



ICAO

Doc 10101

Manual on Flight Crew-Machine Interface Recordings

First Edition, 2021



Approved by and published under the authority of the Secretary General



| ICAO

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AMENDMENTS

Amendments are announced in the supplements to the *Products and Services Catalogue*; the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

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FOREWORD

Flight data recorders (FDRs) and cockpit voice recorders (CVRs) have been effectively used in accident and incident investigations for a number of years. Considering that many different sources of data are accessed besides flight recorders, it was revealed during many accident investigations that the data from FDRs and CVRs were not sufficient for investigators to fully understand all of the factors that contributed to an accident. It was realized that, while very useful, FDRs and CVRs do not capture all pilot actions and non-verbal communications, such as a crew member pointing to a gauge or screen that is out or fluctuating. In cases where flight crew-machine interface recordings (FCMIRs) have been available, accident investigators have found the information very useful in determining causes/contributing factors and ultimately identifying ways to improve aviation safety. Although there is limited experience with image recorder recordings, image recording systems in lightweight flight recorders have matured over time and now encompass video recordings of the cockpit, recording data link messages (such as controller-pilot data link communications (CPDLC)) and screen capture recordings. The ICAO Council adopted FCMIR provisions in Annex 6 — *Operation of Aircraft, Part I — International Commercial Air Transport — Aeroplanes* in 2018. These provisions already required recording data link messages, if the aircraft was so equipped, and now require the recording of information displayed to flight crew from electronic displays as well as the operation of switches and selectors by the flight crew. The use of image recorders in the cockpit was not required due to privacy concerns.

This manual was developed with contribution from subject matter experts and provides States with guidance material for the implementation of appropriate provisions for FCMIRs as required by Annex 6 Part I, Chapter 6, 6.3.4 and provides references to the protections needed for these recordings.

Comments on this manual, particularly with respect to its application and usefulness, are appreciated. These comments will be taken into consideration in the preparation of subsequent editions. Comments concerning this manual should be addressed to:

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GLOSSARY

DEFINITIONS

Balancing test. The determination whereby the competent authority(ies) assesses competing public interests and decides which interest should prevail leading to the determination referred to in Annex 13 — *Aircraft Accident and Incident Investigation*.

Data Quality. Refers to the proportion of data that can be recovered and is not corrupted or inaccurate.

Flight crew-machine interface recording (FCMIR). A function that records information displayed to flight crew as well as switches and controls used by them to operate the aircraft. A recording may comprise one or more types of data such as those captured by image and flight data recorders or other formats appropriate to specific interfaces.

Note.— For the purpose of this definition, flight crew is any licensed crew member charged with duties essential to the operation of an aircraft during a flight duty period.

Flight recorder data download. Means of copying the digital data stored in the crash protected memory module for replay at a later time.

Flight recorder data retrieval. Retrieval of data from the recording medium for the task of presenting the data for analysis purposes.

Flight recorder readout. An analysis of the recorded data from a flight recorder.

Flight recorder replay. The act of reconstructing the recorded situations/scenarios.

Maintenance¹. The performance of tasks required to ensure the continuing airworthiness of an aircraft, including any one or combination of overhaul, inspection, replacement, defect rectification, and the embodiment of a modification or repair.

Maintenance². The performance of tasks on an aircraft, engine, propeller or associated part required to ensure the continuing airworthiness of an aircraft, engine, propeller or associated part, including any one or combination of overhaul, inspection, replacement, defect rectification, and the embodiment of a modification or repair.

ACRONYMS AND ABBREVIATIONS

AAIB	Air Accident Investigation Branch, United Kingdom
ACAS	Airborne collision avoidance system
AIA	Accident investigation authority
AIR	Airborne image recorder
AIRS	Airborne image recording system
ARTCC	Air route traffic control centre

-
1. Applicable until 4 November 2020
 2. Applicable as of 5 November 2020

BEA	Bureau d'Enquêtes et d'Analyses, France
CAM	Cockpit area microphone
CARS	Cockpit audio recording system
CPDLC	Controller-pilot data link communications
CVR	Cockpit voice recorder
DITS	Digital information transfer system
DL	Data link
DLC	Data link communications
DU	Display unit
EFB	Electronic flight bag
EUROCAE	European Organisation for Civil Aviation Equipment
EGT	Exhaust gas temperature
FCMI	Flight crew-machine interface
FCMIR	Flight crew-machine interface recording
FDR	Flight data recorder
FLIRECSWG	Flight Recorder Specific Working Group of the Flight Operations Panel
FRSMM	Flight Recorder System Maintenance Manual
GCAS	Ground collision avoidance system
GPWS	Ground proximity warning system
HSI	Horizontal situation indicator
HUD	Head-up display
LCD	Liquid crystal display
MOPS	Minimum operation performance specification
ms	milliseconds
ND	Navigation display
NTSB	National Transportation Safety Board, United States
PFD	Primary flight display
QAR	Quick access recorder
RTCA	Radio Technical Commission for Aeronautics
SARP	Standards and Recommended Practices
SSP	State safety programme
TAWS	Terrain awareness warning system
TCAS	Traffic alert and collision avoidance system

PUBLICATIONS

International Civil Aviation Organization (ICAO)

Annex 6 — *Operation of Aircraft*
Part I — *International Commercial Air Transport — Aeroplanes*
Part II — *International General Aviation — Aeroplanes*
Part III — *International Operations — Helicopters*

Annex 13 — *Aircraft Accident and Incident Investigation*

Annex 19 — *Safety Management*

Manuals

Manual of Aircraft Accident and Incident Investigation (Doc 9756)

Safety Management Manual (SMM) (Doc 9859)

Manual on Protection of Safety Information, Part I — Protection of Accident and Incident Investigation Records (Doc 10053)

Manual on Location of Aircraft in Distress and Flight Recorder Data Recovery (Doc 10054)

Manual on Flight Recorder System Maintenance (Doc 10104)

OTHERS

United Kingdom Civil Aviation Authority

CAP 762: The Effectiveness of Image Recorder Systems in Accident Investigations

Published on CAA UK website:

<http://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=2527>

European Organization for Civil Aviation Equipment (EUROCAE) (www.eurocae.net)

ED-112A — *Minimum Operational Performance Specification for Crash Protected Airborne Systems*

ED-155 — *Minimum Operational Performance Specification for Lightweight Flight Recording Systems*

ED-204A — *Information Security Guidance for Continuing Airworthiness*

RTCA (RTCA.org)

DO-355 — *Information Security Guidance for Continuing Airworthiness*

Chapter 1

INTRODUCTION

1.1 BACKGROUND

1.1.1 Flight recorders, or “black boxes,” have become synonymous with aircraft accident and incident investigations. The recovery of the flight recorders and subsequent retrieval and analysis of the valuable information stored within the crash-protected memory is widely recognized as a valuable investigation tool, both by the aviation industry and by the general public. Flight recorder information contributes to an effective accident or incident investigation and promotes improvements in safety. The quick access recorder (QAR), as a derivative of the flight data recorder (FDR), is an essential part of flight monitoring systems that improve operational safety and efficiency.

1.1.2 However, the FDR is not the sole component that contributes to the logging of useful information. An FDR system is made up of many components and interconnections with aircraft systems and dedicated sensors. As technology has developed, the ability to record images of the cockpit and capture information displayed to the crew has become easier and more economically viable. Recorded images of the cockpit environment may provide valuable information to accident and incident investigators and contribute to a better understanding of the events leading up to an accident or incident. Image and screen capture recordings also provide investigators insight into what the aircraft presented to the flight crew, what they were dealing with and how they handled the situation.

1.1.3 Eight safety recommendations addressed to ICAO recommended that provisions for the availability of image recordings be included in Annex 6 — *Operation of Aircraft*. The issues leading to these recommendations included the unavailability of data on either the cockpit voice recorder (CVR) or FDR to analyse human performance, a lack of data because no CVR or FDR was installed in the aircraft, and uncertainty about what information was displayed to the flight crew during the event. Examples of such safety recommendation are as follows:

- a) France’s Bureau d’Enquêtes et d’Analyses (BEA) has issued five safety recommendations since 1994 on this subject, most notably in the context of the investigation into the Air France flight 447 accident on 1 June 2009;
- b) the United States’ National Transportation Safety Board (NTSB) has also proposed and reiterated similar safety recommendations¹; and
- c) in 2016, the United Kingdom’s Air Accidents Investigation Branch (AAIB) reiterated the need for airborne image recorders (AIRs) by recommending the requirement for the installation of cockpit image recorders, in aircraft required to be equipped with FDR and CVR, to capture flight crew actions within the cockpit environment².

1.1.4 The purpose of the safety recommendations is to gain information related to the cockpit environment to include non-verbal crew communications, crew workload, and instrument display selections and status, which is not available from FDRs or CVRs. Flight crew-machine interface recordings (FCMIRs), in combination with FDR and CVR recordings, provide a better understanding of the crew’s interactions with the aircraft and its instruments.

1. <https://www.nts.gov/safety/safety-recs/recletters/A-15-001-008.pdf>

2. <https://www.gov.uk/aaib-reports/aircraft-accident-report-aar-1-2016-g-wnsb-23-august-2013>