AUTONOMOUS DISTRESS TRACKING OF AIRCRAFT IN FLIGHT

EXPLANATION OF TERMS

Autonomous distress tracking (ADT) device. A generic term describing equipment which detects a distress condition and transmits information from which a position can be determined at least once every minute.

ADT service. The provision of a means to make available autonomously transmitted position information on an aircraft in distress.

ADT service provider. An organisation providing aircraft operators with means to make available autonomously transmitted position information of an aircraft in distress.

Distress condition. A state that, if the aircraft behaviour event is left uncorrected, can result in an accident. Aircraft behaviour events can include, but are not limited to, unusual attitudes, unusual speed conditions, collision with terrain and ground proximity warnings, and total loss of thrust/propulsion on all engines.

EUROCAE. EUROCAE is a non profit organisation formed at Lucerne, Switzerland, in 1963, as a European forum focusing on electronic equipment for air transport. It deals exclusively with aviation standardisation, for both airborne and ground systems and equipment.

Location of aircraft in distress repository (LADR). A secure, web-based storage facility which collects, stores and makes available (to subscription holders) position information supplied from ADT devices, so that operators can comply with Annex 6 — *Operation of Aircraft*, Part I — *International Commercial Air Transport — Aeroplanes*, paragraph 6.18.3, which states:

> 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.

Location of aircraft in distress repository (LADR) contributor. A subset of LADR subscriber, which provides data to the LADR. This would typically be an ADT service provider, but could be, for example, an air traffic services unit, a rescue coordination centre, or an airline operations department.

Location of aircraft in distress repository (LADR) data user. A subset of LADR subscriber, which has ‘read only’ access to the LADR. This could be, for example, an accident investigation authority, State department, or an airline operations department.

Location of aircraft in distress repository (LADR) subscriber. An entity which has applied for, and been granted access to, the LADR.

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ABBREVIATIONS

ACC. Area control centre.

ADT. Autonomous distress tracking.

ANSP. Air navigation services provider (the company or organization providing ATS, not the individual ATS unit).

ATS. Air traffic services.

ATSU. Air traffic services unit. An overarching term covering different types of ATS unit, including area control centres, approach control units, and aerodrome towers.

ELT. Emergency locator transmitter. May be suffixed: (AD) – automatic deployable; (AF) – automatic fixed; (AP) – automatic portable; (DT) – distress tracking; or (S) – survival.

GADSS. Global aeronautical distress and safety system.

GNSS. Global navigation satellite system.

LADR. Location of an aircraft in distress repository.

OPS CTRL. ICAO OPS Control directory.

PFLR. Post-flight localization and recovery.

RCC. Rescue coordination centre.

SARPs. Standards and recommended practices.

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INTRODUCTION

1 The Global Aeronautical Distress and Safety System (GADSS) was established to mitigate challenges in the global air navigation system, regarding the timely identification and localization of aircraft in distress, such as occurred with the accidents of Air France flight AF447 and Malaysia Airlines flight MH370.

2 GADSS provides an effective and globally consistent approach to enhancing the alerting procedures of search and rescue services by addressing a number of key improvement areas.

3 In order to achieve these improvements, GADSS contains three main elements:

a. Aircraft tracking;

b. Location of an aircraft in distress (achieved through autonomous distress tracking (ADT) of aircraft in flight); and

c. Post-flight localization and recovery (PFLR).

4 Utilising these elements, GADSS ensures an up-to-date record of aircraft progress is maintained and, in case of a crash, forced landing or ditching, ensures information on the location of survivors, the aircraft and recoverable flight data is available.

5 For GADSS to function as intended, flight crew and aircraft operators, air traffic controllers and air navigation services providers (ANSPs), ADT service providers, and rescue coordination centres (RCCs) need to understand each other's roles, responsibilities and processes to ensure effective communication, robust coordination and harmonized implementation across the globe.

6 This document, however, provides guidance to these entities specifically on the implementation of 3 b) – the location of an aircraft in distress – aspect of GADSS, in order to assist with the development of each entity's procedures, so as to be compliant with the ICAO standards concerned.

7 The Standard defining location of an aircraft in distress[1] requires that, as of 1 January 2023, aircraft issued with a certificate of airworthiness for the first time, with a maximum certificated take off mass of over 27 000 kg, "shall autonomously transmit information from which a position can be determined by the operator at least once every minute, when in distress." The ICAO provisions also

[1] Annex 6 — *Operation of Aircraft*, Part I — *International Commercial Air Transport — Aeroplanes* paragraph 6.18 refers.

recommend that this requirement be applied to aircraft with a maximum certificated take off mass of over 5 700 kg.

8 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. EUROCAE document ED-237 *Minimum Aviation System Performance Specification for Criteria to detect In-Flight Aircraft Distress Events to trigger Transmission of Flight Information* sets out criteria to measure such behaviour events and determine when activation of ADT devices is required.

9 The key entities involved in implementation of the location of aircraft in distress are:

a. Aircraft operators (airline companies and aircraft owners; not the flight crew);
b. ADT service providers;
c. ANSPs; and
d. RCCs.

AUTONOMOUS DISTRESS TRACKING

10 Several significant functional requirements are necessary to permit the effective implementation of autonomous distress tracking of aircraft in flight, including:

a. detection of a distress condition;

b. autonomous transmission of information from which a position can be determined, including a time stamp. This could take the form of, *inter alia*, transmitted GNSS coordinates, or a radio signal which can be triangulated. The system used for this transmission shall be capable of transmitting the information in the event of aircraft electrical power loss, at least for the expected duration of the entire flight;

c. a means for the aircraft operator to receive such transmitted position information;

d. validation by the aircraft operator of the distress condition (i.e. it is valid and not the result of a faulty ADT device or some other reason) to avoid unnecessary burdens to SAR services; and

e. a means for the aircraft operator to make the position information of a flight in distress available to the appropriate organizations, as established by the State of the Operator.

11 A simplified schematic timeline for an emergency situation is shown at Figure 1 to illustrate the sequence of events occurring when an ADT device is activated.

12 The initial autonomous transmission by the aircraft should commence no later than five seconds after the detection of the activation event. Pilots may also manually activate an ADT device.

13 An ADT device can only be deactivated by the same mechanism that activated it (i.e. when an ADT device is manually activated, only the flight crew can manually deactivate it; when an ADT device is automatically activated, it can only be automatically deactivated).

14 Activation of an ADT device does not constitute an emergency requiring SAR services to be alerted. Such activation, which may result from a situation recoverable by the flight crew, is instead deemed a notification. The validation of the activation is further described below in paragraph 22.

15 The ICAO Standards and Recommended Practices (SARPs) related to ADT devices are not technology-specific; aircraft operators may select the device most suited to their operations. Whilst multiple systems which meet the requirements of the SARPs are available, RCCs should note that

there exists one system which behaves differently from the others in one significant aspect. Utilising their existing data distribution network, as well as the LADR process described herein, Cospas-Sarsat has developed a system which will deliver ADT notifications to RCCs via both LADR and SIT185 messages. This system is described in **Appendix A**.

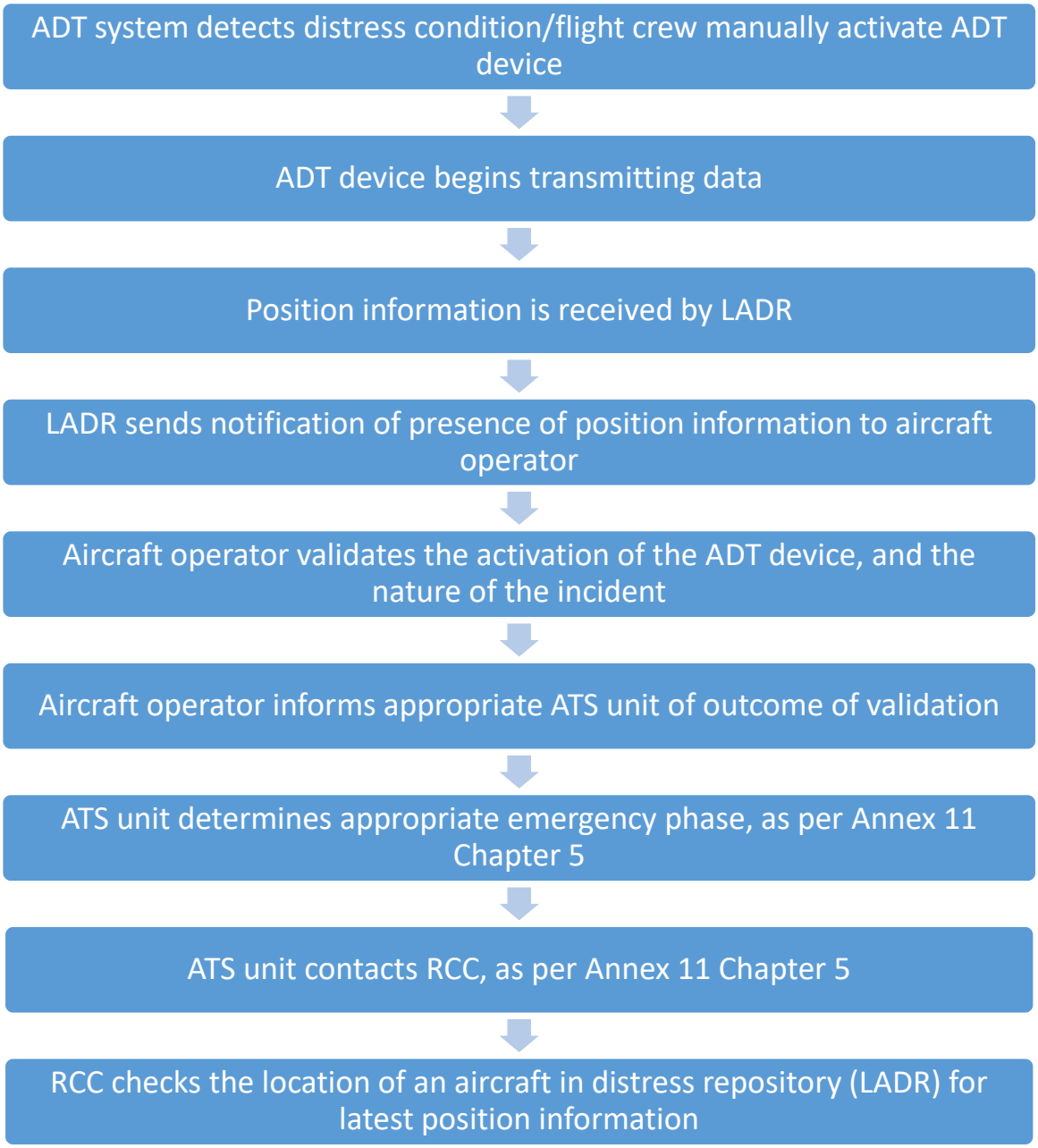

Figure 1. Schematic sequence of events arising from an autonomous distress tracking device activation.

LOCATION OF AN AIRCRAFT IN DISTRESS REPOSITORY (LADR)

16 The LADR, a secure storage facility with a web-based viewer, collects, stores and makes available (to subscription holders) position information supplied from ADT devices, so that operators can comply with Annex 6 — *Operation of Aircraft*, Part I — *International Commercial Air Transport — Aeroplanes*, paragraph 6.18.3.

17 The information stored by the LADR includes, as a minimum, last known position of an aircraft in distress (latitude and longitude), date and time of transmission of information, date and

time of receipt of information, and aircraft identification information (one or more of aircraft registration, call sign, aircraft address (24-bit), and SELCAL (Selective calling) code.) Operators may also submit other information, *inter alia*, level (recommended to be included), accuracy of position data, heading, and airspeed[1]. The availability of this information in the LADR will fulfil the requirement of paragraph 10 c) and e), thereby enhancing SAR and recovery capabilities.

18 ICAO will act as the LADR Administrator, and ensure only appropriate entities, such as ADT service providers, RCCs, area control centres (ACCs), or aircraft operators concerned, can gain access to, or deposit data in, the LADR. RCCs will be granted access to all data. ACCs will be granted access to data related to locations within their FIR, and the surrounding 80 nautical miles (to allow them to be informed on events close to, or about to enter, their FIR, which could have an impact on their operations, and to allow for the possibility that position inaccuracy might show the aircraft in an adjacent FIR.) Aircraft operators will be granted access only to data related to their own aircraft, based on the ICAO issued 3-letter designator for the air operator certificate holder. ACCs and RCCs could also be granted the opportunity to provide limited data, in order to update the LADR with supplementary information relevant to SAR services. [*Secretariat note. Actual data access eligibility to be confirmed post-functional workshop, August 2020.*]

19 Appropriate entities will be able to request a free subscription to the LADR through the ICAO OPS Control Directory (OPS CTRL), which can be accessed at: www.icao.int/safety/globaltracking. Both systems will use the ICAO Data Network for Aviation (DNA) for authentication and single sign-in.

20 LADR subscribers can elect to receive a notification whenever new ADT information relevant to them arrives in the LADR. LADR subscribers will then need to look in the LADR to access the ADT data. LADR data users will have read-only access to available information according to their profile.

21 Subscribing to the LADR is voluntary for all entities other than aircraft operators, who will need to subscribe in order to "ensure that the location of an aircraft in distress repository (LADR) is automatically updated with autonomous distress tracking (ADT) data from an aircraft in a distress condition" (Doc 8168, *Procedures for Air Navigation Services — Aircraft Operations*, Volume III – *Aircraft Operating Procedures*, Section 10, Chapter 2, paragraph 2.2.1) [*Secretariat note. Reference to be confirmed.*] However, RCCs are strongly encouraged to subscribe in order to have access to up to date and accurate position information of aircraft potentially in distress.

AIRCRAFT OPERATOR

22 Upon receipt of notification of an ADT device activation, the aircraft operator is responsible for validating the cause of the activation. There are three possible outcomes from this activity:

a. aircraft operator finds the activation to be invalid, or no longer valid, i.e. confirms there was a 'false alarm', or that the flight crew has recovered the aircraft from the distress condition;

b. aircraft operator finds the activation to be valid, i.e. confirms the aircraft is in distress; or

c. aircraft operator is uncertain whether the activation is valid or invalid (for example, is unable to contact the flight crew), in which case a valid activation must be assumed.

23 Several means of validation of an activation can be utilised, including but not limited to voice communications with the flight crew, data link communications, and observation of flight tracking data.

24 As per the responsibilities outlined in Annex 6 — *Operation of Aircraft*, Part I — *International Commercial Air Transport — Aeroplanes*, Appendix 9, the aircraft operator will

[1] The full list of mandatory and optional data elements is published in the LADR Functional Specification, and can be accessed at https://www.icao.int/safety/globaltracking/Documents.

inform the appropriate area control centre if there is reason to believe that the aircraft is in distress. This could be due to a confirmation of the validity of the activation, or inability to contact the crew to validate the nature of the activation. Contact details for area control centres can be obtained from the ICAO OPS Control Directory (OPS CTRL), which can be accessed at: www.icao.int/safety/globaltracking. Access to data is governed by user profiles, in line with those for the LADR.

AREA CONTROL CENTRE

25 The appropriate area control centre will record all information relevant to the state of emergency of the aircraft, including the outcome of actions taken under paragraph 22, and forward such information to the appropriate RCC in accordance with the uncertainty, alert and distress phases, as per Annex 11 — *Air Traffic Services*, Chapter 5, paragraph 5.2.

26 It is possible that the appropriate ACC and/or RCC will already be aware of a distress condition by means other than the LADR (via a MAYDAY transmission for instance), and appropriate action may already have commenced.

OTHER POINTS TO NOTE

27 Annex 6 — *Operation of* Aircraft, Part I — *International Commercial Air Transport — Aeroplanes* was amended to allow an ADT device to replace the automatic ELT. Consequently, after 1 January 2023, some aircraft may no longer be equipped with a 121.5 MHz homing transmitter. An ADT device is not required to have a homing transmitter.

28 The ICAO SARPs apply only to aircraft for which an individual certificate of airworthiness is first issued on or after 1 January 2023. However, operators have the option to retrofit older aircraft, thereby avoiding the need to equip with an automatic ELT.

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APPENDIX A

UTILISING ELT(DT) TO LOCATE AIRCRAFT IN DISTRESS

1 The International Cospas-Sarsat Programme is a satellite-aided search and rescue initiative organized as a treaty-based, non-profit, intergovernmental, humanitarian cooperative of 45 nations and agencies. Conceived and initiated by Canada, France, the United States, and the former Soviet Union in 1979, it is dedicated to detecting and locating radio beacons activated by persons, aircraft or vessels in distress, and forwarding this alert information to authorities that can take action for rescue.

2 The Cospas-Sarsat system utilizes a network of satellites that provides global coverage. Distress alerts are detected, located and forwarded to over 200 countries and territories at no cost to beacon owners or the receiving government agencies. Since the first rescue using Cospas-Sarsat technology in September 1982, the Cospas-Sarsat System has provided assistance in rescuing more than 50,000 persons in more than 15,000 SAR events.

3 Specifications for the Distress Tracking ELT (ELT(DT)) have been developed by the International Cospas-Sarsat Programme. These specifications allow aircraft operators to comply with the ICAO provisions by utilising either manual activation of the ELT(DT) by flight crew, or automatic activation of the ELT(DT) when a distress condition is detected.

4 Notification of the activation of the ELT(DT) and other associated information will be automatically transmitted via the Cospas-Sarsat Space and Ground Segments directly to relevant RCCs, and automatically sent to the LADR. This dual delivery differs from other ADT systems, and may result in RCCs being notified of the same event by multiple means.

5 As well as the standard information transmitted in any ELT alert, Cospas-Sarsat will include in the ELT(DT) message sent to RCCs and the LADR the three letter designator for the aircraft operating agency, aircraft position and level, and whether the device was triggered manually or automatically, in compliance with the specifications of the LADR. The age of the latest position report received will also be provided; e.g. “position 23-34.44N 070-33.55W is less than 1 minute old”.[1]

6 ELT(DT)s operate using aircraft power, with an independent back-up power supply in case of aircraft electrical failure. The specified duration of autonomous operation of ELT(DT) is a minimum of 370 minutes while using an independent power supply, and it will transmit a message with encoded location information at the following intervals:

a. every 5 seconds for the first 2 minutes following activation;

b. every 10 seconds after 2 minutes until 5 minutes following activation; and

c. every 30 seconds after 5 minutes following activation.

7 An ELT(DT) may also include the following capabilities:

a. for an ELT(DT) that is crash survivable, sufficient battery life to provide 24 hours of 406 MHz message transmissions, and 48 hours of 121.5 MHz direction-finding signal transmissions; or

b. for an ELT(DT) combined with the function of an ELT(AF) (automatic fixed), an ELT(AP) (automatic portable), or an ELT(AD) (automatic deployable), sufficient

[1] Cospas-Sarsat Document C/S A.002, “Cospas-Sarsat Mission Control Centres Standard Interface Description” provides sample ELT(DT) alert and cancellation messages.

battery life to provide 24 hours plus 370 minutes of 406 MHz message transmissions, and 48 hours of 121.5 MHz direction-finding signal transmissions.

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