g. airspeed, altitude and magnetic heading. The quality of data shall not be less than that required by para. 6.1.1.

## **5 Accident Investigation Requirements**

### **5.1 General**

In order to ensure a high probability of flight recorded data being readily available for analysis following an accident and to comply with the read-out procedures specified in the Maintenance Schedule, the equipment manufacturer is required to confirm the availability of read-out facilities capable of complying with paragraph 5.2.

### **5.2 Head-out Requirements**

It shall be possible to provide, within 24 hours of receipt of unblemished data:

- a) a lasting analogue presentation of the recorded parameters (not necessarily including calibration correction) for the entire accident flight in graphical form for visual assessment, and
- b) a print-out of the original data, or calibrated data, in engineering units and decimal form.

**NOTE:** It is considered that this would normally involve the provision of data on a computer compatible magnetic tape. Continuous manual processing will not be an acceptable means of compliance.

## **6 Requirements for Reliability and Maintenance**

### **6.1 Reliability Requirements**

In order to ensure a reasonable probability that data will be available for accident investigation purposes, it is required that, from an adequate and representative sample of all the evidence available from record read-out (i.e. readout for maintenance and any other purposes), including flights started with a known unserviceable flight data recorder, the aeroplane operator shall show to the satisfaction of the CAA that there is a 92% probability that data is being recorded to a standard which will not significantly degrade the type of analysis which would be carried out in the majority of cases of accident investigation.

**6.1.1 Investigation Data Standard** The standard of data available shall be assessed on inspection of the read-out from a completed flight, including a period of cruise at a representative altitude and the periods required by the Air Navigation Order before and after the airborne portion of the flight.

**NOTES:** For the purposes of the above requirement, a satisfactory standard implies that successive errors and the overall error rate on any or all parameters are sufficiently infrequent. The assessment may be carried out by a simple visual appraisal of an analogue record. Where, however, it is desired to use other methods, or where the results of the visual assessment are doubtful, the following guidelines may be used to indicate a standard which is the minimum likely to be acceptable: -

- 1) Isolated significant errors on any parameter should not occur more frequently than once in 20 words of that parameter.
- 2) Successive significant errors on any parameter should not occur more frequently than once per 5 minutes, and not for a period longer than 5 seconds.
- 3) Loss of data on several or all parameters should not be such that data is lost for more than 8 seconds in any 2 minutes.

- 4) The total loss of a single parameter due to a flight data recorder system malfunction should be regarded as a loss of 20% of all information in an eight or nine parameter system. In a full 26 parameter system the total loss of a single parameter should be regarded as a loss of 5% of all information.

#### 6.1.2 **Achievement of Reliability Requirement**

- a) To demonstrate compliance with 6.1 the aeroplane maintenance schedule shall specify the periodic read-out of the recorded data. The period between read-outs is assessed on the basis of available supplementary checks (e.g. periodic tests by ground test on built-in test equipment, a monitor with a high probability of detecting failure, and on the demonstrated equipment installation reliability standards).
- b) The aeroplane operator shall review periodically the standards being achieved and, in agreement with the CAA, adjust the check periods accordingly, subject to the minimum reliability standards being maintained.

#### 6.2 **Calibration**

To ensure that the accuracy of data sources is being maintained, these shall be calibrated at intervals to be specified in the aeroplane maintenance schedules. The most recent calibration shall be retained by the aeroplane operator.

To ensure that the overall system performance is maintained an input to output system functional check for a minimum number of representative sources, shall be required at intervals to be specified in the aeroplane maintenance schedule.

#### 6.3 **Overhaul**

Equipment overhaul periods shall, where appropriate, be specified in the aeroplane Maintenance Schedule.

#### 6.4 **Record Retention**

The records required to be retained in accordance with the Air Navigation Order shall be in the form of an analogue trace or a digital transcription or the original record.

The time scale shall be such that the data can be read to an accuracy of 1 second or less.

**Table 1: System Accuracy:**

<b>Parameter</b>	<b>Record Interval (Secs) See Note 1</b>	<b>Minimum Range</b>	<b>Accuracy</b>	<b>Remarks</b>
1 Time	1		0.125% hour	GMT or elapsed time
2 Pressure Altitude	1	-305m (-1,000ft) to max. certificated altitude of the aeroplane + 1524m (5,000ft).	RSS value of scale error test of G.115 and recording and readout error $\pm 15\text{m}$ (50ft)	
3 Airspeed	1	60kts to $V_{DF} + 20\text{kts}$	Such that error will not exceed $\pm 3\%$ at speeds at and above the stalling speed of the aeroplane at the maximum landing weight	Accuracy related to pitot minus static pressure
4 Normal Acceleration (i.e. normal to the longitudinal and lateral axes of the aeroplane)	$\frac{1}{8}$	-3 'g' to +6 'g'	$\pm 0.086$ 'g' measured at each increment of one 'g' from 1 'g' datum (excluding long term datum drift)	See paragraph 3.11
5 Compass Heading	1	360°	$\pm 2^\circ$	
6 Gyro Pitch Attitude	$\frac{1}{4}$	$\pm 80^\circ$ or max. pitch angle normally available from the attitude transmitter.	$\pm 2^\circ$ or $\pm 10\%$ of increment from level flight indication, whichever is the greater	
7 Gyro Roll Attitude	$\frac{1}{2}$	$\pm 180^\circ$	$\pm 3^\circ$ or 10% of increment from level flight indication, whichever is the greater	

**Table 1: System Accuracy:**

<b>Parameter</b>	<b>Record Interval (Secs) See Note 1</b>	<b>Minimum Range</b>	<b>Accuracy</b>	<b>Remarks</b>
8 Engine Power (each engine) EPR or P7 for turbojet aeroplanes. Torque and RPM for propeller driven aeroplanes (Note 2)	One Engine to be sampled each sec. (i.e. a 4-engined aeroplane will have a particular engine sampled every 4 secs but with a one second stagger between different engines. 3-engined aeroplanes may sample each engine every 4 secs if longitudinal acceleration is being recorded.)	Full Range	Such that thrust can be determined to within $\pm 10\%$ full thrust	
9 Flap Angle (Note 3)	$\frac{1}{2}$	Full Range	Such that each gated position is unambiguously determinable from the record	Use of flap selector as data source will not be acceptable
10 "Press to Transmit" Action	1	Event Mark		
11 Lateral Acceleration	$\frac{1}{4}$	$\pm 1$ 'g'	$\pm 0.02g$ or $\pm 5\%$ of increment from zero datum, whichever is the greater, (excluding long term datum drift).	
12 Longitudinal Acceleration	1	$\pm 1$ 'g'	As for Lateral Acceleration	
13 Reverse (each engine)	4 (1 second stagger)	Event Mark		See parameter 8 re-three engined aeroplanes
14 Leading-edge high lift devices where fitted- position of cockpit control	$\frac{1}{2}$	Event Mark		
15 Airbrakes or spoilers where fitted - position of cockpit control	$\frac{1}{2}$	Event Mark		
16 Pitch Trim	$\frac{1}{2}$	Full Range	$\pm 3\%$ of full range	

**Table 1: System Accuracy:**

Parameter	Record Interval (Secs) See Note 1	Minimum Range	Accuracy	Remarks
17 Temperature	2	Covering OAT range of -90°C to +45°C.	Such that indicated OAT can be determined to within $\pm 3^\circ\text{C}$ .	TAT, SAT, OAT etc., may be recorded.
18 Undercarriage	2	Event Mark		Indication of "Undercarriage in Transit"
19 Primary flying Controls (Note 4)	$\frac{1}{4}$	Full Range	$\pm \frac{1}{2}^\circ$ or 3% of full movement, whichever the greater	Control Surface Position
		Full Range	$\pm 3\%$ of Full Range	Control Input Position
		$\pm 222\text{ N } (\pm 50\text{ lbf})$ $\pm 156\text{ N } (\pm 35\text{ lbf})$ $\pm 666\text{ N } (\pm 150\text{ lbf})$	$\pm 44\text{ N } (\pm 10\text{ lbf})$ $\pm 31\text{ N } (\pm 7\text{ lbf})$ $\pm 133\text{ N } (\pm 30\text{ lbf})$	Column Force Wheel Force Pedal Force
20 ILS Localiser Signal	1	$\pm 150$ micro-amps	$\pm 3\%$ of full range	
21 ILS Glideslope Signal	1	$\pm 150$ micro-amps	$\pm 3\%$ of full range	
22 Radio Altitude	1	70m (230 ft) downwards	$\pm 0.6\text{m } (\pm 2\text{ft})$ or $\pm 3\%$ of indicated height, whichever is the greater	If provided
23 Essential AC Voltage or frequency	2	30% to 12% of normal value	$\pm 5\%$ of normal value (Voltage) $\pm 1\%$ of normal value (Frequency)	Parameter to be selected on basis of value of data
24 Warnings (Note 5)		Event Marks		The Record interval of parameters 24, 25 and 26 can be adjusted to suit 4 sec frame
25 Automatic flight control system engagement (Note 6)	See Remarks Column	Event Marks		
26 Automatic flight control system mode (Note 7)		Event Marks		

- NOTES:**
- 1) The record interval is the maximum time,  $\pm 1/64$  seconds, between successive samples.
  - 2) Where auxiliary thrust units are provided it will be acceptable to record an event mark denoting the attainment and removal of a selected high level of power output.

- 3) Where gated flap positions are provided and intermediate selections are not possible a record by means of event marks will be acceptable, provided that they are derived from the operating mechanism and not from the flap selector.
- 4) Where there are only one or two control surfaces in each plane, measurement should be taken from each surface; where more than two surfaces are provided the measurement should be taken from a common stage (preferably that stage which is closest to the control surfaces) in the control run. "Column/Wheel/Pedal" forces will be an acceptable alternative to control surface deflections providing that the measurements are taken at, or immediately adjacent to, the operating controls. In complex systems it may be necessary, if not already covered by parameter 24, to monitor "System Status" in addition to Deflections/Forces.
- 5) Warnings should cover the following:
  - Fire (Each Engine and APU)
  - Cabin Pressurisation
  - Other Red Light Warnings leading to engine shut down
  - Fuselage Smoke
  - Essential Hydraulic/Pneumatic Power
- 6) Autopilot Engagement of each control axis (i.e. Pitch, Roll, Yaw, Autothrottle and Autolift Devices) where these are independently selectable. Basic autopilot engagement to be recorded where axes are not independently selectable.
- 7) Selection of each "Capture" or "Acquire" mode, and Autoland, to be recorded together with autoland selection (i.e. Prime Land).