Certification Specifications and Acceptable Means of Compliance for Airborne Communications, Navigation and Surveillance (CS-ACNS) Issue 3 — CHANGE INFORMATION

EASA publishes issues of certification specifications as consolidated documents. These documents are used for establishing the certification basis for applications made after the date of entry into force of the applicable issue.

Consequently, except for a note 'Issue No: ACNS/3' under the amended paragraph, the consolidated text of CS-ACNS does not allow readers to see the detailed amendments that have been introduced compared to the previous issue. To allow readers to see them, this document has been created. The same format/layout has been used as for the publication of notices of proposed amendment (NPAs):

— deleted text is ~~struckthrough~~;

— new or amended text is highlighted in blue;

— an ellipsis '(…)' indicates that the rest of the text is unchanged.

Note to the reader

In the amendments, and in particular in existing (that is, unchanged) text, the term 'Agency' *is used interchangeably with* 'EASA'. *The interchangeable use of these two terms is more apparent in the consolidated versions. Therefore, please note that both terms refer to the* 'European Union Aviation Safety Agency (EASA)'.

SUBPART E — OTHERS

SECTION 3 — LOCATION OF AN AIRCRAFT IN DISTRESS

GENERAL

CS ACNS.E.LAD.001 Applicability and scope

This Section provides standards for the installation of equipment and systems that are intended to help locate an aircraft in distress, in accordance with Regulation (EU) No 965/2012 ('Air OPS Regulation'), including when such equipment and systems replace an emergency locator transmitter (ELT) or a low-frequency underwater locating device (ULD). Accidents and distress situations within the scope of this Section are those that take place between take-off and landing, or at an airfield, and severely damage the aircraft, irrespective of the number of fatalities and injuries.

GM1 ACNS.E.LAD.001 Applicability and scope

COMMON GUIDANCE FOR ALL SOLUTIONS

Point CAT.GEN.MPA.210 of Annex IV (Part-CAT) to the Air OPS Regulation requires robust and automatic means to accurately determine, following an accident during which the aircraft is severely damaged, the location of the point of end of flight. Point CAT.GEN.MPA.210 is applicable to some categories of large aeroplanes, when operated for commercial air transport (CAT).

The objective of point CAT.GEN.MPA.210 is to have a high probability of timely and accurately locating the accident site after an accident during which the aircraft is severely damaged, irrespective of the accident location and survivability. The scope of point CAT.GEN.MPA.210 includes non-survivable accidents. However, this Section does not address unlawful interference.

Means compliant with point CAT.GEN.MPA.210 are expected to:

— quickly inform the SAR authority concerned that an accident occurred or is about to occur and provide them with information that can easily be used for locating the accident site; and

— help the safety investigation authority concerned locate the accident site and the aircraft wreckage so that they can collect evidence in a reasonable time frame.

Therefore, if a means compliant with point CAT.GEN.MPA.210 is installed onboard the aircraft, point CAT.IDE.A.280 does not require equipping the aircraft with an automatic ELT, and point CAT.IDE.A.285 does not require equipping the aircraft with a low-frequency ULD.

The approval of the transmission service that processes signals sent by an airborne system to comply with point CAT.GEN.MPA.210 is out of the scope of this Section.

This Section includes:

— 'non-specific' acceptable means of compliance (AMC) and common guidance material (GM) (applicable to all solutions); and

— 'specific' AMC and GM (applicable only to a particular type of solution).

For each certification specification (CS), there may be one or several non-specific AMC, and one or several specific AMC. When selecting one of the three types of solutions that are described below, all non-specific AMC and all AMC specific to the type of solution selected need to be met to demonstrate compliance with the related CS. When selecting a solution that is different from all these types of solutions or is a combination of several types of solutions, the means of compliance need to include all non-specific AMC and additional conditions to be agreed with EASA.

This Section includes three types of solutions:

— Automatic deployable flight recorder (ADFR)

An ADFR is composed of a recorder in a deployable package, a deployment system, and sensors in the aircraft. The deployable package contains an ELT that facilitates locating it, and a structure having both an aerofoil function and a float function. The sensors detect the deformation of the aircraft structure caused by the accident and the water pressure due to immersion. These detections result in the automatic deployment of the deployable package as well as in the activation of the ELT. Thanks to the deployment characteristics, the deployable package lands clear of the main impact point. It floats on water if the accident site is in water. The ELT transmits 406-MHz signals that are detected by satellites of the international COSPAS-SARSAT programme. This enables locating the point of end of flight within a few minutes. The ELT also transmits a 121.5-MHz homing signal to support the on-site search and rescue (SAR) of potential survivors. The recording function of the ADFR is not necessary to comply with point CAT.GEN.MPA.210.

— Distress tracking ELT (ELT(DT))

An ELT(DT) is a specific type of ELT that relies on an 'automatic triggering function'. That function monitors aircraft parameters and automatically triggers the ELT when it detects conditions that are likely to result in an accident during which the aircraft is severely damaged. The flight crew can also manually activate the ELT(DT) in case of a distress situation. Once the ELT is activated, it transmits 406-MHz signals that are detected by satellites of the international COSPAS-SARSAT programme. This enables locating the point of end of flight within a few minutes. If the accident is survivable, a crash-survivable ELT (the ELT(DT) or an automatic ELT) transmits, after the impact, the 406-MHz signals to satellites of the international COSPAS-SARSAT programme and a 121.5-MHz homing signal. These signals enable accurately locating the point of end of flight and support the on-site search and rescue of potential survivors.

— High-rate tracking (HRT)

HRT relies on an airborne system that frequently transmits signals that enable locating the aircraft in case of an accident. The frequency of the transmission and the accuracy of the transmitted position data are such that the point of end of flight can be located within a few minutes. Adequate position accuracy of the point of end of flight after a survivable accident is achieved either through high frequency of transmission, or transmission after reaching the point of end of flight, or both. A 121.5-MHz homing signal is also transmitted after a survivable accident to support the on-site search and rescue of potential survivors.

This Section's requirements do not address remote activation or remote deactivation of airborne systems.

CS ACNS.E.LAD.010 Definitions

This CS contains definitions of terms that are only applicable to this Section and may differ from definitions of terms in CS ACNS.A.GEN.005 'Definitions':

— 'accident during which the aircraft is severely damaged' is an accident during which the aircraft sustains damage or structural failure that:

  — adversely affects the structural strength, performance or flight characteristics of the aircraft; and

  — would normally require a major repair or replacement of the affected component,

  except for an engine failure or damage to the engine, when the damage is limited to a single engine (including its cowlings or accessories), to propellers, wing tips, antennas, probes, vanes, tyres, brakes, wheels, fairings, panels, landing gear doors, windscreens, the aircraft skin (such as small dents or puncture holes), or for minor damage to main rotor blades, tail rotor blades, the landing gear, and minor damage resulting from hail or bird strike (including holes in the radome);

— 'activation of the system' is the transition of the system from another state to the activated state;

— 'activation signals' are signals transmitted by the system to enable determination of the location of the point of end of flight without sending mobile SAR facilities to the area of the transmitter;

— 'automatic activation of the system' is activation of the system that is automatically triggered by airborne equipment;

— 'automatic triggering function' is a function that is performed by airborne equipment, that monitors aircraft parameters, and that automatically activates the system when it detects conditions that are likely to result in an accident during which the aircraft is severely damaged;

— 'communication infrastructure' is the network of sensors, repeaters, and stations that are used to detect activation signals and deactivation signals, to process into data the information contained in these signals, and further distribute this data to the intended recipients; this infrastructure typically includes satellites and ground stations;

— 'deactivation of the system' is the transition of the system from the activated state to another state;

— 'deactivation signals' are signals that are transmitted by the system to indicate its deactivation;

— 'distress situation' is a situation wherein the aircraft and its occupants are threatened by grave and imminent danger or require immediate assistance;

— 'erroneous automatic activation' is undesirable automatic activation that results from an equipment failure or from an error during the development of the equipment;

— 'functions of the system' are the minimum set of functions performed by the system to comply with point CAT.GEN.MPA.210 of Annex IV (Part-CAT) to Regulation (EU) No 965/2012 ('Air OPS Regulation'); they include: arming and disarming, detection of activation conditions, automatic activation and automatic deactivation, manual activation and manual deactivation, collection of the information to be transmitted, transmission of activation signals and transmission of

deactivation signals, indication of activation to the flight crew, transmission of a homing signal, and means to determine the causes of undesirable automatic activation;

— 'homing signal' is a signal that allows mobile SAR facilities in the vicinity of the transmitter to continuously proceed towards the transmitter;

— 'manual activation of the system' is activation of the system that is manually triggered by a crew member;

— 'manual deactivation of the system' is deactivation of the system that is manually triggered by a crew member;

— 'point of end of flight' is, depending on the nature of the accident, the point where the aircraft crashed into land or water, or landed on land or water, or was destroyed;

— 'solution based on an ADFR' is a solution using equipment that meets the requirements applicable to an automatic deployable flight recorder (ADFR), except those related to the recording and retrieval of data for accident investigation purposes;

— 'solution based on an ELT(DT)' is a solution based on an automatic triggering function that is coupled with an emergency locator transmitter of a distress tracking type (ELT(DT));

— 'solution based on HRT' is a solution based on an automatic triggering function that is coupled with airborne equipment other than an ELT and that frequently transmits the aircraft position and the information that an accident during which the aircraft is severely damaged is likely to occur;

— 'signals' are the information that is transmitted by the system;

— 'survivable accident' is an accident such that, if an automatic fixed emergency locator transmitter (ELT(AF)) were correctly installed on board the aircraft, the ELT(AF) would not be exposed to conditions exceeding the environmental test conditions applicable to an ELT(AF), specified in EUROCAE ED-62B (including Change 1), Chapter 4;

— 'system' is the organised set of airborne applications and airborne equipment to comply with point CAT.GEN.MPA.210 of Annex IV (Part-CAT) to Regulation (EU) No 965/2012 ('Air OPS Regulation');

— 'the system is activated' means that the system is transmitting activation signals;

— 'the system is armed' means that all the functions of the system are operating or are ready to operate immediately (in particular, the detection of an accident condition and the signal transmission);

— 'the system is disarmed' means that the system cannot be automatically activated but may be manually activated.

GM1 ACNS.E.LAD.010 Definitions

COMMON GUIDANCE FOR ALL SOLUTIONS

(a) A survivable accident is usually understood as an accident where some aircraft occupants could survive. However, for the purpose of demonstrating the performance of the system in conditions representatives of a survivable accident, the definition of 'survivable accident' in this

Section is based on the environmental conditions applicable to an ELT(AF), specified in EUROCAE ED-62B (including Change 1), Chapter 4.

(b) The following terms, as defined in EUROCAE ED-62B (including Change 1), are used for ELTs throughout this Section:

(1) 'class': determines a range of operating temperatures;

(2) 'capability C (crash survivability)': means meeting minimum crash-resistance specifications;

(3) 'capability H1 (121.5-MHz homing signal)': means transmitting a homing signal at a frequency of 121.5 MHz;

(4) 'capability G (internal/integral GNSS receiver)': means containing a GNSS receiver and transmitting GNSS coordinates through the 406-MHz signal;

(5) 'capability T.001 (first generation)': means meeting the requirements of COSPAS-SARSAT document C/S T.001 'Specification for Cospas-Sarsat 406MHz Distress Beacons'; and

(6) 'capability T.018 (second generation)': means meeting the requirements of COSPAS-SARSAT document C/S T.018 'Specification for Second Generation Cospas-Sarsat 406MHz Distress Beacons'.

(c) Non-dedicated airborne data sources that are used for the detection of activation conditions are usually not considered part of the system, except for the source of position information that is transmitted through the activation signals.

(d) An automatic triggering function is intended to activate the system before an accident occurs and should not be confused with a crash sensor.

CS ACNS.E.LAD.020 System approval

All equipment that the system is composed of is approved.

AMC1 ACNS.E.LAD.020 System approval

ACCEPTABLE MEANS OF COMPLIANCE APPLICABLE TO ALL SOLUTIONS

All ELTs that are part of the system should be approved in accordance with European Technical Standard Order (ETSO)-C126c. The conditions for approval of equipment other than ELTs should be agreed with EASA.

AMC2 ACNS.E.LAD.020 System approval

ACCEPTABLE MEANS OF COMPLIANCE SPECIFIC TO SOLUTIONS BASED ON AN ADFR

(a) The system should meet the conditions of AMC1 ACNS.E.LAD.020.

(b) The ADFR and its integrated ELT should meet the specifications of European Technical Standard Order (ETSO)-2C517, except that the recording of data to facilitate accident investigations is not necessary for compliance with CS ACNS.E.LAD.020.

(c) The ADFR should be installed in accordance with CS 25.1457 of the Certification Specifications for Large Aeroplanes (CS-25), except that the recording of data to facilitate accident investigations is not required for compliance with CS ACNS.E.LAD.020.

(d) the ELT that is integrated into the deployable package of the ADFR should be of class 0 unless, during normal aircraft operation, the ELT is exposed to temperature cycles for which class 1 is sufficient.

(e) The ELT that is integrated into the deployable package of the ADFR should have capabilities G (internal/integral GNSS receiver) and H1 (121.5-MHz homing signal) unless an ELT(AF) or (AP) with capabilities C (crash survivability), G, and H1 is installed.

AMC3 ACNS.E.LAD.020 System approval

ACCEPTABLE MEANS OF COMPLIANCE SPECIFIC TO SOLUTIONS BASED ON AN ELT(DT)

(a) The system should meet the conditions of AMC1 ACNS.E.LAD.020

(b) The ELT(DT) should have capability G (internal/integral GNSS receiver).

(c) The ELT(DT) should have capabilities C (crash survivability) and H1 (121.5-MHz homing signal) unless an ELT(AF) or (AP) with capabilities C and H1 is installed.

(d) The ELT(DT) should be installed in accordance with EUROCAE ED-62B (including Change 1), Chapter 6.

TRANSMISSION

CS ACNS.E.LAD.110 Transmission of the activation signals

(a) Following activation of the system, the system transmits the activation signals within a time frame that maximises the likelihood that the communication infrastructure receives at least once the information that is required for activation signals.

(b) The characteristics of the activation signals are such that the communication infrastructure can detect them and process their required information into data.

AMC1 ACNS.E.LAD.110 Transmission of the activation signals

ACCEPTABLE MEANS OF COMPLIANCE APPLICABLE TO ALL SOLUTIONS

If activation signals are transmitted by other equipment than an ELT:

(a) a detailed description of the communication infrastructure that will be used by the system should be provided, including evidence that this communication infrastructure can detect and process activation signals; and

(b) the time frame to transmit activation signals following activation of the system should be based on assumptions about the performance of the communication infrastructure.

AMC2 ACNS.E.LAD.110 Transmission of the activation signals

ACCEPTABLE MEANS OF COMPLIANCE SPECIFIC TO SOLUTIONS BASED ON AN ELT(DT)

(a) The system should meet the conditions of AMC1 ACNS.E.LAD.110.

(b) The transmission of the activation signals should start no later than 5 seconds after detection of an activation condition or after manual activation by the flight crew.

AMC3 ACNS.E.LAD.110 Transmission of the activation signals

ACCEPTABLE MEANS OF COMPLIANCE SPECIFIC TO SOLUTIONS BASED ON HRT

(a) The system should meet the conditions of AMC1 ACNS.E.LAD.110.

(b) The transmission of the activation signals should start no later than 5 seconds after detection of an activation condition or after manual activation by the flight crew.

GM1 ACNS.E.LAD.110 Transmission of the activation signals

COMMON GUIDANCE FOR ALL SOLUTIONS

It is recommended that activation signals are transmitted even when part of the information that is required by CS ACNS.E.LAD.140 is not available to the system (e.g. due to the failure of some data sources).

CS ACNS.E.LAD.120 Repeated transmission of the activation signals

Once activated, the system repeatedly transmits activation signals so that they can be detected by the communication infrastructure at time intervals that do not exceed 1 minute. The system continues to transmit those signals at least until it reaches the point of end of flight or until it is deactivated.

AMC1 ACNS.E.LAD.120 Repeated transmission of the activation signals

ACCEPTABLE MEANS OF COMPLIANCE APPLICABLE TO ALL SOLUTIONS

If activation signals are transmitted by other equipment than an ELT, the time intervals for transmitting activation signals should be based on assumptions about the performance of the communication infrastructure that will detect those activation signals.

CS ACNS.E.LAD.130 Transmission of the deactivation signals

(a) Upon deactivation of the system, the system automatically transmits deactivation signals so that the information that is required for deactivation signals is transmitted within 1 minute of the time of deactivation.

(b) Transmission of deactivation signals is repeated so that the communication infrastructure receives the information that is required for deactivation signals with a 99.9-% probability.

(c) The characteristics of the deactivation signals are such that the communication infrastructure can detect them and process their required information into data.

AMC1 ACNS.E.LAD.130 Transmission of the deactivation signals

ACCEPTABLE MEANS OF COMPLIANCE APPLICABLE TO ALL SOLUTIONS

If deactivation signals are transmitted by other equipment than an ELT, a detailed description of the communication infrastructure that is used by the system should be provided, including evidence that this communication infrastructure will detect and process deactivation signals.

CS ACNS.E.LAD.140 Activation signals — essential information

The activation signals contain sufficient information to determine:

— that the system is activated;

— the latitude and longitude of the aircraft;

— the times at which the latitude and longitude were valid;

— the identification of the aircraft from which the activation signals are sent; and

— the type of airborne equipment that transmitted the signals.

AMC1 ACNS.E.LAD.140 Activation signals — essential information

ACCEPTABLE MEANS OF COMPLIANCE APPLICABLE TO ALL SOLUTIONS

(a) If the activation signals are transmitted in flight, every activation signal containing information that is used to determine the latitude or longitude of the aircraft should be sent no later than 2 seconds after the time at which this information is valid.

(b) The information that is used to determine the latitude and longitude of the aircraft should be included in the activation signals even if this information is inaccurate.

(c) If an activation signal contains latitude or longitude information, this information should be provided in the World Geodetic System 84 (WGS84) (G1150 or later) or in another realisation of the International Terrestrial Reference Frame (IERS) (2000 or later).

(d) The information contained in the activation signals or their characteristics should be sufficient to determine with certainty whether those signals were transmitted by an automatic ELT, an ELT(DT), or another type of equipment.

GM1 ACNS.E.LAD.140 Activation signals — essential information

GUIDANCE FOR SOLUTIONS BASED ON AN ELT(DT)

The primary position source for the ELT(DT) does not need to be an internal or integral GNSS receiver. The ELT(DT) can encode the latitude and longitude based on an approved aircraft position source when this source is available. When the aircraft position source is lost, automatically reverting the position source to the internal GNSS receiver of the ELT(DT) is needed to meet CS ACNS.E.LAD.230.

CS ACNS.E.LAD.150 Activation signals — supplementary information

If any of the following information is readily available to the system and supported by the communication infrastructure to which the system transmits activation signals, then it is part of the information of the activation signals:

— whether the transmitted latitude and longitude were stamped as invalid data;

— the estimated accuracy of the transmitted latitude and longitude;

— whether the system was automatically or manually activated;

— the aircraft altitude;

— the ground speed of the aircraft;

— the aircraft course; or

— the vertical speed of the aircraft.

GM1 ACNS.E.LAD.150 Activation signals — supplementary information

COMMON GUIDANCE FOR ALL SOLUTIONS

(a) When considering an already approved aircraft type, information 'readily available to the system' can be understood as information whose collection only requires changes to the airborne equipment that is part of the system. For new type certificates, the supplementary information to be contained in activation signals should be agreed with EASA.

(b) 'supported by the communication infrastructure' can be understood as information that can be processed into data by the communication infrastructure without modifying that infrastructure.

CS ACNS.E.LAD.160 Deactivation signals — essential information

The deactivation signals contain sufficient information to determine:

— that the system was deactivated;

— the identification of the aircraft from which the deactivation signals are sent; and

— the type of airborne equipment that transmitted the signals.

CS ACNS.E.LAD.170 Transmission of a homing signal

(a) In case of a survivable accident, a 121.5-MHz homing signal is automatically transmitted after reaching the point of end of flight. The characteristics of the 121.5-MHz homing signal are compatible with standard homing direction finders.

(b) The flight crew can manually initiate the transmission of a 121.5-MHz homing signal, at least when the aircraft is not airborne.

(c) The flight crew can manually stop the transmission of the 121.5-MHz homing signal whether this transmission was automatically or manually initiated unless the homing-signal transmitter is detached from the aircraft.

(d) The 121.5-MHz homing signal is transmitted for at least 48 hours or until the aircraft is submersed.

AMC1 ACNS.E.LAD.170 Transmission of a homing signal

ACCEPTABLE MEANS OF COMPLIANCE APPLICABLE TO ALL SOLUTIONS

(a) The 121.5-MHz homing-signal transmitter should meet the specifications of EUROCAE ED-62B (including Change 1) that are applicable to:

(1) an automatic ELT with capabilities C (crash survivability) and H1 (121.5-MHz homing signal) and of class 0 or 1; or

(2) an ELT(DT) with capability C and H1, and of class 0 or 1,

except for specifications related to the transmission of the 406-MHz signal, to COSPAS-SARSAT requirements, to ELT controls, or the ELT monitoring system.

(b) When the same battery powers both the transmission of the activation signals and of the 121.5-MHz homing signal, the battery capacity should be sufficient to cover the transmission of the 121.5-MHz homing signal for 48 hours and the transmission of the activation signals for a duration sufficient to meet CS ACNS.E.LAD.420.

(c) The system should detect that the aircraft collided with terrain or water to initiate the transmission of a 121.5-MHz homing signal. The detection may be made by means of an acceleration sensor ('g-switch') or through other methods. Refer to EUROCAE ED-62B (including Change 1), Section 2.9.5.1

(d) The installation of the homing-signal transmitter and of its antenna should be such that after a successful ditching or landing, the transmission is possible despite damage to, or immersion of, the lower part of the fuselage and/or the wings.

GM1 ACNS.E.LAD.170 Transmission of a homing signal

COMMON GUIDANCE FOR ALL SOLUTIONS

(a) CS ACNS.E.LAD.170 could be met by installing an ELT(AF) or (AP).

(b) It is recommended that the manual activation of the system (see CS ACNS.E.LAD.250) also initiates the transmission of the 121.5-MHz homing signal as soon as, but not before, the aircraft reaches the point of end of flight.

OPERATION, ACTIVATION AND DEACTIVATION

CS ACNS.E.LAD.210 Normal operation

(a) The system is automatically armed at the beginning of the flight and while the aircraft is still above the departure airfield.

(b) The system remains armed at least as long as the aircraft is airborne.

AMC1 ACNS.E.LAD.210 Normal operation

ACCEPTABLE MEANS OF COMPLIANCE APPLICABLE TO ALL SOLUTIONS

The correct arming of the system should be demonstrated through dedicated testing during certification, and, if necessary, through system status monitoring.

AMC2 ACNS.E.LAD.210 Normal operation

ACCEPTABLE MEANS OF COMPLIANCE SPECIFIC TO SOLUTIONS BASED ON AN ELT(DT)

(a) The system should meet the conditions of AMC1 ACNS.E.LAD.210.

(b) Except for specific operations, such as maintenance, an arming and a disarming signal should be automatically sent to the ELT(DT). The ELT(DT) should be armed no later than when the aircraft becomes airborne.

GM1 ACNS.E.LAD.210 Normal operation

GUIDANCE FOR SOLUTIONS BASED ON AN ADFR

'armed' ADFR means that the ADFR is ready to be deployed as soon as its sensors detect an accident.

GM2 ACNS.E.LAD.210 Normal operation

GUIDANCE FOR SOLUTIONS BASED ON AN ELT(DT)

Arming and disarming of an ELT(DT) is defined in EUROCAE ED-62B (including Change 1), Section 2.9.5.1. Arming results in the transition to the armed state. Disarming results in the transition to the disarmed state.

CS ACNS.E.LAD.230 Continued operation after losing normal electrical power

(a) If the system does not include deployable equipment, it remains armed or activated throughout the following:

(1) flight with normal electrical power, for the maximum possible duration of flight in that condition, followed by;

(2) flight with all the systems generating normal electrical power inoperative, for the maximum possible duration of flight in that condition.

(b) If the system includes deployable equipment, it remains armed or activated throughout the following:

(1) flight with normal electrical power, for the maximum possible duration of flight in that condition, followed by;

(2) flight with all the systems generating normal electrical power inoperative, for the maximum possible duration of flight in that condition, followed by;

(3) 15 minutes on the ground with all systems generating normal electrical power inoperative.

GM1 ACNS.E.LAD.230 Continued operation after losing normal electrical power

COMMON GUIDANCE FOR ALL SOLUTIONS

(a) The system could remain armed or activated throughout the sequences specified in CS ACNS.E.LAD.230 by installing an ELT(AF) or (AP).

(b) It is recommended to minimise the probability of inadvertent transmission of a disarming signal during a crash impact.

GM2 ACNS.E.LAD.230 Continued operation after losing normal electrical power

GUIDANCE FOR SOLUTIONS BASED ON AN ADFR

The 15-minute period on the ground with all the systems generating normal electrical power inoperative is intended to cover the case of a ditching if the ADFR sensors do not detect a crash impact condition (no severe damage to the airframe). Depending on the ditching condition, the aircraft may stay afloat for a certain time, resulting in a delay before a water immersion sensor triggers the deployment. If the aircraft stays afloat for more than 15 minutes, it is assumed that the ditching conditions allow some flight or cabin crew members to manually activate the ELT that is integrated into the deployable package of the ADFR or is attached to the aircraft, and that ELT(S)s, when present, are also activated.

CS ACNS.E.LAD.240 Automatic activation

(a) The system is automatically activated when an accident during which the aircraft is severely damaged has just occurred, is occurring, or is likely to occur within minutes.

(b) The system is not automatically activated in other conditions than those specified in (a).

AMC1 ACNS.E.LAD.240 Automatic activation

ACCEPTABLE MEANS OF COMPLIANCE SPECIFIC TO SOLUTIONS BASED ON AN ADFR

Meeting the conditions of AMC2 ACNS.E.LAD.020 satisfies CS ACNS.E.LAD.240.

AMC2 ACNS.E.LAD.240 Automatic activation

ACCEPTABLE MEANS OF COMPLIANCE APPLICABLE TO SOLUTIONS BASED ON AN ELT(DT) AND TO SOLUTIONS BASED ON HRT

(a) The system should include an automatic triggering function to activate the ELT(DT) or the HRT, as applicable.

(b) The criteria that are used by the automatic triggering function should comply with EUROCAE ED-237, except that if the aircraft is not equipped with an ELT(AF) or (AP), the automatic triggering function should not be inhibited when the aircraft is airborne. If the accidents and incidents flight data sets that are referred to in EUROCAE ED-237, Appendix 1 do not cover all possible scenarios, additional accident or incident flight data sets should be included to verify the event detection rate.

(c) In addition to (b), the system should be automatically activated upon detection of conditions that:

(1) occur during the flight,

(2) disable the automatic triggering function, and

(3) are unlikely during normal aircraft operation.

GM1 ACNS.E.LAD.240 Automatic activation

COMMON GUIDANCE FOR ALL SOLUTIONS

(a) As specified in EUROCAE ED-237, 'A minimum occurrence duration of a particular condition of a scenario (the persistence time) should also be considered as part of the triggering criteria logic'. For each of the criteria, a trade-off needs to be found between reliable detection of accidents and limiting the frequency of nuisance activation.

(b) The system may automatically transmit signals other than activation signals and deactivation signals. However, CS ACNS.E.LAD.240 restricts the automatic transmission of activation signals to accidents during which the aircraft is severely damaged.

GM2 ACNS.E.LAD.240 Automatic activation

GUIDANCE FOR SOLUTIONS BASED ON AN ELT(DT) AND FOR SOLUTIONS BASED ON HRT

The purpose of point (c) of AMC2 ACNS.E.LAD.240 is to activate the system when a condition occurs during the flight that:

(a) is unlikely during normal aircraft operation (e.g. the simultaneous loss of independent data sources that are used by the automatic triggering function), but possible in some accident scenarios during which the aircraft is severely damaged (such as in-flight fire, uncontained engine failure, explosive decompression, etc.); and

(b) disables the automatic triggering function before the activation criteria used by that function are met.

Equipment failures that occur during normal aircraft operation are not within the scope of AMC2 ACNS.E.LAD.240. They are addressed by integrity requirements (refer to CS ACNS.E.LAD.620).

CS ACNS.E.LAD.250 Manual activation

(a) Whether the system is armed or not, it can be manually activated by the flight crew.

(b) Manual deployment of any part of the system is prevented during flight.

AMC1 ACNS.E.LAD.250 Manual activation

ACCEPTABLE MEANS OF COMPLIANCE APPLICABLE TO ALL SOLUTIONS

The controls to manually activate and deactivate the system should be designed and installed to reduce the risks of inadvertent activation and of inadvertent deactivation (e.g. using guarded switches).

GM1 ACNS.E.LAD.250 Manual activation

COMMON GUIDANCE FOR ALL SOLUTIONS

The system could be manually activated by the flight crew by installing an ELT(AF) or (AP).

CS ACNS.E.LAD.260 Automatic deactivation

(a) When the system is automatically activated, it is automatically deactivated if it detects a confirmed return to a safe flight condition.

(b) When the system is manually activated, it cannot be automatically deactivated during flight.

(c) Automatic deactivation of the system does not inhibit subsequent automatic activation during flight.

GM1 ACNS.E.LAD.260 Automatic deactivation

GUIDANCE FOR ALL SOLUTIONS

To prevent premature automatic deactivation, the criteria for 'a confirmed return to a safe flight condition' are usually more stringent than those for activating the system or typically include a confirmation time. However, such criteria should also ensure that the system does not remain activated longer than necessary, to avoid triggering false alerts.

CS ACNS.E.LAD.270 Manual deactivation

(a) When the system is manually activated, it can be manually deactivated if the transmitter is attached to the aircraft.

(b) When the system is automatically activated, it cannot be manually deactivated during flight.

(c) Manual deactivation of the system does not inhibit subsequent automatic or manual activation during flight.

CS ACNS.E.LAD.280 Indications to the flight crew and self-monitoring

(a) The system provides timely indication to the flight crew that it is activated or that it is transmitting the homing signal.

(b) The system is equipped with self-monitoring that detects failures of the following functions:

— arming and disarming,

— detection of activation conditions,

— automatic activation,

— automatic deactivation, and

— collection of the information to be transmitted.

AMC1 ACNS.E.LAD.280 Indications to the flight crew and self-monitoring

ACCEPTABLE MEANS OF COMPLIANCE APPLICABLE TO ALL SOLUTIONS

When the system is activated, an alert as defined in CS 25.1322 of the Certification Specifications for Large Aeroplanes (CS-25), should be provided.

GM1 ACNS.E.LAD.280 Indications to the flight crew and self-monitoring

GUIDANCE FOR ALL SOLUTIONS

The self-monitoring that is required by CS ACNS.E.LAD.280 to be performed by the system does not need to detect failures affecting the transmission of signals or, if the system includes deployable equipment, the deployment capability.

CS ACNS.E.LAD.290 Means to analyse automatic activation

The system provides means to determine, after a flight without an accident, the condition that triggered the automatic activation.

AMC1 ACNS.E.LAD.290 Means to analyse automatic activation

ACCEPTABLE MEANS OF COMPLIANCE APPLICABLE TO ALL SOLUTIONS

The information that is necessary to determine the condition that triggered the automatic activation should:

(a) support the operator in performing a quick and effective analysis;

(b) be recorded by non-deployable airborne equipment or transmitted during the flight for recording on the ground; and

(c) be sufficient to identify the aircraft and determine the time of each case of activation.

ROBUSTNESS

CS ACNS.E.LAD.310 Environmental and crash conditions encountered during accidents

(a) Environmental conditions that may be encountered during the flight of a non-survivable accident do not adversely affect the transmission of information that is sufficient to achieve the position accuracy of the point of end of flight required for non-survivable accidents.

(b) Conditions that may be encountered when the aircraft collides with terrain or water do not adversely affect the transmission of information that is sufficient to achieve the position accuracy of the point of end of flight required for non-survivable accidents.

(c) The position accuracy of the point of end of flight required for survivable accidents is achieved under environmental conditions that are encountered during survivable accidents where the aircraft is severely damaged.

(d) Requirements applicable to the transmission of a homing signal are met under environmental conditions that are encountered during survivable accidents where the aircraft is severely damaged.

AMC1 ACNS.E.LAD.310 Environmental and crash conditions encountered during accidents

ACCEPTABLE MEANS OF COMPLIANCE APPLICABLE TO ALL SOLUTIONS

(a) The system should meet the certification specifications for the transmission of activation signals, while the equipment needed for that function is subject to the environmental test conditions of Tables 1 and 2 of this AMC, except for ELTs that are approved in accordance with European Technical Standard Order (ETSO)-C126c.

(b) If activation signals need to be transmitted by non-deployable equipment after reaching the point of end of flight to meet CS ACNS.E.LAD.410, that equipment (including antennas) should be demonstrated to pass the following tests:

(1) the impact shock test of EUROCAE ED-112A, Section 2-4.2.1;

(2) the penetration resistance test of EUROCAE ED-112A, Section 2-4.2.3;

(3) the static crush test of EUROCAE ED-112A, Section 2-4.2.4; and

(4) the high-temperature fire test of EUROCAE ED-112A, Section 2-4.2.5, except that the duration of the high-temperature fire test does not need to be longer than the time that is sufficient for transmitting the activation signals and complying with CS ACNS.E.LAD.410.

Successful transmission of activation signals should be demonstrated at the end of this sequence of tests.

(c) If activation signals need to be transmitted by non-deployable equipment after reaching the point of end of flight to meet CS ACNS.E.LAD.420, that equipment (including antennas) should successfully transmit the activation signals after being subjected to the environmental tests applicable to an ELT(AF) in Tables 4-1 and 4-2 of EUROCAE ED-62B (including Change 1). However, if the duration of the flame test of EUROCAE ED-62B, Section 4.5.13 is not sufficient to ensure that at least a complete data set, such as that specified in CS ACNS.E.LAD.140, is received and that CS ACNS.E.LAD.420 is met, an appropriate duration should be determined and used for the flame test.

(d) If activation signals need to be transmitted by deployable equipment after reaching the point of end of flight to meet CS ACNS.E.LAD.410, that equipment should meet the same environmental standard as specified for an ADFR in European Technical Standard Order (ETSO)-2C517, and should be installed as specified for an ADFR in CS 25.1457 of the Certification Specifications for Large Aeroplanes (CS-25), except that the recording of data to facilitate accident investigations is not necessary for compliance with CS ACNS.E.LAD.310.

(e) The homing-signal transmitter and antennas that are used by the system for transmitting the homing signal should successfully transmit the 121.5-MHz homing signal when subjected to the environmental tests applicable to an ELT(AF) in Tables 4-1 and Table 4-2 of EUROCAE ED-62B (including Change 1).

(f) If ELTs are used to meet CS ACNS.E.LAD.310, they should be installed in accordance with EUROCAE ED-62B (including Change 1), Chapter 6.

Table 1 — Minimum environmental qualification level test conditions applicable to the system

The following tests may be performed in any order or combination. Unless otherwise specified, compliance with requirements on the transmission of activation signals (CS ACNS.E.LAD.110 and CS ACNS.E.LAD.120) as well as compliance with requirements on the information of activation signals (CS ACNS.E.LAD.140) should be ensured for each test. In addition, the test should be considered failed if undesirable activation occurs during the test.

Equipment that is used by the system may be replaced between tests. Unless otherwise specified, dedicated power sources may be replaced if the duration of the test is greater than the duration of the battery capacity.

The test categories indicated in this Table are those defined in EUROCAE ED-14G. The column 'Test categories' contains a mention of '(MINIMUM)' because more stringent test categories may be required to demonstrate that the system performs as intended under specific environmental conditions applicable to an aircraft type. When no test category is indicated in this Table, select an appropriate test category for the system.

If the system includes deployable equipment, 'The system should be activated' in column 'ADDITIONAL TEST CONDITIONS' means that the system should be activated without deploying that equipment, and that the performance of the automatic deployment does not need to be checked ('System performance should be checked' does not include checking the performance of the deployment mechanism).

Note: the environmental conditions and test procedures that are described in EUROCAE ED-14G and in RTCA DO-160G are identical so that RTCA DO-160G may be used instead of EUROCAE ED-14G.

TESTS ACCORDING TO EUROCAE ED-14G			**ADDITIONAL TEST CONDITIONS**
CONDITIONS	**SECTION IN ED-14G**	**TEST CATEGORIES (MINIMUM)**	
Temperature and altitude Low temperature High temperature Altitude	4.0 4.5.1 4.5.2 & 4.5.3 4.6.1	A1	The system should be activated before the test; compliance with CS ACNS.E.LAD.120 and CS CNS.E.LAD.140 should be ensured during the test. If the projected duration of the test is greater than the duration of the dedicated power source, system activation can be delayed until the temperature is stabilised at the operating temperature.
Decompression Overpressure	4.6.2 4.6.3	A1	The decompression test should be performed at a pressure altitude of 50 000 ft. The system performance should be checked after the test.

Temperature variation	5.0	B	The system should be activated before the test; CS ACNS.E.LAD.120 and CS ACNS.E.LAD.140 should be met during the test.
Humidity	6.0	B	System performance should be checked after the test.
Operational shock & crash safety	7.0		System performance should be checked after the test.
Vibration	8.0	R and H	The system should be activated before the test; compliance with CS ACNS.E.LAD.120 and CS ACNS.E.LAD.140 should be ensured during the test.
Waterproofness	10.0	W	The system performance should be checked after the test.
Magnetic effect	15.0	B	The system should be activated before the test.
Power input	16.0		The system should be activated before the test; compliance with CS ACNS.E.LAD.120 and CS ACNS.E.LAD.140 should be ensured during the test in both normal and abnormal operating conditions.
Voltage spike	17.0		The system should be activated before the test; compliance with CS ACNS.E.LAD.120 and CS ACNS.E.LAD.140 should not be affected by the test conditions.
Audio frequency susceptibility	18.0		System performance should be checked during the test.
Induced signal susceptibility	19.0		System performance should be checked during the test.
Radio frequency susceptibility	20.0	TR	System performance should be checked during the test.
Radio frequency transmission	21.0	H	
Lightning-induced transient susceptibility	22.0		System performance should be checked after the test.
Lightning direct effects	23.0		The test is applicable to external antennas only. The antenna should still be operative after the test.
Icing	24.0		The test is applicable to external antennas and equipment.

			Compliance with CS ACNS.E.LAD.120 and CS ACNS.E.LAD.140 should be ensured during the test.
Electrostatic discharge	25.0	A	System performance should be checked after the test.
Flammability	26.0	C	

Table 2 — Flame test

CONDITIONS	TEST CONDITIONS
Flame	The flame test should be performed for the following components: transmitter of activation signals, antennas used by the system, and antenna cabling. At the start of the flame test, the temperature of these components should be stabilised at an ambient room temperature. The fire source should be in a tray of 1 m^2 and 100 mm deep, containing water with a depth of 50 mm, in which 10 l of Avgas 100 LL is floating. The Avgas should be ignited and allowed to burn for 15 (± 2) seconds, before performing the following flame test: (a) place the components in a position directly over the centre of the fire tray at a height of 1 m (± 25 mm) above the tray; and (b) let the components remain in the flame for a duration corresponding to the time frame defined in CS ACNS.E.LAD.110. The flame test should be conducted in conditions as near as practicable to still air conditions. After removal from the flame, the components of the test should be allowed to cool naturally to ambient temperature before being tested. Compliance with CS ACNS.E.LAD.120 and CS ACNS.E.LAD.140 should be ensured after the test.

AMC2 ACNS.E.LAD.310 Environmental and crash conditions encountered during accidents

ACCEPTABLE MEANS OF COMPLIANCE SPECIFIC TO SOLUTIONS BASED ON AN ADFR

The system should meet the conditions of AMC1 ACNS.E.LAD.310, except that meeting the conditions of AMC2 ACNS.E.LAD.020 satisfies CS ACNS.E.LAD.310 regarding the ADFR and its integrated ELT.

AMC3 ACNS.E.LAD.310 Environmental and crash conditions encountered during accidents

ACCEPTABLE MEANS OF COMPLIANCE SPECIFIC TO SOLUTIONS BASED ON AN ELT(DT)

(a) The system should meet the conditions of AMC1 ACNS.E.LAD.310.

(b) The ELT(DT), its antennas, and other components that are required for the transmission of activation signals should be installed so as to minimise the risk of disconnection during an accident.

(c) When installing an ELT(DT) that uses an integral battery (as defined in EUROCAE ED-62B, including Change 1), mitigation measures should be taken to ensure that the ELT(DT) remains powered after a survivable accident.

AMC4 ACNS.E.LAD.310 Environmental and crash conditions encountered during accidents

ACCEPTABLE MEANS OF COMPLIANCE SPECIFIC TO SOLUTIONS BASED ON HRT

(a) The system should meet the conditions of AMC1 ACNS.E.LAD.310.

(b) The installation of the components that are necessary to transmit activation signals should minimise the probability that failures resulting from environmental conditions that may be encountered before reaching the point of end of flight hinder the performance of the system.

GM1 ACNS.E.LAD.310 Environmental and crash conditions encountered during accidents

COMMON GUIDANCE FOR ALL SOLUTIONS

The accident conditions to be considered for compliance with CS ACNS.E.LAD.310 do not include the case of sudden in-flight destruction of the aircraft.

CS ACNS.E.LAD.320 Flight dynamics and locating the aircraft

(a) Based on detailed assumptions about the minimum performance of the communication infrastructure, it is demonstrated that:

(1) if the system transmits activation signals before or without deploying any equipment:

(i) the activation signals and the deactivation signals are transmitted in such a manner that the communication infrastructure detects these signals at all possible values of aircraft pitch attitude, aircraft roll attitude, aircraft altitude, and aircraft speed, as well as at all possible rates of change of these parameters within the normal flight envelope;

(ii) the following is not adversely affected on accident flight trajectories with parameter values within the ranges of Table 1 of this CS:

(A) performance of the automatic activation of the system;

(B) performance of the transmission of the activation signals by the system;

(C) detection of the activation signals by the communication infrastructure; and

(D) position accuracy of the point of end of flight that is required for non-survivable accidents; and

(iii) the position accuracy of the point of end of flight that is required for survivable accidents is achieved on typical flight trajectories of survivable accidents;

(2) if the system transmits activation signals from deployable equipment:

(i) the deployable equipment has at least the same performance as an ADFR with regard to deployment, activation, and crashworthiness of the transmitter;

(ii) unless the system transmits before deployment activation signals that are sufficient to achieve the position accuracy for non-survivable accidents, the crash testing specifications of the transmitter in the deployable equipment and the deceleration properties of the deployable equipment are such that the transmission of activation signals is not adversely affected by impact shock forces that are representative of deployment during a non-survivable aircraft collision with terrain;

(iii) the communication infrastructure detects the activation signals of the deployable equipment when that equipment is deployed and not moving; and

(iv) the communication infrastructure detects the activation signals and deactivation signals when the aircraft stands on its landing gears and no equipment is deployed; and

(3) the performance specified in (1) or (2), as applicable, is achieved at any location.

(b) Documentation is prepared, which demonstrates the minimum performance of a communication infrastructure that is required for complying with (a).

Table 1 — Parameter ranges for typical accident flight trajectories

Parameter	Range	Unit
Pitch attitude	+/–60	Degrees
Roll attitude	+/–60	Degrees
Pitch rate	+/–20	Degrees/second
Roll rate	+/–30	Degrees/second
Yaw rate	+/–20	Degrees/second
Altitude	From 0 to the absolute ceiling of the aircraft	Feet
Longitude	+/–180	Degrees
Latitude	+/–90	Degrees
Speed	From 0 to Vd/Md (design diving speed)	Knots
Vertical speed	From maximum negative vertical speed at Vd to maximum positive vertical speed	Feet/minute

AMC1 ACNS.E.LAD.320 Flight dynamics and locating the aircraft

ACCEPTABLE MEANS OF COMPLIANCE APPLICABLE TO ALL SOLUTIONS

The following detailed assumptions about the minimum performance of the communication infrastructure should be provided regarding:

(a) the distribution of sensors, repeaters, and stations over time and in space, and the resulting coverage of the communication infrastructure; and

(b) the minimum availability and integrity of the communication infrastructure that is needed to ensure that the communication infrastructure is very likely to detect and transmit without errors activation signals from an aircraft; 'availability' should be understood as the probability that the communication infrastructure can process the information that is contained in activation signals into data and transmit this data as intended.

AMC2 ACNS.E.LAD.320 Flight dynamics and locating the aircraft

ACCEPTABLE MEANS OF COMPLIANCE SPECIFIC TO SOLUTIONS BASED ON AN ADFR

(a) The system should meet the conditions of AMC1 ACNS.E.LAD.320.

(b) Assuming that:

(1) when it is released, the deployable package of the ADFR has an initial ground speed (in the local horizontal plane) of 300 knots or the design diving speed, whichever is lower;

(2) there is no wind; and

(3) Vi is the highest impact velocity at which the ELT in the deployable package of the ADFR is demonstrated to successfully transmit a 406-MHz signal after an impact shock test as specified in EUROCAE ED-112A, Section 3-3.2,

the horizontal distance needed for the deployable package of the ADFR to be decelerated solely by aerodynamic forces to a ground speed equal to Vi should not exceed 70 metres.

(c) Unless the aircraft is equipped with an ELT(AF) or (AP), the ADFR should be installed to achieve a 95-% probability that at least one satellite of the international COSPAS-SARSAT programme receives the 406-MHz signal transmitted by the ELT that is integrated into the deployable package of the ADFR when the aircraft stands on its landing gears and that package is not deployed.

AMC3 ACNS.E.LAD.320 Flight dynamics and locating the aircraft

ACCEPTABLE MEANS OF COMPLIANCE APPLICABLE TO SOLUTIONS BASED ON AN ELT(DT) AND TO SOLUTIONS BASED ON HRT

(a) The system should meet the conditions of AMC1 ACNS.E.LAD.320.

(b) If the system transmits activation signals before or without deploying equipment, the performance that is defined as successful regarding:

— automatic activation (refer to CS ACNS.E.LAD.240);

— transmission of the activation signals (refer to CS ACNS.E.LAD.110 and CS ACNS.E.LAD.120);

— detection of the activation signals by the communication infrastructure; and

— position accuracy of the point of end of flight (refer to CS ACNS.E.LAD.410),

should be demonstrated on typical accident flight trajectories with parameter values within the ranges of Table 1 of CS ACNS.E.LAD.320. In addition, the position accuracy of the point of end of flight for survivable accidents (refer to CS ACNS.E.LAD.420) should be demonstrated on typical flight trajectories of survivable accidents. The demonstrations should be made in the most unfavourable conditions of time and location, or a sensitivity analysis should be conducted to demonstrate that the variation in time or location does not significantly affect the result. The threshold values for automatic activation should be contained within a range where successful transmission is demonstrated.

Verification may rely on computer-based simulations and ground tests. In the case of a subsonic aeroplane, a verification method may be to:

(1) demonstrate that the system was successfully automatically activated and transmitted the activation signals, and that the communication infrastructure detected the activation signals (including assessment of the link budget) based on the flight data sets on accidents and incidents that are referred to in EUROCAE ED-237, Appendix 1;

(2) demonstrate that the example flight trajectory of Subpart 3, Section E, Appendix A meets the position accuracy requirement of CS ACNS.E.LAD.410 ('Position accuracy for non-survivable accidents'); and

(3) demonstrate that the position accuracy requirement of CS ACNS.E.LAD.420 ('Position accuracy for survivable accidents') is met, assuming that during the last 20 seconds before reaching the point of end of flight:

(i) valid position data is available from the position source of the system; and

(ii) the aircraft makes a stabilised turn at a ground speed of 180 knots and a bank angle of 45°.

(c) The antennas that are used by the system, including position source antennas, should be installed so that position determination and transmission of the activation signals are successful at all aircraft attitude angles and aircraft speeds that correspond to normal operation.

(d) The antennas that are used by the system, including position source antennas, should be installed so that position determination and transmission of the activation signals are likely to be successful at aircraft pitch attitudes, aircraft roll attitudes, aircraft speeds, and rates of change of these parameters that might be experienced between the time of activation of the system and reaching the point of end of flight.

GM1 ACNS.E.LAD.320 Flight dynamics and locating the aircraft

COMMON GUIDANCE FOR ALL SOLUTIONS

(a) With regard to assumptions about the coverage of the communication infrastructure, it is recommended to consider the coverage that is provided for at least 95 % of the time, to assess compliance with paragraph (a) of CS ACNS.E.LAD.320.

(b) With regard to the availability and integrity of the communication infrastructure, COSPAS-SARSAT document C/S R.012 ('COSPAS-SARSAT 406-MHz MEOSAR implementation plan') includes the following minimum performance requirements:

(1) availability: 'The system should be available 99.5 % of the time over a period of one year.'; and

(2) processing anomalies: 'The system should not produce more than one processing anomaly for every 10,000 alert messages. A processing anomaly is an alert message produced by the system, which should not have been generated, or which provided incorrect information.'.

CS ACNS.E.LAD.340 Activation and transmission over water and over land

Automatic activation of the system and transmission of the activation signals are successful whether the point of end of flight is located over water or over land.

AMC1 ACNS.E.LAD.340 Activation and transmission over water and over land

ACCEPTABLE MEANS OF COMPLIANCE APPLICABLE TO ALL SOLUTIONS

(a) If the system relies on non-deployable equipment that transmits activation signals after reaching the point of end of flight to comply with CS ACNS.E.LAD.410 or CS ACNS.E.LAD.420, those activation signals should be transmitted within 15 seconds after reaching that point.

(b) If the system relies on activation signals that are transmitted by deployable equipment to locate the point of end of flight, that equipment should be floatable and capable of transmitting after being deployed over or in water.

CS ACNS.E.LAD.350 Means and procedures to prevent undesirable activation

(a) No means, except for circuit protective devices that are specified by applicable requirements, are provided in the cockpit or cabin to disarm or disable the system during flight.

(b) Instructions are provided to the flight crew to address manual activation of the system and handling of undesirable activation.

(c) The instructions for continued airworthiness include procedures to avoid that activation signals are inadvertently transmitted during maintenance of the system.

AMC1 ACNS.E.LAD.350 Means and procedures to prevent undesirable activation

ACCEPTABLE MEANS OF COMPLIANCE APPLICABLE TO ALL SOLUTIONS

The instructions provided to the flight crew should be included in the aircraft flight manual (AFM). Those instructions should address as a minimum the following:

(a) conditions that justify manual activation of the system and conditions that do not justify manual activation;

(b) recommended flight crew action after manual activation or manual deactivation of the system; and

(c) recommended flight crew action in case of undesirable activation (automatic or manual); these recommendations should address as a minimum the following:

(1) using in a timely manner available communication means to inform the relevant ATS unit and the operator of the undesirable activation; and

(2) action, if any, to stop the undesirable activation.

GM1 ACNS.E.LAD.350 Means and procedures to prevent undesirable activation

COMMON GUIDANCE FOR ALL SOLUTIONS

To reduce cases of undesirable activation, CS ACNS.E.LAD.350 permits to include specific means to disarm or disable the system during maintenance activities or before specific design flights or production flights.

CS ACNS.E.LAD.360 Shared airborne resources and transmission means

The use of shared airborne resources or transmission means does not adversely affect the performance of the system.

GM1 ACNS.E.LAD.360 Shared airborne resources and transmission means

COMMON GUIDANCE FOR ALL SOLUTIONS

In CS ACNS.E.LAD.360:

(a) 'airborne resources' means any object (processor, memory, software, data, etc.) or component that is used by a processor, an integrated modular avionics platform, core software or an application. An airborne resource may be shared by multiple applications or may be dedicated to a specific application. An airborne resource may be physical (a hardware device) or logical (a piece of information).

(b) 'transmission means' include transmitters and antennas.

ACCURACY

CS ACNS.E.LAD.410 Position accuracy for non-survivable accidents

The performance of the system ensures that based on the data that is received from the communication infrastructure, the point of end of flight is located with a two-dimensional position accuracy of 6 nautical miles (95-% probability) within 20 minutes of reaching the point of end of flight when the accident is not survivable.

AMC1 ACNS.E.LAD.410 Position accuracy for non-survivable accidents

ACCEPTABLE MEANS OF COMPLIANCE APPLICABLE TO ALL SOLUTIONS

Compliance with CS ACNS.E.LAD.410 should be demonstrated:

(a) through the assumptions about the performance of the communication infrastructure that are provided in accordance with CS ACNS.E.LAD.320; and

(b) in applicable environmental conditions (refer to CS ACNS.E.LAD.310).

AMC2 ACNS.E.LAD.410 Position accuracy for non-survivable accidents

ACCEPTABLE MEANS OF COMPLIANCE SPECIFIC TO SOLUTIONS BASED ON HRT

(a) The system should meet the conditions of AMC1 ACNS.E.LAD.410.

(b) To demonstrate compliance with CS ACNS.E.LAD.410, the following should be considered:

(1) the maximum time interval between two successive transmissions of aircraft position information; and

(2) the accuracy of the transmitted aircraft position.

GM1 ACNS.E.LAD.410 Position accuracy for non-survivable accidents

COMMON GUIDANCE FOR ALL SOLUTIONS

(a) If the system transmits activation signals before or without deploying equipment, Appendix A defines an example flight trajectory that can be used, together with defined assumptions about the communication infrastructure, to assess the position accuracy of the point of end of flight for non-survivable accidents.

(b) If the position of the point of end of flight is computed based on position information that is transmitted before reaching that point, then the two-dimensional position accuracy of the point of end of flight depends at least on:

(1) the position-reporting period; and

(2) the accuracy of each transmitted position, which depends on:

(i) the two-dimensional position accuracy that is provided by the source of position information; and

(ii) the time accuracy of the transmitted position.

CS ACNS.E.LAD.420 Position accuracy for survivable accidents

The performance of the system ensures that based on the data that is received from the communication infrastructure, the point of end of flight is located with a two-dimensional position accuracy of 200 meters (95-% probability) within 20 minutes of reaching the point of end of flight when the accident is survivable.

AMC1 ACNS.E.LAD.420 Position accuracy for survivable accidents

ACCEPTABLE MEANS OF COMPLIANCE APPLICABLE TO ALL SOLUTIONS

(a) Compliance with CS ACNS.E.LAD.420 should be demonstrated through the assumptions on the performance of the communication infrastructure that are provided in accordance with CS ACNS.E.LAD.320.

(b) Compliance with CS ACNS.E.LAD.420 should be demonstrated under nominal GNSS satellite constellation conditions.

(c) If an ELT is used to comply with CS ACNS.E.LAD.420, that ELT should:

(1) be a second-generation automatic ELT or an ELT(DT);

(2) transmit an encoded position and use a message-coding protocol that is compatible with the position accuracy objective of CS ACNS.E.LAD.420;

(3) have capabilities G (internal/integral GNSS receiver) and C (crash survivability); and

(4) be automatically activated upon detection of a crash impact.

INTEROPERABILITY

CS ACNS.E.LAD.520 Frequency spectrum

The system transmits activation and deactivation signals on frequencies that are protected by the International Telecommunication Union (ITU) Radio Regulations and that belong to the protected aeronautical safety spectrum or to the protected distress spectrum.

AMC1 ACNS.E.LAD.520 Frequency spectrum

ACCEPTABLE MEANS OF COMPLIANCE APPLICABLE TO ALL SOLUTIONS

For ELTs that are part of the system, meeting the conditions of AMC1 ACNS.E.LAD.020 satisfies CS ACNS.E.LAD.520.

SYSTEM PERFORMANCE

CS ACNS.E.LAD.610 Continuity

The system is designed to provide a level of continuity that supports its intended operation.

AMC1 ACNS.E.LAD.610 Continuity

ACCEPTABLE MEANS OF COMPLIANCE APPLICABLE TO ALL SOLUTIONS

The loss of a function of the system should be considered a minor failure condition.

GM1 ACNS.E.LAD.610 Continuity

COMMON GUIDANCE FOR ALL SOLUTIONS

(a) Any of the following may contribute to a loss of a function of the system:

(1) failure of the arming of the system;

(2) loss of capability to detect an accident condition;

(3) loss of capability to transmit either the activation signals or the 121.5-MHz homing signal; or

(4) incomplete information in the activation signals.

(b) The functions of the system are defined in CS ACNS.E.LAD.010.

CS ACNS.E.LAD.620 Integrity

The system is designed to provide a level of integrity that supports its intended operation.

AMC1 ACNS.E.LAD.620 Integrity

ACCEPTABLE MEANS OF COMPLIANCE APPLICABLE TO ALL SOLUTIONS

(a) The erroneous automatic activation of the system should be considered a major failure condition.

(b) The transmission of activation signals that contain an erroneous aircraft position or erroneous aircraft identification should be considered a minor failure condition.

(c) The transmission of deactivation signals that contain erroneous aircraft identification should be considered a minor failure condition.

GM1 ACNS.E.LAD.620 Integrity

COMMON GUIDANCE APPLICABLE TO ALL SOLUTIONS

(a) The failure condition of point (a) of AMC1 ACNS.E.LAD.620 for the case of erroneous automatic activation is intended to prevent that a large number of false alerts are caused by erroneous automatic activation of the system and have a significant and worldwide impact on SAR authorities.

(b) A piece of equipment that is part of the system and that contributes to the failure condition of point (a) of AMC1 ACNS.E.LAD.620 could be inactive when the system is not activated, including when the system is armed. This piece of equipment could be, for example, a processor in sleep mode or an ELT. If errors in the design of the software or of the electronic hardware of such piece of equipment do not cause undesirable automatic activation of the system when that piece of equipment is inactive, that software and electronic hardware may be developed in accordance with design assurance level (DAL) D.

CS ACNS.E.LAD.650 Risk for third parties

If the system uses deployable equipment:

(a) the effects on persons other than aircraft occupants are considered when assessing a failure condition corresponding to the unintended deployment of such equipment; and

(b) the system provides a specific indication to the flight crew when such equipment is deployed.

AMC1 ACNS.E.LAD.650 Risk for third parties

ACCEPTABLE MEANS OF COMPLIANCE SPECIFIC TO SOLUTIONS BASED ON AN ADFR

Meeting the conditions of AMC2 ACNS.E.LAD.020 satisfies CS ACNS.E.LAD.650 regarding the deployable package of the ADFR.

APPENDICES

Appendix A — Example flight trajectory

This Appendix defines an example flight trajectory applicable to a subsonic aeroplane to verify that the system that is defined in CS ACNS.E.LAD.010 meets the position accuracy objectives of CS ACNS.E.LAD.410 (based on the assumptions about the performance of the communication infrastructure, which are defined in paragraph (a) of CS ACNS.E.LAD.320). This Appendix is applicable to a system that transmits activation signals before or without deploying equipment.

(a) Verification condition

(1) The system should be in the least favourable configuration (e.g. if a power supply transition may reset the system, the system is reset; or if a GNSS receiver may be in a cold or warm start-up condition, the cold start-up condition is used).

(2) If a satellite constellation is used, the verification should be based on the number and distribution of satellites that are available for 95 % of the time (e.g. no use of spare satellites).

(3) Location and time of the test or simulation are the least favourable ones. This could be demonstrated by performing a location and time sensitivity analysis.

(4) The verification should include tests that allow confirmation of the radio frequency link performance.

(5) The applicant should document the verification results, including:

(i) assumptions about the system and the communication infrastructure;

(ii) substantiated deviations from the example flight trajectory and its sequence that are described in point (b) of this Appendix;

(iii) the tested flight trajectories;

(iv) for each point of a tested flight trajectory:

(A) position, attitude, speed, and acceleration;

(B) the number of communication infrastructure sensors that are actively used;

(C) the communication link performance (link budget); and

(D) the exchanged data; and

(v) for each tested flight trajectory, the location of the point of end of flight, which is determined based on the activation signals that are transmitted along the tested flight trajectory.

(b) Example flight trajectory

The example flight trajectory and the status of the system should be as described below:

(1) change the system to the armed state and maintain a static position for 15 seconds (s) at an altitude between 0 and 500 metres (m); the attitude angles are:

(i) pitch attitude angle: 0°,

(ii) bank angle: 0°, and

(iii) heading: north;

(2) accelerate in a straight line in north direction, while climbing to reach a 5 000-m altitude after 60 seconds; the horizontal acceleration should be 5.55 m/s^2 throughout this phase so that a horizontal speed of 333 m/s is reached at a 5 000-m altitude;

(3) maintain a horizontal speed of 333 m/s for 60 s, while climbing to 10 000 m;

(4) level out, set the pitch attitude angle, roll attitude angle, and heading to 0, activate the system, and while maintaining a horizontal speed of 333 m/s, apply the following during 30 s:

(i) roll:

(A) bank right with a constant roll rate of +30°/s until reaching +30°, then bank left with a constant roll rate of –30°/s until reaching –30°; and

(B) continue this sequence until the end of the 30-s sequence; and

(ii) keep the heading, pitch attitude angle, and altitude unchanged;

(5) while maintaining the same altitude at a constant horizontal speed of 333 m/s, apply the following during 2 s:

(i) pitch attitude: pitch down at a constant pitch rate of –10°/s until reaching –20°;

(ii) roll attitude: bank left at a constant roll rate of –30°/s until reaching –60°; and

(iii) keep the heading and altitude unchanged;

(6) from this point and until altitude is 0 m (corresponding to the point of end of flight), maintain a horizontal speed of 333 m/s, a pitch attitude angle of –20°, and a vertical speed of –80 m/s, while applying the following sequence:

(i) during 17.5 s:

(A) maintain the roll attitude angle at –60°; and

(B) decrease the heading at a constant yaw rate of –10°/s;

(ii) during 4 s:

(A) increase the roll attitude angle at a roll rate of 30°/s to reach +60°; and

(B) decrease the yaw rate at a yaw acceleration of 5°/s² to reach +10°/s;

(iii) during 17.5 s:

(A) maintain the roll attitude angle at +60°; and

(B) increase the heading at a constant yaw rate of +10°/s; and

(iv) during 4 s:

(A) decrease the roll attitude angle at a constant roll rate of –30°/s to reach -60°; and

(B) decrease the yaw rate at a yaw acceleration of -5°/s² to reach –10°/s; and

(7) after reaching the point of end of flight (altitude is 0 m), maintain stationary position for 60 s.

(c) Pass criteria

The last two-dimensional position that is determined through the activation signals that were transmitted before reaching the point of end of flight is within 6 nautical miles (NM) of the position of that point.