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| <b>EASA</b>   | <b>CERTIFICATION MEMORANDUM</b>  |
|  | <p><b>EASA CM No.: EASA CM - AS – 001 Issue: 01</b></p> <p><b>Issue Date: 12<sup>th</sup> of June 2012</b></p> <p><b>Issued by: Avionics System section</b></p> <p><b>Approved by: Head of Certification Experts Department</b></p> <p><b>Regulatory Requirement(s): CS 23.1301, 1309 and 1457;<br/>CS 25.1301, 1309 and 1457; CS 27.1301, 1309 and 1457;<br/>CS 29.1301, 1309 and 1457.</b></p> |

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## **Subject**

### **Quality of Recording of Cockpit Voice Recorders**

**Log of Issues**

| Issue | Issue date | Change description |
|-------|------------|--------------------|
| 01    | 12.06.2012 | First issue.       |
|       |            |                    |
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## Table of Contents

|   |           |
|---|-----------|
| <b>1. INTRODUCTION</b> .....                            | <b>4</b>  |
| 1.1. Purpose and Scope .....                            | 4         |
| 1.2. References .....                                   | 4         |
| 1.3. Abbreviations .....                                | 5         |
| 1.4. Definitions .....                                  | 5         |
| <b>2. BACKGROUND</b> .....                              | <b>7</b>  |
| <b>3. EASA CERTIFICATION POLICY</b> .....               | <b>8</b>  |
| 3.1. EASA Policy .....                                  | 8         |
| 3.2. Who this Certification Memorandum Affects .....    | 9         |
| <b>4. REMARKS</b> .....                                 | <b>9</b>  |
| <b>APPENDIX: REPLAY CENTRE SELECTION CRITERIA</b> ..... | <b>10</b> |

# 1. INTRODUCTION

## 1.1. PURPOSE AND SCOPE

The purpose of this Certification Memorandum is to provide specific guidance for compliance to applicable CS-23, CS-25, CS-27 and CS-29 requirement related to Cockpit Voice Recorders (CVR).

In particular, this Certification Memorandum describes how compliance to CVRs recording quality requirements can be demonstrated.

## 1.2. REFERENCES

It is intended that the following reference materials be used in conjunction with this Certification Memorandum:

| Reference     | Title   | Code           | Issue | Date                           |
|---------------|---|----------------|-------|--------------------------------|
| 1301          | Function and installation   | CS-23,25,27,29 |       |                                |
| 1309          | Equipment, system and installations   | CS-23,25,27,29 |       |                                |
| 1457          | Cockpit Voice Recorder  | CS-23,25,27,29 |       |                                |
| 1529          | Instructions for Continued Airworthiness  | CS-23,25,27,29 |       |                                |
| ETSO-C123b    | Cockpit Voice Recorder Systems  |                |       | 21 <sup>st</sup> December 2010 |
| ETSO-C123a    | Cockpit Voice Recorder Systems  |                |       | Superseded by ETSO-C123b       |
| ED-112        | Minimum Operational Performance Specification For Crash Protected Airborne Recorder Systems |                |       | March 2003                     |
| ED-56A        | Minimum Operational Performance Requirement for Cockpit Voice Recorder System               |                |       | December 1993                  |
| SIB N°2009-28 | Flight Data Recorder and Cockpit Voice Recorder Dormant Failures                            |                |       | 9 <sup>th</sup> December 2009  |

### 1.3. ABBREVIATIONS

The following abbreviations are used in this Certification Memorandum:

| Abbreviation | Meaning   |
|--------------|---|
| <b>a/c</b>   | <b>A</b> ircraft  |
| <b>AMC</b>   | <b>A</b> cceptable <b>M</b> eans of <b>C</b> ompliance                        |
| <b>CAM</b>   | <b>C</b> ockpit <b>A</b> rea <b>M</b> icrophone                               |
| <b>CS</b>    | <b>C</b> ertification <b>S</b> pecification                                   |
| <b>CVR</b>   | <b>C</b> ockpit <b>V</b> oice <b>R</b> ecorder                                |
| <b>MOPS</b>  | <b>M</b> inimum <b>O</b> perational <b>P</b> erformance <b>S</b> pecification |
| <b>SIB</b>   | <b>S</b> afety <b>I</b> nformation <b>B</b> ulletin                           |
| <b>STC</b>   | <b>S</b> upplementary <b>T</b> ype <b>C</b> ertificate                        |
| <b>TC</b>    | <b>T</b> ype <b>C</b> ertificate  |

### 1.4. DEFINITIONS

The following definitions are used in this Certification Memorandum:

| Definition                   | Meaning   |
|------------------------------|---|
| <b>CVR system</b>            | <p>The CVR system comprises the recorder itself (the CVR), its dedicated sensors, dedicated processing and communication equipment, and dedicated indicators and controls. The CVR system includes as a minimum:</p> <ul style="list-style-type: none"> <li>• CVR</li> <li>• Cockpit equipment dedicated to the CVR, including a monitor and failure indication, one or more area microphones (CAM) and associated pre-amplifiers,</li> <li>• A means of converting the analogue audio signals to a digital format</li> <li>• Audio interface equipment, including microphone/telephone signal summing amplifiers,</li> <li>• A means of converting a time synchronization signal to a format which can be recorded,</li> <li>• Digital data busses and/or networks providing communications between elements of the system.</li> </ul> |
| <b>Channel 1<sup>1</sup></b> | Captain's audio panel   |
| <b>Channel 2</b>             | First Officer's audio panel   |

<sup>1</sup> Definitions of channels are consistent with ED-112 and aims only for right interpretation of issues described in section 2. It should be noted definitions of channels in this Certification Memorandum deviates from sequential allocation of channels in CS XX.1457.

|                  |                           |
|------------------|---------------------------|
| <b>Channel 3</b> | Additional crew positions |
| <b>Channel 4</b> | Cockpit Area Microphone   |

## 2. BACKGROUND

Cockpit Voice Recorder (CVR) system is installed for the purposes of the investigation of a reportable accident or incident. For that purpose, the quality of recording should provide for a high level of intelligibility of speech and an accurate reproduction of the sounds and background noise audible in the cockpit.

Based on information from various European accident investigation authorities, it appears that new or modified CVR system installations may not provide the quality expected for the Cockpit Area Microphone (CAM) and other voice recording channels.

The problems identified include but are not restricted to:

1. Poor quality of the recording on channel 4 due to an underperforming preamplifier.
2. Poor quality of the recording on channel 4 due to insufficient sensitivity of the CAM.
3. Saturation of recording on channel 4 by very low frequency vibrations, due to excessive sensitivity of the CAM to low frequency signals or wrong installation of the CAM.
4. Excessive electrical background noise of 400 Hz frequency on any channel, due to an incorrect shielding of CVR audio wirings.
5. Signals from channel 1 and channel 2 recorded with opposite phase signs, which can result in signals cancelling each other when mixed.
6. Clipping of the signals on channels 1 and 2 when coming from the oxygen mask microphones, due to an excessive sensitivity of the oxygen mask microphones. The consequence is reduced intelligibility.
7. On channels 1 and 2, where crew microphone and radio reception signals are recorded in the same channel, microphone signals are overridden by radio reception signal, caused by a radio reception signal set too high in comparison to the input to the microphones.
8. A negative-going electrical signal produced when there is a positive-going pressure wave at the CAM diaphragm. This may result in a significant attenuation of the signal, since the CAM diaphragm responses to overpressure and underpressure are not symmetric.
9. An erroneous allocation of CVR channel to the CAM, resulting in the CAM being recorded with reduced quality (CAM channel is higher specification than a crew channel, and therefore it requires more memory space on the CVR).

CS XX.1457 (a) requires that a/c equipped with CVR record voice communications of flight crew members and audio signals on the flight deck. Applicable in general terms to all a/c systems, CS XX.1301 and 1309 require CVR perform as expected.

CSXX.1457 (b) addresses the need to select the appropriate location for the CAM and install pre-amplifiers and filters, when needed, in order that it contributes to the intelligibility of the recorded communications at the first and second pilot stations and voice communications of other crew members on the flight deck when directed to those stations. It also recommends the play back of recording for intelligibility assessment.

The AMC 25.1457-Cockpit Voice Recorders refers to EUROCAE document **ED-56A** '*Minimum Operational Performance Requirement for Cockpit Voice Recorder System*', as referred to in ETSO-C123a as guidance in showing compliance with CS 25.1457. These references have been superseded by ED-112 '*Minimum Operational Performance Specification for Crash Protected Airborne Recorder Systems*' and ETSO-123b respectively. The current ETSO-123b uses **ED-112** as a reference for MOPS for CVR systems. The ETSO is an equipment approval

which does not cover installation aspects. Consequently the installation aspects including installed performance, flight test and maintenance defined in ED-112 should be addressed during the installation process.

The Certification Specifications (CS) and Acceptable Means of Compliance (AMC) do not fully address all considerations associated with the quality of recorded audio signal.

Those previously mentioned aspects not covered by ETSO-123b are key elements to ensure the adequate CVR recording quality is achieved.

As a consequence, it has been deemed necessary by EASA to provide additional guidance on showing compliance to applicable requirements related to quality of recording of CVRs.

## **3. EASA CERTIFICATION POLICY**

### **3.1. EASA POLICY**

The intent of this EASA Certification Memorandum is to provide guidance for complying with CS.XX 1457 requirement applicable to CVRs. In particular, this Certification Memorandum describes how compliance to CVRs recording quality requirements can be demonstrated.

The EASA additional guidance is as follow:

Those applicants performing a new installation or modification of CVR system should observe recommendations made on the installation of CVR elements in ED-112. (Refer to Chapter 2-5 Equipment installation and installed performance, Chapter I-6.1.1 Interface design, Chapter I-6.1.2 Recorder Operation and I-6.1.3 Bulk Erasure Interlocks for further guidance). Particular attention should be given by installers to the location of the CAM. (Refer to Chapter I-6.2. Equipment location for further guidance.)

For existing installations, where a cockpit modification that may impact on any element of CVR system location (i.e. CAM, microphones, preamplifiers, audio cables, etc) is performed, installation recommendations should be observed as well.

In considering installations made according ED-56A standard, applicants may observe recommendations made on the installation and installed performances at Chapter 6 of the ED-56A when performing any CVR system modification, provided such specific installation could not follow ED-112 recommendations.

To ensure CVR systems are properly installed and to verify the audio signal recorded from all audio channels achieve the acceptable level of quality, applicants should conduct a check during flight. The recording obtained should be evaluated to confirm acceptable level of quality during all normal regimes of flight including taxiing, take-off, cruise, approach and landing. For helicopters, hover and autorotation should be included. For existing installations, where an element of the CVR system was modified or the location of an element of the CVR was changed, it is acceptable to check only the CVR channels impacted by this modification.

ED-112 provides guidance for procedure to be applied to aircrafts. (Refer to Chapter I-6.3)

The replay and evaluation should be performed by a replay centre. The appendix of this Certification Memorandum contains recommendations regarding criteria to select a replay centre. Applicants should provide as part of the compliance demonstration a statement with regards to the acceptability of the replay and evaluation centre. Guidance is provided in Annex I-A of ED-112.



A replay and evaluation report on the CVR replay should be part of the compliance demonstration by the applicant.

Along the service life of CVR systems, maintenance practices should be taken into account to ensure quality of recording is not degraded. Guidance for appropriate maintenance task can be found in Annex I-C of the ED-112.

Applicants should consider EASA SIB nº 2009-28 “Flight Data Recorder and Cockpit Voice Recorder Dormant Failures” when preparing instructions for continued airworthiness associated to CVR systems.

### **3.2. WHO THIS CERTIFICATION MEMORANDUM AFFECTS**

This Certification Memorandum affects applicants who need to show compliance with CS-XX.1457 Cockpit Voice Recorder requirements.

It is applicable to installations of new CVR systems or modifications. It is also applicable to modifications on the cockpit that may impact on the location of any element of CVR system (i.e. CAM, microphones, preamplifiers, audio cables, etc).

## **4. REMARKS**

1. Suggestions for amendment(s) to this EASA Certification Memorandum should be referred to the Certification Policy and Planning Department, Certification Directorate, EASA. E-mail [CM@easa.europa.eu](mailto:CM@easa.europa.eu) or fax +49 (0)221 89990 4459.
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## APPENDIX: REPLAY CENTRE SELECTION CRITERIA

An acceptable replay and evaluation centre should fulfil all of the conditions below:

- The equipment used for CVR recording replay should meet the specifications of Paragraph I-A.2 of Annex I-A of ED-112 or a higher standard;
- The equipment used for CVR recording replay should be located in a clean, quiet area which is separated from other work areas sufficiently to ensure the privacy of recordings;
- Access to the replay equipment should be restricted to authorised personnel only;
- Provision should be made for the secure storage of CVR recording media and any copies made;
- The replay and evaluation of recordings should be performed by personnel with adequate knowledge of CVR systems and aircraft operations, and who have appropriate experience of the techniques used to evaluate recordings; and
- The replay centre should document the observations made from the evaluation of the recording into a report.

Note:

Due to privacy concerns, the use of CVR recordings for purposes other than the investigation of an accident or a serious incident is restricted. Therefore, recorders laboratories of some safety investigation authorities and some test centres working for safety investigation authorities have a unique experience in assessing the quality of CVR recording.

As a consequence, a safety investigation authority might be best positioned to act as a replay centre. Alternatively, a safety investigation authority might be able to recommend an acceptable replay centre.

Nevertheless, it is not required the replay centre is a safety investigation authority. The replay centre need not be a separate organisation from the applicant.