Certification Memorandum

Installation of ELTs

EASA CM–AS-008 Issue 01 issued 12 December 2016

Regulatory requirement(s): CS xx.1301, CS xx.1309, CS xx.1529, CS xx.1581

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Log of issues

Issue	Issue date	Change description
001	12.12.2016	First issue.

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1. Introduction

1.1. Purpose and scope

The purpose of this Certification Memorandum is to provide specific guidance for compliance to CS xx.1301, xx.1309, xx.1529 and xx.1581 specifications with regard to Emergency Locator Transmitters (ELT).

This Certification Memorandum provides guidance for the installation of ELTs and recommendations for the maintenance procedures that might improve the reliability of ELTs.

1.2. References

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

Reference	Title	Code	Issue	Date
ICAO Annex 6	Operation of Aircraft			
ICAO Annex 10	Aeronautical Telecommunications			
ETSO-2C91a	Emergency Locator Transmitter (ELT) equipment	---	---	24/10/2003 (cancelled)
ETSO-2C126	406 MHz Emergency Locator Transmitter (ELT)	---	---	24/10/2003 (superseded)
ETSO-C126a	406 MHz Emergency Locator Transmitter (ELT)	---	---	05/07/2012 (superseded)
ETSO-C126b	406 and 121.5 MHz Emergency Locator Transmitter	---	---	05/08/2016
TSO-C126b	406 MHz Emergency Locator Transmitter (ELT)	---	---	26/11/2012
EUROCAE ED-62A	Minimum Operational Performance Specification for Aircraft Emergency Locator Transmitters 406 MHz and 121.5 MHz (Optional 243 MHz)	---	---	February 2009
Commission Regulation (EU) No 965/2012	Laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council	---	---	5/10/2012
RTCA/DO-182	Emergency Locator Transmitter (ELT) Equipment Installation and Performance	---	---	Issued 11-17-82

Reference	Title	Code	Issue	Date
RTCA/DO-204A	Minimum Operational Performance Standards for 406 MHz Emergency Locator Transmitters (ELT)	---	---	12-06-07
SIB 2013-04	Hook and Loop Style Fasteners as Mounting Mechanism for an Emergency Locator Transmitter (ELT)	---	---	13 February 2013
CAP 1144	ADELT Review Report- CAA	---	---	January 2014
AR-2012-128	A review of the effectiveness of emergency locator transmitters in aviation accidents (from Australian Transport Safety Bureau)	---	---	21 May 2013

1.3. Abbreviations

AD	Automatic Deployable
AF	Automatic Fixed
AFM	Aircraft Flight Manual
AP	Automatic Portable
CAA UK	Civil Aviation Authority
CAT	Commercial Air Transport
CM	Certification Memorandum
CofA	Certificate of Airworthiness
CPI	Crash Position Indicator
CS	Certification Specification
EASA	European Aviation Safety Agency
ELT	Emergency Locator Transmitter
ETSO	European Technical Standard Order
FAA	Federal Aviation Administration
ICA	Instructions for Continued Airworthiness
ICAO	International Civil Aviation Organization
MHz	Megahertz

MOPSC	Maximum Operational Passenger Seating Configuration
NAA	National Aviation Authority
NCC	non-commercial operations with complex motor-powered aircraft
NCO	non-commercial operations with other-than-complex motor-powered aircraft
RF	Radio Frequency
S	Survival
SAIB	Special Airworthiness Information Bulletin
SAR	Search And Rescue
SIB	Safety Information Bulletin
TU	Transmitting Unit
VHF	Very High Frequency
VSWR	Voltage Standing Wave Ratio

1.4. Definitions

These definitions are extracted from EUROCAE ED-62A and correspond with the different types of ELTs considered in it. Those types of ELTs are in line with ICAO Annex 6 – Operation of Aircraft:

ELT (AF)	ELT is intended to be permanently attached to the aircraft before and after a crash, is automatically activated by the shock of the crash and is designed to aid SAR teams in locating a crash site.
ELT (AP)	ELT is intended to be rigidly attached to the aircraft before a crash and is automatically activated by the shock of the crash but readily removable from the aircraft after a crash. It functions as an ELT (AF) during the crash sequence. If the ELT does not employ an integral antenna, the aircraft mounted antenna may be disconnected and an auxiliary antenna (stored on the ELT case) connected in its place. The ELT can be tethered to a survivor or a life raft. This type of ELT is intended to aid SAR teams in locating the crash site or survivor(s).
ELT (S)	The ELT shall survive the crash forces, be capable of radiating a signal, have an aural and/or visual indication that power is on. Activation of an ELT (S) is usually by manual means but automatic activation (e.g.: by water activation) may apply. Class A (buoyant) This type of ELT is intended to be removed from the aircraft, deployed and activated by survivors of a crash. It can be tethered to a life raft or a survivor. The equipment shall be buoyant and it shall be designed to operate when floating in fresh or salt water, and shall be self-righting to establish the antenna in its nominal position in calm conditions. ELT (S) Class B (non-buoyant)

	This type of ELT shall be integral to a buoyant device in the aircraft, deployed and activated by the survivors of a crash.
ELT (AD) or ADELT	This type of ELT is intended to be rigidly attached to the aircraft before a crash and automatically deployed after the crash sensor has determined that a crash has occurred or after activation by hydrostatic sensor. This type of ELT shall float in water and is intended to aid SAR teams in locating the crash site.
CRASH ACCELERATION SENSOR	A device which detects an acceleration and initiates the transmission of emergency signals when such acceleration exceeds a predefined threshold (Gth). It is also designated as g switch.

2. Background

Emergency Locator Transmitters (ELT) are radio beacons installed on most aircraft in order to transmit distress signals in the event of an accident or emergency landing. The signal transmitted at 406 MHz is detected by the satellites of the COSPAR/SARSAT constellation providing the location of the ELT and activating the Search and Rescue (SAR) service, with the aim of increasing the chances of survival. The ELT also transmits a homing signal on 121.5 MHz to guide the SAR aircraft in the vicinity of the crash site.

The Commission Regulation (EU) No 965/2012 *laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008*[1] establishes detailed rules for commercial air transport operations with aeroplanes and helicopters. (See Part-CAT annex IV: CAT.IDE.A.280 Emergency locator transmitter (ELT), CAT.IDE.A.285 Flight over water, CAT.IDE.A.305 Survival equipment, CAT.IDE.H.280 Emergency locator transmitter (ELT), CAT.IDE.H.300 Life-rafts, survival ELTs and survival equipment on extended overwater flights and CAT.IDE.H.305 Survival equipment)

Commission Regulation (EU) No 965/2012 also regulates the operation of non-commercial operations with aeroplanes, helicopters, balloons and sailplanes. (See Part-NCC annex VI and Part-NCO annex VII: NCC.IDE.A.215 Emergency locator transmitter (ELT), NCC.IDE.H.215 Emergency locator transmitter (ELT), NCO.IDE.A.170 Emergency locator transmitter (ELT), NCO.IDE.H.170 Emergency locator transmitter (ELT), NCO.IDE.S.135 Flight over water and NCO.IDE.B.130 Flight over water).

Data collected by Safety Investigation Authorities from accident investigation reports involving mainly helicopters and general aviation aeroplanes show that the availability of ELT signal transmission is low after a crash. As a consequence, SAR activity is delayed or unpractical. Finding the aircraft wreckage quickly not only increases the chance of survival of the occupants, but also reduces the risk to pilots of SAR aircraft who commonly need to operate in marginal weather conditions.

In accidents where ELTs did not work effectively (or at all), it was found that the performance of ELTs could be affected by:

- Not selecting the ELT activation to the armed position before flight;
- Inappropriate installation of the ELT or any of the activation sensors;
- Discharged batteries;
- Corrosion;
- Disconnection of the co-axial antenna cable from the unit during impact;
- Damage and/or removal of the antenna during impact;

[1] Commission Regulation (EU) No 965/2012 of 5 October 2012 laying down technical requirements and administrative procedures related to air operations pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council can be found at http://easa.europa.eu/regulations.

- Radiation obstructed by the wreckage.

Some other issues such as human factors or maintenance may cause inadvertent activation, causing unnecessary SAR activity, or deployment of the ADELT, which can also create hazards to people on the ground and make the aircraft difficult to find if the ELT is deployed far away from the actual accident site.

This Certification Memorandum does not intend to deal with issues inherent to ELT design as it is assumed the ELT is compliant to an ETSO standard. This Certification Memorandum deals with those issues related to the installation and maintenance of the system that are out of the scope of the ETSO approval and are specific to the installation on the aircraft.

3. EASA Certification Policy

3.1. EASA Policy

The Emergency Locator Transmitter (ELT) is considered as a passive and dormant device whose status is unknown until it is required to perform its intended function. As such, its performance is highly dependent on its reliability in a challenging event and dependent on proper installation and post-installation testing. Guidance on this subject is contained in RTCA/DO-182, *Emergency Locator Transmitter (ELT) Equipment Installation and Performance and EUROCAE/ED-62A*[2]*, Minimum Operational Performance Specification for aircraft Emergency Locator Transmitters 406 MHz and 121.5 MHz (Optional 243 MHz)*.

This EASA policy addresses some of the potential issues referenced in the previous section and aims to provide further guidance on the installation and post-installation testing when seeking for compliance to CS xx.1301, xx.1309, xx.1529, xx.1581 requirements.

3.1.1. Installation aspects of ELTs

The installation of the equipment should be designed in accordance with the ELT manufacturer's installation instructions.

3.1.1.1. ELT transmitter unit and crash acceleration sensors installation

The location of the ELT should be chosen to minimize the potential for inadvertent activation or damage by impact, fire, or contact with passengers or baggage.

The ELT unit should be mounted to primary aircraft load-carrying structures such as trusses, bulkheads, longerons, spars or floor beams (not aircraft skin). Otherwise, the structure should meet the requirements of the test specified in section 6.1.8 (a) of the ED-62A. This test is quoted for quick reference:

> *"The mounts shall have a maximum static local deflection no greater than 2.5 mm when a force of 450 Newtons (l00 lbf) is applied to the mount in the most flexible direction. Deflection measurements shall be made with reference to another part of the airframe not less than 0.3 m or more than 1.0 m from the mounting location."*

However, this does not apply to ELT(S), which should be installed or stowed in a location that is conspicuously marked and readily accessible, or should be integral to a buoyant device such as a life raft, depending if it is Class A or B.

Crash acceleration sensor installation can be also a source of nuisance triggers, missed activation or missed deployment due to improper installation.

Nuisance triggers can occur when the crash acceleration sensor does not work as expected or is installed in a way that it is exposed to shocks or vibration levels outside those assumed during equipment qualification,

[2] Both RTCA and EUROCAE can be assumed harmonised since the RTCA DO-182 was considered by EUROCAE Working Group 74 during the preparation of EUROCAE ED-62A.

making it susceptible to activate inadvertently. It also can be activated as a result of improper handling and installation practices.

Non activation can occur when operational ELTs are attached to the aircraft in a way that prevents the crash sensor from sensing actual crash forces.

Particular attention should be paid to the installation orientation of the crash acceleration sensor. Equipment containing a crash sensor will be clearly marked by the ELT manufacturer to indicate the correct installation orientation(s), if appropriate, for crash sensing.

Installation design should follow the instructions contained in the installation manual provided by the equipment manufacturer. In general, for fixed–wing aircraft, the sensor should be installed in such a way that it senses forces at least in the main longitudinal direction of the aircraft. In the case of a helicopter installation, if the equipment has been designed to be installed on fixed-wing aircraft, the equipment manufacturer has historically recommended the installation to be oriented with an angle of 45 degrees with respect to the main longitudinal axis. This may help the sensor to detect forces in directions other than the main longitudinal axis, since during a helicopter crash, the direction of the impact may easily differentiate from the main aircraft axis. Nevertheless, it should be noted that this is not the unique solution for helicopters. There are products currently available on the market that are designed specifically for helicopters and/or designed to sense forces in several axes.

3.1.1.2. Use of hook and loop fasteners

In several recent aircraft accidents, ELTs mounted with hook and loop style fasteners (commonly known from the brand name Velcro®), have detached from their aircraft mounting. The separation of the ELT from its mount could cause the antenna connection to sever, rendering the ELT ineffective. A SIB has been issued to bring this to the attention of both ELT manufacturers and ELT installation designers.

Inconsistent installation and reinstallation practices can lead to the hook and loop style fasteners not having the necessary tension to perform its intended function. Additionally, the retention capability of the hook and loop style fastener may degrade over time, due to wear and environmental degradation from vibration, temperature, or contamination. The safety concern about these attachments increases when the ELT manufacturer's instructions for continued airworthiness (ICA) do not contain specific instructions for regularly inspecting the hook and loop style fasteners, or a replacement interval (e.g. life limit). This concern applies, regardless of how the hook and loop style fastener is installed in the aircraft.

The separation effect occurred, even though the hook and loop style fastener was tested during initial ETSO (European Technical Standard Order) compliance verification against crash shock requirements.

Therefore, EASA recommends aircraft manufacturers and ELT installation designers (i.e. aircraft modification) to review the ELT manufacturer's existing ICA and to ensure that the ICA for the aircraft or the modification, as applicable, are appropriately addressing the handling of hook and loop style fasteners for ELT retention.

EASA has published SIB 2013-04, issued on 13 February 2013, addressing this topic and endorsing FAA recommendations of the Special Airworthiness Information Bulletin (SAIB) HQ-12-32 dated 23 May 2012.

Both EASA and FAA have recently updated ETSO/TSO-C126 to standard 'b' introducing the limitation to use hook and loop fasteners as an acceptable means of attachment for automatic fixed (AF) and automatic portable (AP) ELTs.

3.1.1.3. ELT antenna installation

The recommendations addressed under this paragraph do not apply to ELT(S).

The most recurrent issue found during accident investigations concerning ELTs is the detachment of the antenna (coaxial cable), causing the transmission of the ELT unit to be completely inefficient.

ED-62A chapter 6 addresses external antenna installation and provides guidance, in particular, about:

- Antenna location

- Antenna position relative to ELT Transmit Unit
- Coaxial cable characteristics
- Coaxial cable installation

The most effective antenna configuration for typical high-wing and low-wing aeroplanes is an external antenna, on top of the fuselage, and aft of the wing (high-wing), or near the vertical stabilizer (low-wing). ELT antennas should be located away from other antennas to avoid disruption of antenna radiation patterns. In any case, during installation of the antenna it should be ensured that the antenna has a free line of sight to the orbiting COSPAS-SARSAT satellites at most times when the aircraft is in the normal flight attitude.

Ideally, for the 121.5 MHz ELT antenna, 2.5 meters is a sufficient separation from VHF communications and navigation receiving antennas to minimize unwanted interference. The 406 MHz ELT antenna should be positioned at least 0.8 meter from VHF communications and navigation receiving antennas to minimize interference.

External antennas, which have been shown to be compatible with particular ELTs will either be part of the ETSO/TSO approved ELT or will be identified in the ELT manufacturer's installation instructions. Recommended methods for installing antenna are outlined in FAA AC 43.13-2B.

The antenna should be mounted as close to the respective ELT as practicable. Provision should be taken to protect coaxial cables from disjunction or from being cut. Therefore installation of the external antenna close to the ELT unit is recommended. Coaxial cables connecting the antenna to the ELT Unit should not cross aircraft production breaks.

In the case of external antenna installation, the ED-62A recommends its mounting surface should be able to withstand a static load equal to 100 times the antenna's weight applied at the antenna mounting base along the longitudinal axis of the aircraft. This strength can be demonstrated by either test or conservative analysis.

If the antenna is installed within a fin cap, the fin cap should be made of a material that is RF transparent and will not severely attenuate the radiated transmission or adversely affect the antenna radiation pattern shape.

In the case of internal antenna location, the antenna should be installed as close to the ELT unit as practicable, insulated from metal window casings and restrained from movement within the cabin area. The antenna should be located such that its vertical extension is exposed to an RF transparent window or structure. The antenna's proximity to the vertical sides of the window and to the window panel and casing as well as the minimum acceptable window dimensions should be in accordance with the equipment manufacturer's instructions.

The VSWR of the installed external antenna should be checked at all working frequencies according to the test equipment manufacturer's recommendations on the initial aircraft model certification.

Coaxial cables between the antenna and the ELT unit should have RF connectors that meet vibration requirements of the installation application on each end. When the coaxial cable is installed and the connectors mated, each end should have some slack in the cable, and the cable should be secured to aircraft structures for support and protection.

In order to withstand exposure to fire, the use of fire resistant coaxial cable or the use of fire sleeves compliant to SAE AS1072 to protect the coaxial cable is recommended.

3.1.2. Deployment aspects of ADELTs

General recommendations about ELT installation are provided in ED-62A; however this standard does not provide detailed or extensive guidance for the particular case of ADELTs.

ADELTs have particularities of the design and installation that need to be addressed independently of the general recommendations.

CAA UK has recently published the CAP1144 ADELT Review Report containing a thorough investigation of incidents and accidents reports where ADELTs failed or inadvertently deployed. This section aims to summarise the most important conclusions related to the installation and maintenance practices from this report.

The location of the ELT (AD) and its manner of installation should minimise the risk of injury to persons or damage to the aircraft in the event of inadvertent deployment. If a manual deployment of the ADELT is required, the means to manually deploy the ADELT should be located in the cockpit in such a way, and should be guarded so that, inadvertent manual activation of the ADELT is minimised.

Automatic deployable ELTs should be located so as to minimize damage to the aircraft structure and surfaces during deployment. The ELT deployment trajectory should be demonstrated to be clear of interference from the airframe or other part of the aircraft, or with the rotor in the case of helicopters. The installation should also not compromise the operation of emergency exits or of any other safety features.

In some helicopters, the ADELT is installed at the tail boom. The CAA UK ADELT Research Report concluded that, when an ADELT is installed aft of the transport joint in the tail boom, any disruption of the tail rotor drive shaft has the potential to disrupt or disconnect the ADELT wiring. From accident investigations, it can be seen that if tail boom becomes detached, an ADELT that is installed there, aft of the transport joint, will also become detached, before signals from sensors triggering its deployment can be received.

As a conclusion of that analysis, it is recommended to install the ADELT forward of the transport joint of the tail boom. This recommendation might not be considered if the design is such that ELT system operation is not impacted by the detachment of the structural part where it is installed.

The hydrostatic sensor used for automatic deployment should be installed in a location shown to be immersed within a short time after the crash, but not subject to water exposure in the expected aircraft operations. This assessment should include the most probable aircraft attitude when crashed, i.e. its capability to keep an upright position after a ditching or a crash over water.

The installation supporting the deployment feature should be demonstrated to be robust to immersion. Assuming a crash over water or a ditching, water may immerse not only the beacon and the hydrostatic sensor which is designed for this, but also any electronic component, wires and the source of power used for the deployment.

3.1.3. Additional considerations

This section addresses additional considerations that contribute to the ELT performs its intended function:

- Human factors:

The ELT controls should be designed and installed so that they are not activated unintentionally. These considerations should address the control panel locations, which should be clear from flight crew movements when getting into the cockpit and when operating the aircraft, and the control itself. The means for manually activating the ELT transmission should be guarded in order not to be activated unintentionally.

The Aircraft Flight Manual should document the operation of the ELT, and in particular, any feature specific to the installed model.

- Batteries:

The ELT operates using its own power source. The ELT manufacturer indicates the useful life and expiration date for the batteries by means of dedicated label. The installation of the ELT should be such that the label indicating the battery expiration date is clearly visible without requiring removal of the ELT or other LRU from the aircraft. This would facilitate replacement of the battery and maintenance activities.

3.1.4. Maintenance and inspection aspects

This section provides guidance for the applicant to produce ICA related to ELT systems. The guidance is based on chapter 7 of ED-62A.

The ICA should explicitly mention that:

- The self-test function should be performed according to manufacturer's recommendation but no less than once every six months. Regulation at the place of operation should be considered when performing self-tests, as NAAs may have established specific procedures to perform self-tests. As an example, CAA UK provides such procedures in the CAP 562 Leaflet 25-60 "Guidance on Testing Emergency Locator Transmitters (ELTs)".
- As a minimum, periodic inspection should occur at every battery replacement, unless required more frequently by airworthiness authorities or the manufacturer.

Inspection should include:

- Removal of all interconnections to the ELT antenna and inspection of cables and terminals.
- Removal of the ELT unit and inspection of the mounting.
- Access to battery to check there is no corrosion.
- Check of the Crash sensor (G-switch) is recommended. Refer to ED-62A, section 7.6 periodic inspection for further guidance.
- Measurement of transmission frequencies and power output.

3.1.5. Aircraft Flight Manual (Supplement)

The Aircraft Flight Manual (AFM) should contain the information related to the operation of the ELT, including the use of the remote control panel in the cockpit. If there is any limitation on its use, it should be declared under a specific section of the AFM.

It should also contain detailed instructions for pre-flight and post-flight checks. As a pre-flight check, it should be checked that the ELT remote control is in the armed position. Post-flight, it should be ensured that the ELT is not transmitting by means of activation of the indicator on the remote control.

AFMs, or STC supplements to AFMs, should also contain information on the location and deactivation of ELTs. Indeed, accident investigations have shown that, following aircraft ground impact, the remote control switch on the instrument panel may become inoperative, and extensive fuselage disruption may render the localisation of, and the access to, the ELT unit difficult. As a consequence, in absence of information available to the accident investigators and first responders, this has led to situations where the ELT transmitted for a long time before being shut down, thus blocking the Search and Rescue channel for an extended time period. It is therefore recommended that the AFM or its supplements contain information explaining how to disarm or shut down the ELT after an accident, including when the remote control switch is inoperative.

3.2. Whom this Certification Memorandum affects

This Certification Memorandum affects applicants for TCs, Major Changes, Minor Changes and STC in which the installation of an ELT is involved.

In addition, it could be of interest for aircraft operators and maintenance organisations when dealing with installed ELTs.

4. Remarks

1. Suggestions for amendment(s) to this EASA Certification Memorandum should be referred to the Certification Policy and Safety Information Department, Certification Directorate, EASA. E-mail CM@easa.europa.eu.

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