



APPENDIX 2.3

FLIGHT RECORDERS

(Note.— See Chapter 2, 2.4.16)

The material in this Appendix concerns flight recorders intended for installation in aeroplanes engaged in international air navigation. Crash-protected flight recorders comprise one or more of the following systems: a flight data recorder (FDR), a cockpit voice recorder (CVR), an airborne image recorder (AIR) and/or a data link recorder (DLR). Lightweight flight recorders comprise one or more of the following systems: an aircraft data recording system (ADRS), a cockpit audio recording system (CARS), an airborne image recording system (AIRS) and/or a data link recording system (DLRS).

1. General requirements

1.1 Non-deployable flight recorder containers shall:

- a) be painted a distinctive orange or yellow colour;
- b) carry reflective material to facilitate their location; and
- c) have securely attached an automatically activated underwater locating device operating at a frequency of 37.5 kilohertz (kHz). At the earliest practical date, but not later than 1 January 2018, this device shall operate for a minimum of ninety days.

Note.— Current industry practice is to phase out yellow flight recorder containers at the end of the service life of the flight recorders.

1.2 The flight recorder systems shall be installed so that:

- a) the probability of damage to the recordings is minimized;
- b) they receive electrical power from a bus that provides the maximum reliability for operation of the flight recorder systems without jeopardizing service to essential or emergency loads;
- c) there is an aural or visual means for pre-flight checking that the flight recorder systems are operating properly; and
- d) if the flight recorder systems have a bulk erasure device, the installation shall be designed to prevent operation of the device during flight time or crash impact.



- 1.3 The flight recorder systems, when tested by methods approved by the appropriate certificating authority, shall be demonstrated to be suitable for the environmental extremes over which they are designed to operate.
- 1.4 Means shall be provided for an accurate time correlation between the recorder systems recordings.
- 1.5 The manufacturer shall provide the appropriate certificating authority with the following information in respect of the flight recorder systems:
- a) manufacturer's operating instructions, equipment limitations and installation procedures; and
 - b) manufacturer's test reports.

2. Flight data recorder (FDR)

2.1 The flight data recorder shall start to record prior to the aeroplane moving under its own power and record continuously until the termination of the flight when the aeroplane is no longer capable of moving under its own power.

2.2 Parameters to be recorded

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

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

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

- Pressure altitude
- Indicated airspeed or calibrated airspeed
- Air-ground status and each landing gear air-ground sensor when practicable
- Total or outside air temperature
- Heading (primary flight crew reference)
- Normal acceleration
- Lateral acceleration



- Longitudinal acceleration (body axis)
- Time or relative time count
- Navigation data*: drift angle, wind speed, wind direction, latitude/longitude
- Groundspeed*
- Radio altitude*

2.2.2.2 The following parameters shall satisfy the requirements for attitude:

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

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

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

2.2.2.4 The following parameters shall satisfy the requirements for configuration:

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



- DC electrical bus status*
- APU bleed valve position*
- Computed centre of gravity*

2.2.2.5 The following parameters shall satisfy the requirements for operation:

- Warnings
- Primary flight control surface and primary flight control pilot input: pitch axis, roll axis, yaw axis
- Marker beacon passage
- Each navigation receiver frequency selection
- Manual radio transmission keying and CVR/FDR synchronization reference
- Autopilot/autothrottle/AFCS mode and engagement status*
- Selected barometric setting*: pilot, first officer
- Selected altitude (all pilot selectable modes of operation)*
- Selected speed (all pilot selectable modes of operation)*
- Selected Mach (all pilot selectable modes of operation)*
- Selected vertical speed (all pilot selectable modes of operation)*
- Selected heading (all pilot selectable modes of operation)*
- Selected flight path (all pilot selectable modes of operation)*: course/DSTRK, path angle
- Selected decision height*
- EFIS display format*: pilot, first officer
- Multi-function/engine/alerts display format*
- GPWS/TAWS/GCAS status*: selection of terrain display mode including pop-up display status, terrain alerts, both cautions and warnings, and advisories, on/off switch position
- Low pressure warning*: hydraulic pressure, pneumatic pressure
- Computer failure*
- Loss of cabin pressure*
- TCAS/ACAS (traffic alert and collision avoidance system/airborne collision avoidance system)*
- Ice detection*
- Engine warning each engine vibration*
- Engine warning each engine over temperature*
- Engine warning each engine oil pressure low*
- Engine warning each engine over speed*
- Wind shear warning*
- Operational stall protection, stick shaker and pusher activation*
- All cockpit flight control input forces*: control wheel, control column, rudder pedal cockpit input forces



- Vertical deviation*: ILS glide path, MLS elevation, GNSS approach path
- Horizontal deviation*: ILS localizer, MLS azimuth, GNSS approach path
- DME 1 and 2 distances*
- Primary navigation system reference*: GNSS, INS, VOR/DME, MLS, Loran C, ILS
- Brakes*: left and right brake pressure, left and right brake pedal position
- Date*
- Event marker*
- Head-up display in use*
- Para visual display on*

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

2.2.2.6 *Type IA FDR.* This FDR shall be capable of recording, as appropriate to the aeroplane, at least the 78 parameters in Table A2.3-1.

2.2.2.7 *Type I FDR.* This FDR shall be capable of recording, as appropriate to the aeroplane, at least the first 32 parameters in Table A2.3-1.

2.2.2.8 *Type II FDR.* This FDR shall be capable of recording, as appropriate to the aeroplane, at least the first 15 parameters in Table A2.3-1.

2.2.2.9 The parameters that satisfy the recommendations for flight path and speed as displayed to the pilot(s) are listed below. The parameters without an (*) are mandatory parameters which shall be recorded. In addition, the parameters designated by an (*) are to be recorded if an information source for the parameter is displayed to the pilot and is practicable to record:

- Pressure altitude
- Indicated airspeed or calibrated airspeed
- Heading (primary flight crew reference)
- Pitch attitude
- Roll attitude
- Engine thrust/power
- Landing gear status*
- Total or outside air temperature*
- Time*
- Navigation data*: Drift angle, wind speed, wind direction, latitude/longitude
- Radio altitude*



2.3 Additional information

- 2.3.1 A Type IIA FDR, in addition to a 30-minute recording duration, shall retain sufficient information from the preceding take-off for calibration purposes.
- 2.3.2 The measurement range, recording interval and accuracy of parameters on installed equipment shall be verified by methods approved by the appropriate certificating authority.
- 2.3.3 Documentation concerning parameter allocation, conversion equations, periodic calibration and other serviceability/maintenance information shall be maintained by the operator/owner. The documentation shall be sufficient to ensure that accident investigation authorities have the necessary information to read out the data in engineering units.

3. Cockpit voice recorder (CVR) and cockpit audio recording system (CARS)

3.1 Signals to be recorded

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

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

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

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

- a) voice communication transmitted from or received in the aeroplane by radio;
- b) aural environment on the flight deck; and
- c) voice communication of flight crew members on the flight deck using the aeroplane's interphone system, if installed.



3.1.3 The recorder shall be capable of recording on at least four channels simultaneously except for the recorder in

3.6.3.2.1.3. On a tape-based CVR, to ensure accurate time correlation between channels, the recorder shall record in an in-line format. If a bi-directional configuration is used, the in-line format and channel allocation shall be retained in both directions.

3.1.4 The preferred channel allocation shall be as follows:

Channel 1 — co-pilot headphones and live boom microphone

Channel 2 — pilot headphones and live boom microphone

Channel 3 — area microphone

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

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

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

4. Airborne image recorder (AIR) and airborne image recording system (AIRS)

4.1 Classes

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

Note 1.—To respect crew privacy, the cockpit area view may be designed as far as practical to exclude the head and shoulders of crew members whilst seated in their normal operating position.

Note 2.— There are no provisions for Class A AIR or AIRS in this document.

4.1.2 A Class B AIR or AIRS captures data link message displays.

4.1.3 A Class C AIR or AIRS captures instruments and control panels.

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



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

5. Data link recorder (DLR)

5.1 Applications to be recorded

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

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

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

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

Note.— Descriptions of the applications are contained in Table A2.3-2.

6. Aircraft data recording systems (ADRS)

6.1 Parameters to be recorded ADRS shall be capable of recording, as appropriate to the aeroplane, at least the essential (E) parameters in Table A2.3-3.

6.2 Additional information

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



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

7. Inspections of flight recorder systems

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

7.2 FDR systems or ADRS, CVR systems or CARS, and AIR systems or AIRS shall have recording system inspection intervals of one year; subject to the approval from the appropriate regulatory authority, this period may be extended to two years provided these systems have demonstrated a high integrity of serviceability and self-monitoring. DLR systems or DLRS shall have recording system inspection intervals of two years; subject to the approval from the appropriate regulatory authority, this period may be extended to four years provided these systems have demonstrated high integrity of serviceability and self-monitoring.

7.3 Recording system inspections shall be carried out as follows:

- a) an analysis of the recorded data from the flight recorders shall ensure that the recorder operates correctly for the nominal duration of the recording;
- b) the analysis of the FDR or ADRS shall evaluate the quality of the recorded data to determine if the bit error rate (including those errors introduced by recorder, the acquisition unit, the source of the data on the aeroplane and by the tools used to extract the data from the recorder) is within acceptable limits and to determine the nature and distribution of the errors;
- c) a complete flight recording from the FDR or ADRS shall be examined in engineering units to evaluate the validity of all recorded parameters. Particular attention shall be given to parameters from sensors dedicated to the FDR or ADRS. Parameters taken from the aircraft's electrical bus system need not be checked if their serviceability can be detected by other aircraft systems;
- d) the readout facility shall have the necessary software to accurately convert the recorded values to engineering units and to determine the status of discrete signals;



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- e) an examination of the recorded signal on the CVR or CARS shall be carried out by replay of the CVR or CARS recording. While installed in the aircraft, the CVR or CARS shall record test signals from each aircraft source and from relevant external sources to ensure that all required signals meet intelligibility standards;
- f) where practicable, during the examination, a sample of in-flight recordings of the CVR or CARS shall be examined for evidence that the intelligibility of the signal is acceptable; and
- g) an examination of the recorded images on the AIR or AIRS shall be carried out by replay of the AIR or AIRS recording. While installed in the aircraft, the AIR or AIRS shall record test images from each aircraft source and from relevant external sources to ensure that all required images meet recording quality standards.

7.4 A flight recorder system shall be considered unserviceable if there is a significant period of poor quality data, unintelligible signals, or if one or more of the mandatory parameters is not recorded correctly.

7.5 A report of the recording system inspection shall be made available on request to regulatory authorities for monitoring purposes.

7.6 Calibration of the FDR system:

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



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Table A2.3-1 Parameter guidance for flight data recorders

| Serial number | Parameter | Measurement range | Maximum sampling and recording interval (seconds) | Accuracy limits (sensor input compared to FDR readout) | Recording resolution |
|---------------|---|---|---|--|---------------------------|
| 1 | Time (UTC when available, otherwise relative time count or GPS time sync) | 24 hours | 4 | ±0.125% per hour | 1 second |
| 2 | Pressure altitude | -300 m (-1 000 ft) to maximum certificated altitude of aircraft +1 500 m (+5 000 ft) | 1 | ±30 m to ±200 m (±100 ft to ±700 ft) | 1.5 m (5 ft) |
| 3 | Indicated airspeed or calibrated airspeed | 95 km/h (50 kt) to max V_{S_0} (Note 1) V_{S_0} to 1.2 V_D (Note 2) | 1 | ±5% ±3% | 1 kt (0.5 kt recommended) |
| 4 | Heading (primary flight crew reference) | 360° | 1 | ±2° | 0.5° |
| 5 | Normal acceleration (Note 3) | -3 g to +6 g | 0.125 | ±1% of maximum range excluding datum error of ±5% | 0.004 g |
| 6 | Pitch attitude | ±75° or usable range whichever is greater | 0.25 | ±2° | 0.5° |
| 7 | Roll attitude | ±180° | 0.25 | ±2° | 0.5° |
| 8 | Radio transmission keying | On-off (one discrete) | 1 | | |



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| Serial number | Parameter | Measurement range | Maximum sampling and recording interval (seconds) | Accuracy limits (sensor input compared to FDR readout) | Recording resolution |
|---|---|---------------------------------------|---|--|---|
| 9 | Power on each engine (Note 4) | Full range | 1 (per engine) | ±2% | 0.2% of full range or the resolution required to operate the aircraft |
| 10* | Trailing edge flap and cockpit control selection | Full range or each discrete position | 2 | ±5% or as pilot's indicator | 0.5% of full range or the resolution required to operate the aircraft |
| 11* | Leading edge flap and cockpit control selection | Full range or each discrete position | 2 | ±5% or as pilot's indicator | 0.5% of full range or the resolution required to operate the aircraft |
| 12* | Thrust reverser position | Stowed, in transit, and reverse | 1 (per engine) | | |
| 13* | Ground spoiler/speed brake selection (selection and position) | Full range or each discrete position | 1 | ±2% unless higher accuracy uniquely required | 0.2% of full range |
| 14 | Outside air temperature | Sensor range | 2 | ±2°C | 0.3°C |
| 15* | Autopilot/auto throttle/AFCs mode and engagement status | A suitable combination of discrete | 1 | | |
| <i>Note.— The preceding 15 parameters satisfy the requirements for a Type II FDR.</i> | | | | | |
| 16 | Longitudinal acceleration (Note 3) | ±1 g | 0.25 | ±0.015 g excluding a datum error of ±0.05 g | 0.004 g |
| 17 | Lateral acceleration (Note 3) | ±1 g | 0.25 | ±0.015 g excluding a datum error of ±0.05 g | 0.004 g |
| 18 | Pilot input and/or control surface position—primary controls (pitch, roll, yaw) (Notes 3 and 5) | Full range | 0.25 | ±2° unless higher accuracy uniquely required | 0.2% of full range or as installed |
| 19 | Pitch trim position | Full range | 1 | ±3% unless higher accuracy uniquely required | 0.3% of full range or as installed |
| 20* | Radio altitude | –6 m to 750 m (–20 ft to 2,500 ft) | 1 | ±0.6 m (±2 ft) or ±1% whichever is greater below 150 m (500 ft) and ±5% above 150 m (500 ft) | 0.3 m (1 ft) below 150 m (500 ft) + 0.5% of full range above 150 m (500 ft) |
| 21* | Vertical beam deviation (ILS/CHS/MLS glide path, MLS elevation, IRNAV/LAN vertical deviation) | Signal range | 1 | ±3% | 0.3% of full range |



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| Serial number | Parameter | Measurement range | Maximum sampling and recording interval (seconds) | Accuracy limits (sensor input compared to FIM readout) | Recording resolution |
|---|---|---|---|--|----------------------|
| 22* | Horizontal beam deviation (ILS/HPN/CLS localizer, MLS azimuth, IRNAV/IAN lateral deviation) | Signal range | 1 | ±3% | 0.3% of full range |
| 23 | Marker beacon passage | Discrete | 1 | | |
| 24 | Master warning | Discrete | 1 | | |
| 25 | Each NAV receiver frequency selection (Note 6) | Full range | 4 | As installed | |
| 26* | DME 1 and 2 distance (includes distance to runway threshold (FLS) and distance to missed approach point (IRNAV/IAN) (Notes 6 and 7) | 0-370 km (0-200 NM) | 4 | As installed | 1 852 m (1 NM) |
| 27 | Air/ground status | Discrete | 1 | | |
| 28* | GPWS/TAWS/QCAS status (selection of terrain display mode including pop-up display status) and (terrain alerts, both cautions and warnings, and advisories) and (on/off switch position) | Discrete | 1 | | |
| 29* | Angle of attack | Full range | 0.5 | As installed | 0.3% of full range |
| 30* | Hydraulics, each system (low pressure) | Discrete | 2 | | 0.5% of full range |
| 31* | Navigation data (latitude/longitude, ground speed and drift angle) (Note 8) | As installed | 1 | As installed | |
| 32* | Landing gear and gear selector position | Discrete | 4 | As installed | |
| <i>Note— The preceding 32 parameters satisfy the requirements for a Type I FDR.</i> | | | | | |
| 33* | Groundspeed | As installed | 1 | Data should be obtained from the most accurate system | 1 kt |
| 34 | Brakes (left and right brake pressure, left and right brake pedal position) | (Maximum metered brake range, discrete or full range) | 1 | ±5% | 2% of full range |
| 35* | Additional engine parameters (EPR, N_2 , indicated vibration level, N_2 HOT, fuel flow, fuel cut-off lever position, N_1) | As installed | Each engine each second | As installed | 2% of full range |
| 36* | TCAS/ACAS (traffic alert and collision avoidance system) | Discrete(s) | 1 | As installed | |



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| Serial number | Parameter | Measurement range | Maximum sampling and recording interval (seconds) | Accuracy limits (sensor input compared to FDR readout) | Recording resolution |
|---------------|--|-------------------|---|--|--|
| 37* | Wind shear warning | Discrete | 1 | As installed | |
| 38* | Selected barometric setting (pilot, co-pilot) | As installed | 64 | As installed | 0.1 mb (0.01 in-Hg) |
| 39* | Selected altitude (all pilot selectable modes of operation) | As installed | 1 | As installed | Sufficient to determine crew selection |
| 40* | Selected speed (all pilot selectable modes of operation) | As installed | 1 | As installed | Sufficient to determine crew selection |
| 41* | Selected Mach (all pilot selectable modes of operation) | As installed | 1 | As installed | Sufficient to determine crew selection |
| 42* | Selected vertical speed (all pilot selectable modes of operation) | As installed | 1 | As installed | Sufficient to determine crew selection |
| 43* | Selected heading (all pilot selectable modes of operation) | As installed | 1 | As installed | Sufficient to determine crew selection |
| 44* | Selected flight path (all pilot selectable modes of operation) (course/DETRK, path angle, final approach path (IRMSA VILAN)) | | 1 | As installed | As installed |
| 45* | Selected decision height | As installed | 64 | As installed | Sufficient to determine crew selection |
| 46* | EFIS display format (pilot, co-pilot) | Discrete(s) | 4 | As installed | |
| 47* | Multi-function/engine/alerts display format | Discrete(s) | 4 | As installed | |
| 48* | AC electrical bus status | Discrete(s) | 4 | As installed | |
| 49* | DC electrical bus status | Discrete(s) | 4 | As installed | |
| 50* | Engine bleed valve position | Discrete(s) | 4 | As installed | |
| 51* | APU bleed valve position | Discrete(s) | 4 | As installed | |
| 52* | Computer failure | Discrete(s) | 4 | As installed | |
| 53* | Engine thrust command | As installed | 2 | As installed | 2% of full range |
| 54* | Engine thrust target | As installed | 4 | As installed | 2% of full range |
| 55* | Computed centre of gravity | As installed | 64 | As installed | 1% of full range |
| 56* | Fuel quantity in CO trim tank | As installed | 64 | As installed | 1% of full range |



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| Serial number | Parameter | Measurement range | Maximum sampling and recording interval (seconds) | Accuracy limits (sensor input compared to FDR readout) | Recording resolution |
|---------------|---|--|---|--|------------------------------------|
| 57* | Head-up display in use | As installed | 4 | As installed | |
| 58* | Para-visual display on/off | As installed | 1 | As installed | |
| 59* | Operational stall protection, stick shaker and pusher activation | As installed | 1 | As installed | |
| 60* | Primary navigation system reference (GNSS, DRS, VOR/DME, MLS, Local C, localizer glide slope) | As installed | 4 | As installed | |
| 61* | Ice detection | As installed | 4 | As installed | |
| 62* | Engine warning each engine vibration | As installed | 1 | As installed | |
| 63* | Engine warning each engine over temperature | As installed | 1 | As installed | |
| 64* | Engine warning each engine oil pressure low | As installed | 1 | As installed | |
| 65* | Engine warning each engine over speed | As installed | 1 | As installed | |
| 66* | Yaw trim surface position | Full range | 2 | ±3% unless higher accuracy uniquely required | 0.3% of full range |
| 67* | Roll trim surface position | Full range | 2 | ±3% unless higher accuracy uniquely required | 0.3% of full range |
| 68* | Yaw or sideslip angle | Full range | 1 | ±5% | 0.5° |
| 69* | De-icing and/or anti-icing systems selection | Discrete(s) | 4 | | |
| 70* | Hydraulic pressure (each system) | Full range | 2 | ±5% | 100 psi |
| 71* | Loss of cabin pressure | Discrete | 1 | | |
| 72* | Cockpit trim control input position pitch | Full range | 1 | ±5% | 0.2% of full range or as installed |
| 73* | Cockpit trim control input position roll | Full range | 1 | ±5% | 0.2% of full range or as installed |
| 74* | Cockpit trim control input position yaw | Full range | 1 | ±5% | 0.2% of full range or as installed |
| 75 | All cockpit flight control input forces (control wheel, control column, rudder pedal) | Full range (±311 N (±70 lbf), ±378 N (±85 lbf), ±734 N (±165 lbf)) | 1 | ±5% | 0.2% of full range or as installed |



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| Serial number | Parameter | Measurement range | Maximum sampling and recording interval (seconds) | Accuracy limits (sensor input compared to FDR readout) | Recording resolution |
|---------------|---|-------------------|---|--|----------------------|
| 76* | Event marker | Discrete | 1 | | |
| 77* | Date | 365 days | 64 | | |
| 78* | Actual navigation performance or estimated position error or estimated position uncertainty | As installed | 4 | As installed | |

Note.— The preceding 78 parameters satisfy the requirements for a Type A FDR.

Notes.—

1. stalling speed or minimum steady flight speed in the landing configuration is in Section “Abbreviations and Symbols”.
2. VD design diving speed.
3. Refer to Chapter 2.4, 2.4.16.1.2.2, for increased recording requirements.
4. Record sufficient inputs to determine power.
5. For aeroplanes with control systems in which movement of a control surface will back drive the pilot’s control, “or” applies. For aeroplanes with control systems in which movement of a control surface will not back drive the pilot’s control, “and” applies. In aeroplanes with split surfaces, a suitable combination of inputs is acceptable in lieu of recording each surface separately.
6. If signal available in digital form.
7. Recording of latitude and longitude from INS or other navigation system is a preferred alternative.
8. 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:



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- 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;
 - 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.



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Table A2.3-2. Description of applications for data link recorders

| Item No. | Application type | Application description | Recording content |
|----------|---------------------------------------|--|-------------------|
| 1 | Data link initiation | This includes any applications used to log on to or initiate data link service. In FANS-1/A and ATN, these are ATS facilities notification (AFN) and context management (CM), respectively. | C |
| 2 | Controller-pilot communication | This includes any application used to exchange requests, clearances, instructions and reports between the flight crew and controllers on the ground. In FANS-1/A and ATN, this includes the CPDLC application. It also includes applications used for the exchange of oceanic (OCL) and departure clearances (DCL) as well as data link delivery of taxi clearances. | C |
| 3 | Addressed surveillance | This includes any surveillance application in which the ground sets up contracts for delivery of surveillance data. In FANS-1/A and ATN, this includes the automatic dependent surveillance — contract (ADS-C) application. Where parametric data are reported within the message they shall be recorded unless data from the same source are recorded on the FDR. | C |
| 4 | Flight information | This includes any service used for delivery of flight information to specific aircraft. This includes, for example, data link aviation weather report service (D-METAR), data link-automatic terminal service (D-ATIS), digital Notice to Airmen (D-NOTAM) and other textual data link services. | C |
| 5 | Aircraft broadcast surveillance | This includes elementary and enhanced surveillance systems, as well as automatic dependent surveillance — broadcast (ADS-B) output data. Where parametric data sent by the aeroplane are reported within the message they shall be recorded unless data from the same source are recorded on the FDR. | M* |
| 6 | Aeronautical operational control data | This includes any application transmitting or receiving data used for aeronautical operational control purposes (per the ICAO definition of operational control). | M* |

Key:

C: Complete contents recorded.

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

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



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Table A2.3-3. Parameter guidance for aircraft data recording systems

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



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| No. | Parameter name | Parameter category | Minimum recording range | Maximum recording interval in seconds | Minimum recording accuracy | Minimum recording resolution | Remarks |
|-----|--|--------------------|---|---------------------------------------|---|---|---------|
| 14 | Longitudinal acceleration | E | ± 1 g (*) | 0.25 (0.125 if available) | As installed (± 0.015 g excluding a datum error of ± 0.05 g recommended) | 0.004 g | |
| 15 | Lateral acceleration | E | ± 1 g (*) | 0.25 (0.125 if available) | As installed (± 0.015 g excluding a datum error of ± 0.05 g recommended) | 0.004 g | |
| 16 | External static pressure (or pressure altitude) | R | 34.4 mb (3.44 in-Hg) to 310.2 mb (31.02 in-Hg) or available sensor range | 1 | As installed (± 1 mb (0.1 in-Hg) or ± 30 m (± 100 ft) to ± 210 m (± 700 ft) recommended) | 0.1 mb (0.01 in-Hg) or 1.5 m (5 ft) | |
| 17 | Outside air temperature (or total air temperature) | R | -50° to $+90^{\circ}$ C or available sensor range | 2 | As installed ($\pm 2^{\circ}$ C recommended) | 1 $^{\circ}$ C | |
| 18 | Indicated air speed | R | As the installed pilot display measuring system or available sensor range | 1 | As installed ($\pm 3\%$ recommended) | 1 kt (0.5 kt recommended) | |
| 19 | Engine RPM | R | Full range including overspeed condition | Each engine each second | As installed | 0.2% of full range | |
| 20 | Engine oil pressure | R | Full range | Each engine each second | As installed (5% of full range recommended) | 2% of full range | |
| 21 | Engine oil temperature | R | Full range | Each engine each second | As installed (5% of full range recommended) | 2% of full range | |
| 22 | Fuel flow or pressure | R | Full range | Each engine each second | As installed | 2% of full range | |
| 23 | Manifold pressure | R | Full range | Each engine each second | As installed | 0.2% of full range | |



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| No. | Parameter name | Parameter category | Minimum recording range | Maximum recording interval in seconds | Minimum recording accuracy | Minimum recording resolution | Remarks |
|-----|--|--------------------|--------------------------------------|---------------------------------------|---------------------------------|------------------------------|--|
| 24 | Engine thrust/power/torque parameters required to determine propulsive thrust/power* | R | Full range | Each engine each second | As installed | 0.1% of full range | * Sufficient parameters e.g. EPR/N ₁ or torque/N ₂ as appropriate to the particular engine shall be recorded to determine power in both normal and reverse thrust. A margin for possible overspeed should be provided. |
| 25 | Engine gas generator speed (Ng) | R | 0-150% | Each engine each second | As installed | 0.2% of full range | |
| 26 | Free power turbine speed (Nf) | R | 0-150% | Each engine each second | As installed | 0.2% of full range | |
| 27 | Coolant temperature | R | Full range | 1 | As installed (±5°C recommended) | 1°C | |
| 28 | Main voltage | R | Full range | Each engine each second | As installed | 1 Volt | |
| 29 | Cylinder head temperature | R | Full range | Each cylinder each second | As installed | 2% of full range | |
| 30 | Flaps position | R | Full range or each discrete position | 2 | As installed | 0.5° | |
| 31 | Primary flight control surface position | R | Full range | 0.25 | As installed | 0.2% of full range | |
| 32 | Fuel quantity | R | Full range | 4 | As installed | 1% of full range | |
| 33 | Exhaust gas temperature | R | Full range | Each engine each second | As installed | 2% of full range | |
| 34 | Emergency voltage | R | Full range | Each engine each second | As installed | 1 Volt | |
| 35 | Trim surface position | R | Full range or each discrete position | 1 | As installed | 0.3% of full range | |



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| No. | Parameter name | Parameter category | Minimum recording range | Maximum recording interval in seconds | Minimum recording accuracy | Minimum recording resolution | Remarks |
|-----|--------------------------------|--------------------|-------------------------------------|---------------------------------------|----------------------------|------------------------------|--|
| 36 | Landing gear position | R | Each discrete position ^a | Each gear every two seconds | As installed | | ^a When available, record up-and-locked and down-and-locked position |
| 37 | Novel/unique aircraft features | R | As required | As required | As required | As required | |

Key:

E: Essential parameters

R: Recommended parameters