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Doc 10054

Manual on Location of Aircraft in Distress and Flight Recorder Data Recovery

First Edition, 2019



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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

This manual has been developed to provide guidance on Standards and Recommended Practices (SARPs) contained in Annex 6 — *Operation of Aircraft*, Part I — *International Commercial Air Transport — Aeroplanes*, relating to the location of an aircraft in distress and flight recorder data recovery.

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GLOSSARY

ABBREVIATIONS AND ACRONYMS

ADFR	Automatic deployable flight recorder
ADPCM	Adaptive differential pulse-code modulation
ADRS	Aircraft data recording system
ADS-B	Automatic dependent surveillance — broadcast
ADS-C	Automatic dependent surveillance — contract
ADT	Autonomous distress tracking
AIA	Accident investigation authority
AIR	Airborne image recorder
AMS	Aeronautical mobile satellite
ARINC	Aeronautical Radio, Incorporated
ASR	Air Safety Report
ATC	Air traffic control
ATS	Air traffic services
ATSU	Air traffic service unit
CAM	Cockpit area microphone
CONOPS	Concept of operations
CVR	Cockpit voice recorder
DFL	Data frame layout
DLR	Data link recorder
DTR	Distress tracking data repository
ELT	Emergency locator transmitter
FDA	Flight data analysis
FDAP	Flight data analysis programme
FDAPM	Flight data analysis programme manual
FDR	Flight data recorder
FIR	Flight information region
GADSS	Global Aeronautical Distress and Safety System
GNSS	Global navigation satellite system
GPWS	Ground proximity warning system
IIC	Investigator-in-charge
MASPS	Minimum aviation system performance specification
MOPS	Minimum operational performance specification
MRO	Maintenance, repair and overhaul
MSS	Mobile satellite service
RCC	Rescue coordination centre
SAR	Search and rescue
SARP	Standard and Recommended Practice
ULD	Underwater locating device

PUBLICATIONS

(Referred to in this manual)

ICAO Publications

Annex 2 — Rules of the Air

Annex 6 — Operation of Aircraft

Part I — International Commercial Air Transport — Aeroplanes (Amendment 43)

Annex 11 — Air Traffic Services

Annex 12 — Search and Rescue

Annex 13 — Aircraft Accident and Incident Investigation

Annex 19 — Safety Management

Circular 347 — Aircraft Tracking Implementation Guidelines

Global Aeronautical Distress and Safety System (GADSS) — Concept of Operations — Version 6.0

Other Publications

European Organisation for Civil Aviation Equipment (EUROCAE) Document ED-112A — *Minimum Operational Performance Specification for Crash Protected Airborne Recorder Systems*

EUROCAE Document ED-237 — *Minimum Aviation System Performance Specification for Criteria to Detect In-Flight Aircraft Distress Events to Trigger Transmission of Flight Information*



Chapter 1

INTRODUCTION

1.1 BACKGROUND

1.1.1 Aviation continues to enjoy a high level of safety due to the willingness to learn from past events, among other things. Fundamental to this approach is the ability to recover information from flight recorders after an accident.

1.1.2 Two high-profile events have highlighted limitations in the air navigation system which have both hampered search and rescue efforts and led to a delay in retrieving, or inability to retrieve, flight recorder data from the aircraft involved.

1.1.3 In June 2009, Air France Flight 447, a scheduled flight from Brazil to France, went missing in the Atlantic Ocean. The aircraft's flight data recorders were recovered after several search operations, which lasted nearly two years. Due to this and other such occurrences, several safety recommendations have been addressed to ICAO related to locating accident sites, locating aircraft in distress and the recovery of flight recorder data. These recommendations resulted in proposals for amendments to Annex 6 — *Operation of Aircraft*; however, the proposals were not adopted.

1.1.4 The disappearance on 8 March 2014 of a Malaysia Airlines Boeing 777, operating as Flight MH370, in the Indian Ocean triggered the most comprehensive and costly search operation in aviation history. At the time of publication of this manual, the main wreckage had not yet been discovered, nor had the flight recorders been recovered.

1.1.5 Shortly after the Malaysia Airlines event, a special Multidisciplinary Meeting on Global Flight Tracking (MMGFT) was convened in May 2014 at ICAO Headquarters in Montréal, Canada, so that recommendations for future actions could be proposed. One of the main decisions reached was the need for operators to pursue aircraft flight tracking at a faster pace. The MMGFT concluded by recommending that a final high-level concept of operations (CONOPS) should be delivered to the forthcoming ICAO High-level Safety Conference. It further recommended that ICAO provisions should be developed through a multidisciplinary approach, to support the location of an accident site in a timely manner for the purpose of search and rescue and accident investigation.

1.1.6 The Global Aeronautical Distress and Safety System (GADSS) CONOPS was initiated at a subsequent meeting of an ad hoc working group. The GADSS concept describes, in an evolutionary manner, the execution of actions in the short, medium and long terms with each action resulting in benefits. The CONOPS document specifies the high-level requirements and objectives of the GADSS, which is a system of systems and procedures intended to apply initially to commercial air transport operations (Annex 6, Part I — *International Commercial Air Transport — Aeroplanes* applicability). The CONOPS takes an overall system approach, however, and is consequently not restricted to a particular type of operation. The first steps in implementing the GADSS were taken in the short term by implementing aircraft tracking solutions as proposed by the industry-led Aircraft Tracking Task Force (ATTF) for commercial air transport and by addressing the areas of improvement identified in the GADSS CONOPS.

1.1.7 Further developments included proposals to incorporate provisions for the location of aircraft in distress and the recovery of flight recorder data.

1.2 OBJECTIVES AND SCOPE

1.2.1 Amendment 40A to Annex 6, Part I, which introduced provisions for locating an aircraft in distress and the timely recovery of flight recorder data, was adopted by the ICAO Council on 2 March 2016 and became applicable on 10 November 2016. These provisions, however, have embedded applicability dates of 1 January 2021. The objective of this manual is to provide guidance on the implementation of these provisions.

Note.— The references to Annex 6 in this document reflect the latest version of the Annex at time of publishing (up to and including Amendment 43).

1.2.2 The guidance in this manual is intended to support the provisions in Annex 6, Part I, only. Other proposals contained in the GADSS CONOPS are not addressed in this manual. It is to be noted that the GADSS CONOPS is meant to serve as a high-level road map providing context to the elements which are included in the Annexes and does not in itself imply any obligations on the part of States.

1.3 GLOBAL AERONAUTICAL DISTRESS AND SAFETY SYSTEM (GADSS)

1.3.1 As discussed in 1.2, the adopted Standards related to the location of aircraft in distress and timely recovery of flight recorder data were developed using the GADSS CONOPS as a high-level road map. It is useful to review the GADSS concept to understand the context of these provisions.

1.3.2 On the rare occasions when accidents occur, rescuing survivors has the highest priority, followed by the recovery of casualties, flight recorders and wreckage. The analysis of data from these recorders is very important in supporting accident investigations, which, through identification of the causes and contributing factors of accidents, may contribute towards enhancing safety. To achieve this, an effective and globally consistent approach to improve the alerting of search and rescue services is essential.

1.3.3 As the GADSS addresses all phases of flight under all circumstances including distress, the effectiveness of the current system for alerting search and rescue services should be enhanced by addressing a number of key improvement areas identified within the GADSS. This will result in maintaining an up-to-date record of aircraft progress and, in the case of a crash, forced landing or ditching, the location of survivors, recoverable flight data and the aircraft.

1.3.4 The high-level objectives of the GADSS are therefore defined as follows:

- a) ensure timely detection of aircraft in distress
 - Timely initiation of search and rescue (SAR) actions;
- b) ensure tracking of aircraft in distress and timely and accurate location of end of flight
 - accurate direction of SAR actions;

- c) enable efficient and effective SAR operations; and
 - d) ensure timely retrieval of flight recorder data.
- 1.3.5 The GADSS identifies three specific functions needed to achieve the high-level objectives. Figure 1-1 gives an overview of the GADSS and identifies these primary functions.

1.3.6 Aircraft tracking

1.3.6.1 The aircraft tracking function provides the aircraft operator with aircraft position information directly when air traffic services (ATS) surveillance services obtain the aircraft position at greater than 15-minute intervals. Where it can be confirmed that ATS obtain an aircraft position at 15-minute intervals or less, the aircraft operator does not need to track the aircraft.

1.3.6.2 The aircraft tracking function:

- a) does not introduce any change to current air traffic control (ATC) alerting procedures;
 - b) establishes operator responsibilities for tracking based on areas of operation;
 - c) is not technology-specific and can be achieved using existing on-board equipment; and
 - d) establishes communication protocols between operators and ATC.
- 1.3.6.3 More details regarding aircraft tracking can be found in Circular 347 — *Aircraft Tracking Implementation Guidelines*.

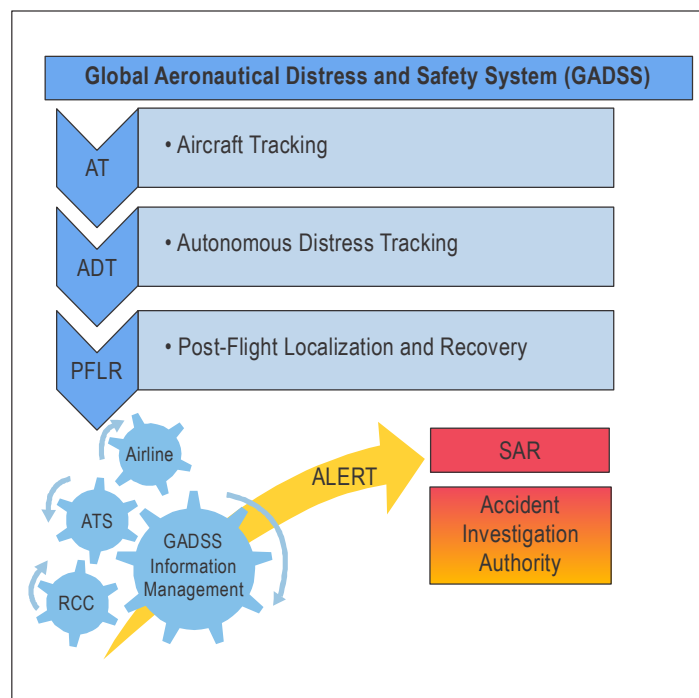


Figure 1-1. Primary functions of the GADSS

1.3.7 Autonomous distress tracking (ADT)

1.3.7.1 The autonomous distress tracking (ADT) function will be used to identify the location of an aircraft in distress with the aim of establishing, to a reasonable extent, the location of an accident site within a 6 NM radius.

1.3.7.2 The ADT function uses on-board systems to broadcast information from which the aircraft position (latitude, longitude and time) can be derived. The aircraft position information will be transmitted, without the need for flight crew action, at least once every minute when an aircraft is in a distress condition. An aircraft is in a distress condition when it is in a state that, if the aircraft behaviour event is left uncorrected, can result in an accident.

Note.— ADT is discussed in detail in Chapter 2.

1.3.8 Post-flight localization and recovery

1.3.8.1 In the event of an accident, the rescue phase to locate possible survivors has the immediate and highest priority. The goal of the post-flight localization function is to guide search and rescue to the accident site.

1.3.8.2 Following an accident, it is beneficial for the accident investigation authority (AIA) to recover the aircraft's structure, components and critical flight data in a timely manner. When the accident occurs over an oceanic area, the task of localizing the aircraft's structure, and particularly its flight recorders, can be difficult.

1.3.8.3 To assist the localization of the wreckage and recovery of flight recorder data after an accident, the post-flight localization and recovery function specifies a number of requirements for emergency locator transmitters (ELTs), underwater locator devices (ULDs) and flight recorders, which are incorporated in Annex 6 provisions

Note.— Post-flight localization (using ADT) is discussed in Chapter 2. Flight recorder data recovery is discussed in detail in Chapter 3.

Chapter 2

GUIDANCE FOR LOCATION OF AIRCRAFT IN DISTRESS

2.1 INTRODUCTION

2.1.1 This chapter provides guidance aimed at helping States and operators to comply with ICAO Standards and Recommended Practices (SARPs) related to the location of an aeroplane in distress and one of its primary components, autonomous distress tracking (ADT).

2.1.2 Throughout this chapter, clarifications to specific excerpts of SARPs are made to promote understanding, explain intent and illustrate potential means of compliance and methods of implementation. The means of compliance are not limited to the methods that are described in this document. States may approve other means of compliance with the applicable SARPs.

2.2 APPLICABILITY AND INTENT OF THE PROVISIONS

2.2.1 General

On 2 March 2016, the ICAO Council adopted Amendment 40A to Annex 6, Part I which included, among other elements, SARPs relating to the location of an aeroplane in distress. These SARPs address the GADSS ADT function. The SARPs became effective on 11 July 2016 and will be applicable on 1 January 2021.

Note.— The references to Annex 6 in this document reflect the latest version of the Annex at time of publishing (up to and including Amendment 43).

2.2.2 SARPs related to location of an aeroplane in distress

2.2.2.1 The essential requirements related to the location of an aeroplane in distress are in Annex 6, Part I, 6.18.1 and 6.18.2, while additional requirements are contained in Appendix 9 to the Annex.

6.18.1 All aeroplanes of a maximum certificated take-off mass of over 27 000 kg for which the individual certificate of airworthiness is first issued on or after 1 January 2021, shall autonomously transmit information from which a position can be determined by the operator at least once every minute, when in distress, in accordance with Appendix 9.

6.18.2 **Recommendation.—** All aeroplanes of a maximum certificated take-off mass of over 5 700 kg for which the individual certificate of airworthiness is first issued on or after 1 January 2021, should autonomously transmit information from which a position can be determined at least once every minute, when in distress, in accordance with Appendix 9.

2.2.2.2 This Standard applies to all new aeroplanes with a take-off mass of greater than 27 000 kg, from the applicability date of 1 January 2021. Paragraph 6.18.2 recommends that this provision apply to all new aeroplanes with a take-off mass of greater than 5 700 kg from the same date.

2.2.2.3 Regardless of the functionality of the ADT system there is still a requirement to carry an ELT in addition to the ADT. The ADT cannot be used to replace both the automatic ELT and the second ELT. While the note included under 6.17.3 clarifies that removal of the automatic ELT is permitted when an ADT is carried, 6.17.1 still recommends that all aircraft be fitted with an automatic ELT. If an automatic ELT is replaced by an ADT system as described in Annex 6, Part I, 6.17.3 b), it is possible that there will be no homing signal for post-accident localization other than a manually activated ELT. In this case, appropriate mitigation measures would need to be in place to ensure the effective response of SAR resources, such as standard operating procedures for manual activation of the ELT.

2.2.2.4 Although these SARPs apply to newly manufactured aeroplanes, there is an incentive to retrofit older aeroplanes by replacing one of the two required ELTs with an ADT device that provides autonomous position information when the aeroplane's distress condition is first detected (see Annex 6, Part I, 6.17.3 b)). The detection of an aeroplane in distress is explained in detail in Section 2.3 of this manual.

2.2.2.5 An *autonomous* distress tracking system continues to operate while the aeroplane is in distress and is resilient to failures of the aeroplane systems. Further details on the meaning of the term "autonomous" can be found in Section 2.5.4 of this manual.

2.2.2.6 The SARPs are not technology-specific and allow for various solutions including a system providing position information directly or the capability to transmit information from which the position may be determined at intervals of one minute or less.

2.2.2.7 The information from which a position can be determined can include the aeroplane position and/or information necessary for systems external to the aeroplane to be able to determine the aeroplane position (e.g. triangulation, trilateration).

2.2.2.8 The phrase "at least once every minute" means that the system must either transmit the position of the aeroplane every minute or transmit sufficient information such that the position can be determined at least every minute. Analysis has shown that in approximately 95 per cent of the cases surveyed, when the position was accurately known within the last minute prior to the crash, the accident site was located within a 6 NM radius of the last known position.

2.2.2.9 Annex 6 also includes a requirement to make the ADT data available:

6.18.3 The operator shall make position information of a flight in distress available to the appropriate organizations, as established by the State of the Operator.

Note.— Refer to 4.2.1.3.1 for operator responsibilities when using third parties.

2.2.2.10 Paragraph 6.18.3 establishes that aeroplane operators are responsible for ensuring that ADT data are made available to applicable stakeholders, and that the State of the Operator determines who may have access to these data.

2.2.2.11 The minimum requirements are for the information to be made available to air traffic service units (ATSUs) and SAR rescue coordination centres (RCCs), as described in Appendix 9, 2.4.

2.2.2.12 Operators retain that responsibility even if third parties perform work on their behalf. In such cases, operators should make sure that policies and procedures are in place to ensure that ADT data are appropriately delivered and readily available to applicable stakeholders.