

Supplementary to AN 83

Introduction

The material in this Appendix concerns flight recorders intended for installation in aeroplanes engaged in international air navigation. Flight recorders comprise two systems – flight data recorders and a cockpit voice recorder. Flight data recorders are classified as Type I, Type II and Type IIA depending upon the number of parameters to be recorded and the duration required for retention of the recorded information.

1. Flight Data Recorder (FDR)

1.1 General requirement

1.1.1 The FDR is to record continuously during flight time.

1.1.2 The FDR container is to :

- a) be painted a distinctive orange or yellow colour;
- b) carry reflective material to facilitate its location; and
- c) have securely attachment an automatically activated under-water locating device.

1.1.3 The FDR is to be installed so that :

- a) the probability of damage to the recording is minimized. To meet this requirement it should be located as far aft as practicable. In the case of pressurized aeroplanes it should be located in the vicinity of the rear pressure bulkhead.
- b) it receives its electrical power from a bus that provides the maximum reliability for operation of the FDR without jeopardizing service to essential or emergency loads; and
- c) there is an aural or visual means for pre-flight checking that the FDR is operating properly.

1.2 Parameters to be recorded

1.2.1 *Type I FDR.* This FDR will be capable of recording, at least the 32 parameters in Table 1. However, other parameters may be substituted with due regard to the aeroplane type and the characteristics of the recording equipment.

1.2.2 *Type II and IIA FDRs.* These FDRs will be capable of recording, as appropriate to the aeroplane, at least the first 15 parameters in Table 1. However, other parameters may be substituted with due regard to the aeroplane type and the characteristic of the recording equipment.

1.3 Additional information

1.3.1 *A TYPE IIA FDR,* in addition to a 30-minute recording duration, is not retain sufficient information from the preceding take-off for calibration purposes.

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

1.3.3 The manufacturer's usually provides the national certificating authority with the following information in respect of the FDRs :

- 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.

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

2 Cockpit voice recorder (CVR)

2.1 General requirements

- 2.1.1 The CVR is to be designed so that it will record 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;
 - d) voice or audio signals identifying navigation or approach aids introduced in the headset or speaker ;
 - e) voice communication of flight crew members using the passenger address system, if installed ; and
 - f) digital communications with ATS, unless recorded by the FDR.
- 2.1.2 The CVR container is to :
- a) be painted a distinctive orange or yellow colour ;
 - b) carry reflective material to facilitate its location ; and
 - c) have securely an automatically activated underwater locating device.
- 2.1.3 To aid in voice and sound discrimination, microphones in the cockpit are to be located in the best position for recording voice communications originating at the pilot and co-pilot stations and voice communications of the other crew members on the flight deck directed to those stations. This can be best be achieve by wiring suitable boom microphones to record continuously on separate channels.
- 2.1.4 The CVR is to be installed so that :
- a) to probability of damage to the recording is minimized. To meet this requirement it should be located as far aft as practicable. In the case pressurized aeroplanes it should be located in the vicinity of the rear pressure bulkhead ;
 - b) it receives its electrical power from a bus that provides the maximum reliability for operation of the CVR without jeopardizing service to essential or emergency loads ;
 - c) there is an aural or visual means for pre-flight checking of the CVR for proper operation ; and
 - d) if the CVR has a bulk erasure device, the installation should be designed to prevent operation of the device during flight time or crash impact.
- 2.2 Performance requirements
- 2.2.1 The CVR will be capable of recording on at lease four tracks simultaneously except for the CVR in Chapter 6, 6.3.7.2. To ensure accurate time correlation between tracks, the CVR is to record in-line time format. If a bi-directional configuration is used, the in-line format and track allocation should be retained in both directions.
- 2.2.2 The preferred track allocation is as follows :
- Track 1 – co-pilot headphones and live boom microphone
 - Track 2 – pilot headphones and live boom microphone
 - Track 3 – - area microphone
 - Track 4 – time reference plus the third and fourth crew member's headphone and live, if applicable.
- Note 1. - Track 1 is located closest to the base of the recording head.*
- Note 2.- The preferred track 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 alternative recording media where such constraints may not apply.*
- 2.2.3 The CVR, when tested by methods approved by the appropriate certificating authority, will be demonstrated to be suitable for the environmental extremes over which it is designed to operate.
- 2.2.4 Means will be provided for an accurate time correlation between the FDR and CVR.

Note – One method of achieving this is by superposing the FDR time signal on the CVR.

2.3 Additional information

The manufacturer usually provides the national certificating authority with the following information in respect of the CVR :

- a) Manufacturer's operating instructions, equipment limitations and installation procedures; and
- b) Manufacturer's test reports.

3. Inspections of FDR and CVR Systems

3.1 Prior to the first flight of the day, the built-in test features on the flight deck for the CVR, FDR and Flight Data Acquisition Unit (FDAU), when installed, should be monitored.

3.2 Annual inspections should be carried out as follows :

- a) the read-out of the recorded data from FDR and CVR should ensure that the recorder operates correctly for the nominal duration of the recording ;
- b) the analysis of the FDR should evaluate the quality of the recorded data to determine if the bit error rate is within acceptable limits and to determine the nature and distribution of the errors ;
- c) a complete flight from the FDR should be examined in engineering units to evaluate the validity of all recorded parameters. Particular attention should 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 read-out facility should 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 recording. While installed in the aircraft, the CVR should record test signals each aircraft source to ensure that all required signals meet intelligibility standards ; and
- f) where practicable, during the annual examination, a sample of in-flight recordings of the CVR should be examined for evidence that the intelligibility of the signal is acceptable.

3.3 Flight recorders systems should 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.

3.4 A report of the annual inspection should be made available on request to the State's regulatory for monitoring purposes.

3.5 Calibration of the FDR system :

- a) The FDR system should be re-calibrated at least every five years to determine any discrepancies in the engineering conversion routines for the mandatory parameters, and to ensure that parameters are being recorded within the calibration tolerance; and
- b) when the parameters of altitude and airspeed are provided by sensors that are dedicated to the FDR system, there should be a re-calibration performed as recommended by the sensor manufacturer, or at least every two years.

TABLE 1 – Parameters of Flight Data Recorders - Aeroplane

Serial Number	Parameter	Measurement Range	Recording Interval (seconds)	Accuracy Limits (Sensor input compared to FDR read-out)
1	Time (UTC when available, otherwise elapsed time)	24 hours	4	±0.125% per hour
2	Pressure-altitude	-300 m (-1000 ft) to maximum certificated altitude of aircraft +1 500 m (+5 000 ft)	1	±30 m to ±200 m (±100 ft to ±700 ft)
3	Indicated airspeed	95 km/h (50 kt) to max V_{So} (Note 1) V_{So} to 1.2 V_D (Note 2)	1	±5% ±3%

4	Heading	360°	1	±2°
5	Normal acceleration	-3 g to +6 g	0.125	±1% of maximum range excluding datum error of ±5%
6	Pitch attitude	±75°	1	±2°
7	Roll attitude	±180°	1	±2°
8	Radio transmission keying	On-off (one discrete)	1	
9	Power on each engine <i>(Note 3)</i>	Full range	1 (per engine)	±2%
10	Trailing edge flap or cockpit control selection	Full range or each discrete position	2	±5% or as pilot's indicator
11	Leading edge flap or cockpit control selection	Full range or each discrete position	2	±5% or as pilot's indicator
12	Thrust reverser position	Stowed, in transit, and reverse	1 (per engine)	
13	ground spoiler/speed brake selection	Full range or each discrete position		±2% unless higher accuracy uniquely required
14	Outside air temperature	Sensor range		±2°C
15	Autopilot/auto throttle/AFCS mode and engagement status	A suitable combination of discrettes		
<i>The preceding 15 parameters satisfy the requirements for a Type II FDR</i>				
16	Longitudinal acceleration	±1 g	0.25	±1.5% max range excluding datum error of ±5%
17	Lateral acceleration	±lg	0.25	±1.5% max range excluding datum error of ±5%
18	Pilot input and/or control surface position-primary controls (pitch, roll, yaw) <i>(Note 4)</i>	Full range		±2° unless higher accuracy uniquely required
19	Pitch trim position	Full range	1	±3% unless higher accuracy uniquely required
20	Radio altitude	-6 m to 750 m (-20 ft to 2 500 ft)	1	±0.6 m (±2 ft) or ±3% whichever is greater below 150 m (500 ft) and ±5% above 150 m (500 ft)
21	Glidepath deviation	Signal range	1	±3%
22	Localizer deviation	Signal range	1	±3%
23	Marker beacon passage	Discrete	1	
24	Master warning	Discrete	1	
25	NAV 1 and 2 frequency selection <i>(Note 5)</i>	Full range	4	As installed
26	DME 1 and 2 distance <i>(Notes 5 and 6)</i>	0 - 370 km	4	As installed
27	Landing gear squat switch status	Discrete	1	
28	GPWS (ground proximity warning system)	Discrete		
29	Angle of attack	Full range	0.5	As installed
30	Hydraulics, each system (low pressure)	Discrete	2	
31	Navigation data(latitude/longitude, ground speed and drift angle) <i>(Note 7)</i>	As installed	1	As installed
32	Landing gear or gear selector position	Discrete	4	As installed

Note: The preceding 32 parameters satisfy the requirements for a Type I FDR.

Notes:

1. V_s stalling speed or minimum steady flight speed in the landing configuration.
2. V_D design diving speed.
3. Record sufficient inputs to determine power.
4. For aeroplanes with conventional control systems "or" applies. For aeroplanes with non-mechanical control systems "and" applies. In aeroplanes with split surfaces, a suitable combination of inputs is acceptable in lieu of recording each surface separately.
5. If signal available in digital form.
6. Recording of latitude and longitude from INS or other navigation system is a preferred alternative.
7. 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:
 - 1) parameters selected by the flight crew relating to the desired flight path, e.g. barometric pressure setting, selected altitude, selected airspeed, decision height, and auto flight system engagement and mode indications if not recorded from another source;
 - 2) display system selection/status, e.g. SECTOR, PLAN, ROSE, NAV, WXR, COMPOSITE, COPY, ETC.;
 - 3) warnings and alerts;
 - 4) the identity of displayed pages for emergency procedures and checklists;
- b) retardation information including brake application for use in the investigation of landing overruns and rejected take-offs; and
- c) additional engine parameters (EPR, NJ, EGT, fuel flow, etc.).