

The probability of causing a serious or fatal injury is expressed as the combination of:

- the probability of an unintended deployment;
 - the probability of a person being hit by the deployed part; and
 - the probability that, if hit by the deployed part, a person will suffer serious or fatal injuries. This probability may be set to 1, as a conservative assumption; otherwise, the applicant may propose another value to EASA for approval.
- c. The assessment of the effects of unintended deployment of the recorder on ground should include:
- i. The risk of injuries caused to persons. This should include those who are involved in aeroplane maintenance, ground handling, taxiing, rescue operations, or emergency evacuation; and
 - ii. The effects on other aircraft and facilities.
- In particular:
- A conspicuous placard or label that is visible from the outside of the aeroplane should be placed adjacent to the recorder deployment point;
 - ICA and/or operational procedures should be provided to prevent injuries during maintenance and ground handling;
 - Operational procedures should define the first actions to be taken by the flight crew when the recorder is no longer attached to the aeroplane, in order to address any risk to continued safe flight and landing and the possible effects on other aircraft and facilities;
 - Procedures should address the precautions that should be taken to avoid injuries which could be caused by an unintended deployment during emergency evacuation;
 - Information that addresses the precautions to be taken by search-and-rescue services after an accident should be publicly available; and
 - The deployment mechanism should only release the recorder in one piece.
- d. There may be a means to manually disengage the deployment capability when the aeroplane is not capable of moving under its own power; however, in this case, an alert should be provided to the flight crew during the pre-flight checks if the deployment capability is disengaged;
- e. The deployable recorder installation should be such as to guarantee the highest probability of the deployment of the recorder in the event of an explosion or a collision. In particular, the installation and the performance of the deployment capability should be such that, in most cases of collision, the deployment of the recorder can take place before the deployment mechanism is damaged. However, the installation should be such that, to the extent possible, the recorder does not deploy in a non-catastrophic occurrence such as a hard landing or a tail strike.
- f. The demonstration of compliance with [CS 25.1457\(e\)](#) should cover the whole flight envelope of the aeroplane, and additional trajectories that might be expected during the initial stages of an accident sequence.

The applicant may use the following Table 1 parameter ranges that have been observed during occurrences of loss of control of large aeroplanes:

Table 1: Parameter ranges

Parameter	Range	Unit
Pitch angle	+/- 60	°
Roll angle	+/- 60	°
Pitch rate	+/- 20	°/s
Roll rate	+/- 30	°/s
Yaw rate	+/- 20	°/s
Altitude	0 to 26 000 ft	ft
Speed	60 kt to V_D/M_D (design diving speed)	
Vertical speed	from maximum negative vertical speed at V_D/M_D to 0	

- g. The alert that the recorder is no longer attached to the aeroplane should be provided as early as permitted by the principles of [AMC 25.1322](#).
- h. The deployment capability should function under all the environmental conditions for which the aeroplane is certificated.
- i. The effect of exposure to environmental conditions (such as temperature, rain, lightning strikes, etc.) on the serviceability of the flight recorder and of its deployment capability should be addressed by design features and/or by ICA. ICA or operational procedures or both should also be provided such as to prevent maintenance and operational actions on the external surfaces of the aeroplane (such as painting, cleaning, application of de-/anti-icing fluids, etc.) from adversely affecting the serviceability of the flight recorder and its deployment capability.
- j. In order to limit the effects on search-and-rescue services of an unintended activation of the emergency locator transmitter (ELT) that is integrated in the recorder:
 - unintended deployment of the recorder should be classified at least as a major failure condition; and
 - operational procedures should define the flight crew actions to be taken after they realise that an unintended recorder deployment has taken place, including actions to prevent an unnecessary search-and-rescue response.

Furthermore, in order to identify the conditions which triggered an unintended deployment of the recorder (including the ensuing activation of the ELT) or an activation of the ELT without deployment of the recorder, appropriate data should be recorded on board or transmitted to the ground to support the post-flight analysis.

9. Evaluation of the CVR recording

The following acceptable means of compliance with [CS 25.1457\(b\)](#) is provided to demonstrate that the performance of a new or modified CVR system is acceptable and that the quality of the CVR recording is acceptable. Inspections of the CVR recording that are part of the Instructions for Continued Airworthiness are not in the scope of this paragraph.

- a. The CVR system should be installed in accordance with the recommendations made in EUROCAE Document ED-112A, in particular:
 - Chapter 2-5, Equipment installation and installed performance, and

- Part I, Cockpit Voice Recorder System, Chapter I-6.1.1 Interface design, I-6.1.2 Recorder Operation and I-6.1.3 Bulk Erasure Interlocks.

Particular attention should be given to the location of the cockpit area microphone (CAM). ED-112A, Chapter I-6.2., Equipment location, provides guidance on this topic.

It should be noted that the CVR may record on more than four channels, and that this may help to avoid superimposition between signal sources recorded on the same CVR channel.

- b. To ensure that the CVR system is properly installed, and to verify that the quality of the audio signals recorded on all the channels is acceptable, the applicant should conduct a flight test. The recording obtained should be evaluated to confirm that the quality is acceptable during all the normal phases of flight (including taxi-out, take-off, climb, cruise, descent, approach, landing, and taxi-in). ED-112A provides guidance for testing a new CVR installation. (Refer to Chapter I-6.3).
- c. The evaluation of the CVR recording should include:
 - i. the tasks described in ED-112A, Annex I-A, Chapter I-A.3;
 - ii. checking that the vocal signal sources are intelligible and that non-vocal alerts on headsets or speakers can be identified;
 - iii. checking that the levels of sidetone signals (e.g. radio) and public address are adjusted so that these signals are audible and do not mask the signals from the flight crew microphones (refer to ED-112A, Part I, Chapter I-6.1.1);
 - iv. checking the start-and-stop function of the CVR system. The CVR should begin to operate no later than when power from sources other than from the alternate power source is available and the pre-flight checklist is started. The CVR should continue to operate until either the completion of the final post-flight checklist or until 10 minutes after power is lost on all engines (and, when applicable the APU) and the aeroplane is on the ground.; and
 - v. checking for the presence of any fault in the memory of the built-in-test feature of the CVR, if applicable.
- d. The evaluation of the CVR recording should fulfil all of the conditions below:
 - i. The equipment used for the CVR recording replay should meet the specifications of Chapter I-A.2 of Annex I-A of ED-112A or a higher standard;
 - ii. The replay and evaluation of CVR recordings should be performed by personnel who have adequate knowledge of CVR systems and aircraft operations, and who have appropriate experience of the techniques used to evaluate recordings;
 - iii. The observations from the evaluation should be documented in an evaluation report. An example of an evaluation report is provided in ED-112A, Annex I-A; and
 - iv. The evaluation report should indicate the quality of each audio signal required to be recorded by [CS 25.1457\(c\)](#) according to defined criteria. For example, the following audio quality rating scale may be used:

GOOD:

- 1. When considering a vocal signal source (crew voice, radio reception, radio sidetone, interphone, public address, synthetic voice in callouts, warnings and alerts) recorded on a channel other than the CAM channel, the signal is intelligible without using any signal post-processing techniques, and no

- significant issue (e.g. saturation, noise, interference, or inadequate signal level of a source) affects the quality of this signal;
2. When considering non-vocal alerts recorded on a channel other than the CAM channel, the sounds are accurately identifiable in the recording without using any signal post-processing techniques, and no significant issue affects the quality of the sound recording;
 3. When considering the CAM, the recording is representative of the actual ambient sound, conversations and alerts as if an observer was listening in the cockpit, and no significant issue affects the quality of the signal; and
 4. No ‘medium’ or ‘major’ issue is identified on any channel (see Table 1 below for examples).

FAIR: a significant issue affects the signal source being considered. However, the related signal can still be analysed without signal post-processing, or by using signal post-processing techniques provided by standard audio analysis tools (e.g. audio level adjustment, notch filters, etc.). The severity of the identified issues is not rated higher than ‘medium’ (see Table 1 below for examples).

POOR: the signal source being considered is not intelligible or not identifiable, and this cannot be corrected even with the use of signal post-processing techniques. The severity of the identified issues is not necessarily rated as ‘major’, it may also be rated as ‘medium’, depending on the consequences for the required signal sources (see Table 1 below for examples); and

- v. the audio quality rating of a CVR channel required by [CS 25.1457\(c\)](#) should be the same as the worst audio quality rating among the signal sources to be recorded on this channel.
- e. The performance of the CVR system should be considered acceptable by the applicant only if, for none of the signal sources required by [CS 25.1457\(c\)](#) or by the applicable operating rules, the quality of the audio recording was rated as ‘poor’. In addition, if the CVR system is part of a new aeroplane type, the performance of the CVR system should be considered acceptable by the applicant only if, for all of the signal sources required by [CS 25.1457\(c\)](#) and by the applicable operating rules, the quality of the audio recording was rated as ‘good’.

Table 1: Examples of issues affecting a signal source and of the associated severity.

Issue severity rating	Examples of issues
MAJOR:	<ul style="list-style-type: none"> — One or more warning or callout is not recorded — Uncommanded interruption of the CAM signal — Unexplained variation of the CAM dynamic range — Hot-microphone function not operative — CVR time code not available — CAM saturation (due to low frequency vibration) — Radio side tone is missing — One required signal source is missing from the recording (e.g. one microphone signal not recorded) — Poor intelligibility of one microphone source (e.g. speech through oxygen mask microphone) — Quasi-permanent physical saturation of the CAM due to its excessive sensitivity — Quasi-permanent electrical saturation of a CVR channel
leading to a ‘POOR’ rating for the affected signal	

	<ul style="list-style-type: none"> — Mechanical and/or electrical interference making the transcription of signals difficult or impossible — Insufficient CAM sensitivity — Fault in the start/stop sequence
MEDIUM: leading to a ‘POOR’ or ‘FAIR’ rating for the affected signals, depending on the duration and the occurrence rate of the issues.	<ul style="list-style-type: none"> — Inappropriate level balance between signal sources on a CVR channel that results in a signal source masking other signal sources — Electrical interference caused by either the aircraft or the recorder power supply — Low dynamic range of the recording on a CVR channel — Low recording level of alert and or callout — Oversensitivity of the CAM line* to electromagnetic interference in the HF, UHF, or EHF domain (Wi-Fi, GSM, 5G, etc.) — Oversensitivity of the CAM line* to electrostatic discharge (ESD) phenomena — Oversensitivity of the CAM to air flow or conditioning noise (bleed air) — Phasing anomaly between CVR channels — Side tone recorded with a low level — Transitory saturation

*CAM line: microphone+control or preamplifier unit+wiring to the CVR

10. Instructions for Continued Airworthiness (ICA)

When developing the ICA for the CVR system, required by [CS 25.1529](#) and [Appendix H](#), the applicant should address all the failures that may affect the correct functioning of the CVR system or the quality of the recorded audio signals.

Examples of failures (indicative and non-exhaustive list):

- Loss of the recording function or of the acquisition function of the CVR;
- Any communication or audio signal (required by [CS 25.1457\(c\)](#) or by the applicable air operations regulations) is missing, or is recorded with an audio quality that is rated ‘poor’ (refer to the example of audio quality rating provided in Section 9 of this AMC);
- Failure of a sensor, transducer or amplifier dedicated to the CVR system (e.g. failure of the cockpit area microphone);
- Failure of a means to facilitate the finding of the CVR recording medium after an accident (e.g. an underwater locating device or an emergency locator transmitter attached to the recorder);
- Failure of any power source dedicated to the CVR (e.g. dedicated battery);
- Failure of the start-and-stop function;
- Failure of a means to detect a crash impact (for the purpose of stopping the recording after a crash impact, or for the purpose of deploying the recorder if it is deployable).

[Amdt 25/2]

[Amdt 25/23]

[Amdt 25/26]

CS 25.1459 Flight data recorders

ED Decision 2020/024/R

(See [AMC 25.1459](#))

- (a) Each flight data recorder required by the operating rules must be approved and must be installed so that –
- (1) It is supplied with airspeed, altitude, and directional data obtained from sources that meet the accuracy requirements of [CS 25.1323](#), [25.1325](#) and [25.1327](#), as appropriate;
 - (2) The vertical acceleration sensor is rigidly attached, and located longitudinally either within the approved centre of gravity limits of the aeroplane, or at a distance forward or aft of these limits that does not exceed 25% of the aeroplane's mean aerodynamic chord;
 - (3) (i) It receives its electrical power from the bus that provides the maximum reliability for operation of the recorder without jeopardising service to essential or emergency loads; and
 - (ii) It remains powered for as long as possible without jeopardising the emergency operation of the aeroplane;
 - (4) There is an aural or visual means for pre-flight checking of the recorder for proper recording of data in the storage medium;
 - (5) If the recorder has a recording duration of less than 25 hours, there is an automatic means to stop the recording within 10 minutes after crash impact. This requirement does not apply to recorders that are powered solely by the engine-driven electrical generator system;
 - (6) There is a means to record data from which the time of each radio transmission either to or from ATC can be determined;
 - (7) If another recorder is installed to perform the cockpit voice recorder function, any single electrical failure that is external to the recorder dedicated to the flight data recorder function does not disable both the recorders; and
 - (8) If the recorder is deployable, it complies with [CS 25.1457\(d\)\(7\)](#).
- (b) If the recorder is not deployable, the container of the recording medium must be located and mounted so as to minimise the probability of the container rupturing, the recording medium being destroyed, or the underwater locating device failing as a result of any possible combinations of:
- (1) impact with the Earth's surface;
 - (2) the heat damage caused by a post-impact fire; and
 - (3) immersion in water.

If the recorder is deployable, the deployed part must be designed and installed so as to minimise the probability of the recording medium being destroyed or the emergency locator transmitter failing to transmit (after damage or immersion in water) as a result of any possible combinations of:

- (1) the deployment of the recorder;
- (2) impact with the Earth's surface;
- (3) the heat damage caused by a post-impact fire; and

- (4) immersion in water.
- (c) A correlation must be established between the flight data recorder readings of airspeed, altitude, and heading and the corresponding readings (taking into account correction factors) of the first pilot's instruments. The correlation must cover the airspeed range over which the aeroplane is to be operated, the range of altitude to which the aeroplane is limited, and 360° of heading. Correlation may be established on the ground as appropriate.
- (d) The container of the flight data recorder must comply with the specifications in CS 25.1457(g) that are applicable to the container of the cockpit voice recorder.
- (e) Any novel or unique design or operational characteristics of the aeroplane must be evaluated to determine if any dedicated parameters must be recorded on the flight data recorder in addition to, or in place of, the parameters that are required by the existing requirements.

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AMC 25.1459 Flight data recorders

ED Decision 2020/024/R

1. General

The installation of a recorder with an ETSO authorisation against ETSO-C124c (or equivalent standard accepted by EASA) satisfies the approval requirement in [CS 25.1459\(a\)](#).

In showing compliance with [CS 25.1459](#), the applicant should take into account EUROCAE Document No ED-112A 'MOPS for Crash Protected Airborne Recorder Systems' or a later revision.

'FDR system' designates the flight data recorder (FDR) and its dedicated equipment. It may include the following items as appropriate to the aircraft:

- a. The equipment necessary to:
 - i. acquire and process analogue and digital sensor signals;
 - ii. store the recorded data in a crash-survivable recording medium; and
 - iii. when necessary, support dedicated sensors.
- b. Digital data busses and/or networks providing communications between elements of the system.

'Deployable recorder' designates a flight recorder that is installed on the aeroplane, and which is capable of automatically deploying from the aeroplane.

2. Automatic means to stop the recording after a crash impact

Refer to the Section of [AMC 25.1457](#) titled 'Automatic means to stop the recording after a crash impact'.

3. Means for pre-flight checking of the recorder

The means for pre-flight checking of the recorder should be able to detect and indicate the following:

- a. a loss of electrical power to the flight recorder system;

- b. a failure of the data acquisition and processing stages;
 - c. a failure of the recording medium and/or drive mechanism; and
 - d. a failure of the recorder to store the data in the recording medium as shown by checks of the recorded data including, as far as is reasonably practicable for the storage medium concerned, its correct correspondence with the input data.
4. Recorder container
Refer to the Section of [AMC 25.1457](#) titled ‘Recorder container’.
5. Combination recorder
Refer to the Section of [AMC 25.1457](#) titled ‘Combination recorder’.
6. Deployable recorder
Refer to the Section of [AMC 25.1457](#) titled ‘Deployable recorder’
7. Instructions for Continued Airworthiness (ICA)

When developing the ICA for the FDR system, required by [CS 25.1529](#) and [Appendix H](#), the applicant should address all the failures that may affect the correct functioning of the FDR system or the quality of the recorded data.

Examples of failures (indicative and non-exhaustive list):

- Loss of the recording function or of the acquisition function of the FDR;
- Any parameter (required by [CS 25.1459\(a\)\(1\)](#) or by the applicable air operations regulations) is missing, or is not correctly recorded;
- Failure of a sensor dedicated to the FDR system;
- Failure of a means to facilitate the finding of the FDR recording medium after an accident (e.g. an underwater locating device or an emergency locator transmitter attached to the recorder);
- Failure of the start-and-stop function;
- Failure of a means to detect a crash impact (for the purpose of stopping the recording after a crash impact, or for the purpose of deploying the recorder if it is deployable).

In addition, the ICA should include the following items, unless the applicant shows that this is not applicable:

- Calibration checks of parameters from sensors dedicated to the flight data recorder to verify the accuracy of these parameters; and
- FDR decoding documentation.

i. Definitions

FDR decoding documentation: a document that presents the information necessary to retrieve the raw binary data of an FDR data file and convert it into engineering units and textual interpretations.

Fixed-frame recording format: a recording format organised in frames and subframes of a fixed length and that are recorded chronologically. ARINC Specifications 573 and 717 provide an example of a fixed-frame recording format.

Variable-frame recording format: a recording format based on recording frames which are individually identified and time stamped, so that their order in the recording file is not important. ARINC Specification 767 provides an example of a variable-frame recording format.

ii. Content of the FDR decoding documentation

The FDR decoding documentation should at least contain information on:

- the aircraft make and model;
- the date and time when the document was modified; and
- in the case of a fixed-frame recording format:
 - the sync pattern sequence;
 - the number of bits per word, of words per subframe, and of subframes per frame; and
 - the time duration of a subframe;
- In the case of a variable-frame recording format, the list of frames, and for each frame:
 - its identification;
 - information on whether the frame is scheduled or event-triggered;
 - the recording rate (for a scheduled frame);
 - the frame event condition (for an event-triggered frame); and
 - the list of parameters, by order of recording;
- For every parameter:
 - its identification: name (and mnemonic code or other identification if applicable);
 - the sign convention and the units of converted values (if applicable);
 - the location of each component of a parameter in the data frame;
 - instructions and equations to assemble the components of each parameter and convert the raw binary values into engineering units (if applicable); and
 - the conversion to text or the discrete decipher logic (if applicable).

iii. Format of the FDR decoding documentation

The FDR decoding documentation should:

- be provided in an electronic format;
- contain all the information described in paragraph f.ii. above; and
- comply with the standard of ARINC Specification 647A or a later equivalent industry standard.

[Amdt 25/23]

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CS 25.1460 Data link recorders

ED Decision 2020/024/R

(See AMC 25.1460)

- (a) Each recorder performing the data link recording function required by the operating rules must be approved and must be installed so that it will record data link communication messages related to air traffic services (ATS) communications to and from the aeroplane.
- (b) Each data link recorder must be installed so that:
 - (1) (i) it receives its electrical power from the bus that provides the maximum reliability for the operation of the recorder without jeopardising service to essential or emergency loads; and
 - (ii) it remains powered for as long as possible without jeopardising the emergency operation of the aeroplane;
 - (2) there is an aural or visual means for pre-flight checking of the recorder for the proper recording of data in the storage medium; and
 - (3) if the recorder is deployable, it complies with CS 25.1457(d)(7).
- (c) If the recorder is not deployable, the container of the recording medium must be located and mounted so as to minimise the probability of the container rupturing, the recording medium being destroyed, or the underwater locating device failing as a result of any possible combinations of:
 - (1) impact with the Earth's surface;
 - (2) the heat damage caused by a post-impact fire; and
 - (3) immersion in water.If the recorder is deployable, the deployed part must be designed and installed so as to minimise the probability of the recording medium being destroyed or the emergency locator transmitter failing to transmit (after damage or immersion in water) as a result of any possible combinations of:
 - (1) the deployment of the recorder;
 - (2) impact with the Earth's surface;
 - (3) the heat damage caused by a post-impact fire; and
 - (4) immersion in water.
- (d) The container of the data link recorder must comply with the specifications applicable to the container of the cockpit voice recorder in CS 25.1457(g).

[Amdt 25/26]