

ETSO-2C517
ED Decision 2020/011/R (applicable from 25.7.2020)
AUTOMATIC DEPLOYABLE FLIGHT RECORDER (ADFR) SYSTEMS FOR LARGE AEROPLANES
1 Applicability

This ETSO provides the requirements which automatic deployable flight recorder (AFDR) systems intended for installation in large aeroplanes that are designed and manufactured on or after the date of this ETSO must meet in order to be identified with the applicable ETSO marking.

2 Procedures
2.1 General

The applicable procedures are detailed in CS-ETSO, Subpart A.

2.2 Specific

None.

3 Technical Conditions
3.1 Basic
3.1.1 Minimum Performance Standard

The applicable standards are those provided in EUROCAE ED-112A, MOPS for Crash Protected Airborne Recorder Systems, dated September 2013, Section 3, as amended by Appendix 1 to this ETSO.

The ADFR system shall also be approved in accordance with the latest revision of the ETSO that is applicable to the supported function:

ETSO-(2)C123()	Cockpit Voice Recorder Systems
ETSO-(2)C124()	Flight Data Recorder Systems
ETSO-(2)C176()	Aircraft Cockpit Image Recorder Systems
ETSO-(2)C177()	Data Link Recorder Equipment

The emergency locator transmitter fitted to the ADFR shall be approved as a minimum in accordance with ETSO-C126c, Type ELT(AD) Class 0 or 1, with capabilities C (Crash resistance), H1 (121.5MHz homing) and be of any generation (capability T.001 or T.018).

3.1.2 Environmental Standard

See CS-ETSO, Subpart A, paragraph 2.1, and EUROCAE ED-112A as amended by Appendix 1 to this ETSO.

3.1.3 Software

See CS-ETSO, Subpart A, paragraph 2.2.

3.1.4 Airborne Electronic Hardware

See CS-ETSO, Subpart A, paragraph 2.3.

3.2 Specific

3.2.1 Failure Condition Classification

See CS-ETSO, Subpart A, paragraph 2.4.

A failure of the ADFR to deploy when required is classified as a minor failure condition.

An unintended deployment of the ADFR is classified as not less than a major failure condition.

Note: The classification of the unintended deployment of the ADFR is driven by the risk to the people on the ground. The unintended deployment of the ADFR may also damage the aircraft. Assessing this impact when installing the article on an aircraft may result in a more stringent classification.

4 Marking

4.1 General

See CS-ETSO, Subpart A, paragraph 1.2.

4.2 Specific

4.2.1 Lettering identification

The equipment shall comply with the identification requirement in EUROCAE ED-112A, Section 3-1, paragraph 3-1.8.3 as amended by Appendix 1 to this ETSO.

5 Availability of Referenced Documents

See CS-ETSO, Subpart A, paragraph 3.

[Amdt ETSO/16]

Appendix 1 to ETSO-2C517 – Minimum Operational Performance Standard (MOPS) for Automatic Deployable Flight Recorder (ADFR) Systems

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The applicable standard is EUROCAE ED-112A, MOPS for Crash Protected Airborne Recorder Systems, dated September 2013, and shall be modified as per Table 1 below.

Table 1 — Modification of EUROCAE ED-112A for ADFR systems

Location	Initial ED-112A text	Amending text
3-1.1	<p>This section details the additional requirements and exceptions that are specific to deployable recorders. The requirements specified in this section shall be met in addition to the requirements of Sections 1 and 2, together with Sections 4 and 5 as applicable, and the appropriate recorder specific parts.</p> <p>A deployable recorder is a recording medium housed in a crash-protected memory module that is automatically deployed (released) from the aircraft at the start of an accident sequence. Its characteristics have the objective of enabling it to land at low speeds clear of the main aircraft wreckage, or, in the event of an over-water accident, its flotation characteristics enable it to float on water. Since the recorder is no longer with the aircraft it should be equipped with a means to locate it.</p> <p>This type of recorder is attached to the exterior of the airframe, and under normal conditions, functions in the same manner as a fixed recorder. The Recorder Memory Unit, Beacon Transmitters, Antennas, Battery Pack and the survival packaging for these units are all an integral part of the Automatic Deployable Package.</p> <p>The deployable Package incorporates flight characteristics that enable it to deploy and rapidly establish a flight trajectory that clears the airframe.</p>	<p>This section details the additional requirements and exceptions that are specific to deployable recorders. The requirements specified in this section shall be met in addition to the requirements of Sections 1 and 2, together with the requirements of Sections 4 and 5 as applicable, and the appropriate recorder-specific parts.</p> <p>A deployable recorder is a recording medium housed in a crash-protected memory module that is automatically deployed (released) from the aircraft at the start of an accident sequence. Its characteristics have the objective of enabling it to land at low speeds clear of the main aircraft wreckage or, in the event of an over-water accident, its flotation characteristics enable it to float on water. An ELT is embedded in the deployable recorder to permit determination of the location of the point of the end of flight, and to locate the recorder.</p> <p>This type of recorder is attached to the exterior of the airframe, and under normal conditions, it functions in the same manner as a fixed recorder. The recorder memory unit, beacon transmitters, antennas, battery pack and the survival packaging for these units are all integral parts of the automatic deployable package.</p> <p>The deployable package incorporates flight characteristics that enable it to deploy and rapidly establish a flight trajectory that clears the airframe.</p>

Location	Initial ED-112A text	Amending text
3-1.2		Ignore 3-1.2
3-1.3	This section defines the minimum specification to be met for Deployable Recorder Systems. It is applicable to any crash-protected recorder that is designed to be deployed, its ancillary equipment and its installation in civil aircraft.	This section defines the minimum specifications to be met for automatic deployable flight recorder systems. It is applicable to any crash-protected recorder that is designed to be deployed from a large aeroplane, and to its ancillary equipment.
3-1.4	<p>3-1.4 APPLICATION</p> <p>Compliance with this section will ensure that deployable systems will perform their function under the conditions encountered in aircraft operations.</p>	<p>Replace by the following paragraph:</p> <p>3-1.4 DEFINITIONS</p> <p>The following definitions are provided for the terms that are used in Section 3.</p> <p>Activation depth The nominal depth of the hydrostatic sensor at which it triggers the deployment of the automatic deployable package (3-1.7.2, 3-3.2.10 as defined in this appendix).</p> <p>ADFR Automatic deployable flight recorder</p> <p>ADFR system The system composed of:</p> <ul style="list-style-type: none"> — the automatic deployable package; and — the system components installed in the aircraft and that support the deployment (the deployment mechanism, sensors except those that detect the deformation of the aircraft, etc.) and the recording. <p>Automatic deployable package The part of the system that is deployed, including the crash-protected memory module, the ELT (also named radio location beacon in ED-112A), its antenna and battery, contained in a floatable aerofoil.</p> <p>Deployment case A deployment condition as defined in Appendix 2 to this ETSO.</p> <p>Deployment time The time from a positive indication of a crash until the deployable recorder is released (ED-112A 3-1.7 f.).</p> <p>Immersion depth The maximum depth of immersion in salt water at which the automatic deployable</p>

Location	Initial ED-112A text	Amending text
		<p>package has been tested (3-3.2.8).</p> <p>Release point The point of the aircraft fuselage from which the automatic deployable package is released.</p> <p>Tested impact speed The speed used in the impact shock test in Section 3-3.2.1 as amended by this appendix, which is declared by the equipment manufacturer.</p>
3-1.5.1	<p>In addition to the safety requirements specified in paragraph 2-1.3.1, the following requirements shall apply to all deployable recorders:</p> <p>a. The exterior of the equipment shall have no sharp edges or projections that could damage inflatable survivable equipment or injure persons.</p> <p>b. The overall quantitative probability (per flight hour) of the failure event 'non-commanded deployment' shall be $< 10^{-7}$. This probability objective addresses such hardware and software components, which contribute directly to the deployment event.</p>	<p>In addition to the safety requirements specified in Section 2-1.3.1, the exterior of the automatic deployable package shall have no sharp edges or projections that could damage inflatable survivable equipment or injure persons.</p>
3-1.5.2	<p>In addition to the certification documents specified in paragraph 2-1.3.4, the following shall be provided:</p> <p>a. Instructions shall be provided for safely removing deployable recorders from the aircraft for maintenance purposes.</p> <p>b. The transmission frequency and modulation characteristics of the radio location beacon.</p>	<p>In addition to the certification documents specified in Section 2-1.3.4, the following shall be provided:</p> <p>a. The transmission frequency and modulation characteristics of the radio beacon.</p> <p>b. Installation instructions that contain:</p> <ol style="list-style-type: none"> 1. the tested impact speed (Impact shock test in Section 3-3.2.1); 2. the deployment time as defined in 3-1.7.f; 3. the distances required for the automatic deployable package to reduce its speed to the tested impact speed in the deployment cases as defined in Appendix 2 to this ETSO;

Location	Initial ED-112A text	Amending text
		<ol style="list-style-type: none"> 4. the activation depth at which the hydrostatic sensor triggers the deployment (3-1.7.2); 5. the immersion depth that the automatic deployable package can withstand as tested in 3-3.2.8; 6. other installation constraints ensuring that the automatic deployable package is released before the immersion can disable the system; 7. the maximum ice thickness that can be permitted before de-icing action is necessary, as determined during the icing test in Table 2 of this ETSO; 8. the recommended recorder orientation on the fuselage to ensure the performance of the deployment when installed; 9. instructions for safely removing deployable recorders from the aircraft for maintenance purposes; 10. the kinetic energy of the automatic deployable package once deployed from a fixed position; 11. other installation constraints. <p>The ADFR system installation manual shall state that the installer must verify that:</p> <ol style="list-style-type: none"> a. the automatic deployable package is installed so that it may not be crushed or penetrated by aircraft parts when deployed and is located in an area limiting the exposure to fire before and after an accident; b. the hydrostatic sensor is installed in a fuselage section as close as possible as the one of the release mechanism; c. the installation is likely to result in an impact speed of the automatic deployable package that is less than the tested impact speed selected for the impact shock test of the crash-protected recording medium (Section 3-3.2.1) for the deployment

Location	Initial ED-112A text	Amending text
		<p>cases listed in Appendix 2 to this ETSO – this may be achieved by comparing the distances determined in 3-1.5.2 b. 3. to the distances between the release point and the aircraft nose for case 1 and between the release point and the lowest part of the fuselage for case 2;</p> <p>d. the installation minimises the risk that the deployment of the automatic deployable package in normal flight conditions affects the capability of continued safe flight and landing.</p>
3-1.6	Refer to ED-112A	Unchanged
3-1.6.1	<p>A visual method to alert the cockpit crew when the deployable recorder is no longer captive to the aircraft shall be provided.</p> <p>The cockpit crew shall have an unobstructed view of the visual indicator when in the normal seated position.</p> <p>The brilliance of any indicator may be adjustable to levels suitable for data interpretation under all cockpit ambient light conditions ranging from total darkness to reflected sunlight.</p>	The ADFR system shall provide a means to inform the flight crew that the recorder is no longer captive to the aircraft.
3-1.7.a	Refer to ED-112A	Unchanged
3-1.7.b	Refer to ED-112A	Unchanged
3-1.7.c	Refer to ED-112A	Unchanged
3-1.7.d.	Refer to ED-112A	Ignore 3.1.7.d.
3-1.7.e.	Refer to ED-112A	Ignore 3.1.7.e.
3-1.7.f	Refer to ED-112A	Unchanged
3-1.7.g	Refer to ED-112A	Unchanged
3-1.7.h		h. There shall be no means for manual deployment.
3-1.7.i		i. when deployed on the ground from a static position, the point of impact of the automatic deployable package shall be within 20 metres of the deployment mechanism in any direction over a horizontal plane one metre below the release point.

Location	Initial ED-112A text	Amending text
3-1.7.	<p>The design characteristics of a deployable recorder should result in the recorder landing clear of the aircraft wreckage.</p> <p>The unit shall incorporate flight characteristics that enable it to rapidly establish a flight trajectory that clears the airframe.</p> <p>The unit shall not be given sufficient initial momentum on deployment such that its release could endanger ground support personnel or the aircraft itself.</p>	<p>The design characteristics of a deployable recorder should result in the recorder landing clear of the aircraft wreckage.</p> <p>The automatic deployable package shall incorporate flight characteristics that enable it to rapidly establish a flight trajectory that clears the airframe.</p> <p>When the aircraft stands on the ground, the automatic deployable package shall not be given sufficient initial momentum on deployment such that its release could endanger ground support personnel or the aircraft itself.</p> <p>The automatic deployable package shall be shown to satisfy the deceleration requirements detailed in Appendix 2 to this ETSO.</p>
3-1.7.1	Refer to ED-112A	Ignore 3-1.7.1
3-1.7.2	Sensor(s) shall be installed to activate deployment of the recorder at a depth of 3 m or more.	<p>The ADFR system shall deploy the automatic deployable package when it detects an immersion by measuring the water pressure. A pressure equivalent to a water activation depth between 1.5 and 2.5 m is recommended for the switching threshold of a hydrostatic pressure switch.</p> <p>The system design shall be such that its progressive immersion does not affect the deployment of the automatic deployable package if installed as per the installation constraints.</p> <p>Automatic deployment shall take place up to 15 minutes after the loss of external electrical power.</p> <p>The installation manual shall contain the identification of all the component electronics, power sources, mechanisms and interconnecting cables, as well as any caution notes that are needed to ensure the activation and deployment of the ADFR system.</p>
3-1.8.1	Refer to ED-112A	Unchanged

Location	Initial ED-112A text	Amending text
3-1.8.2	<p>All deployable recorders shall be equipped with a Class 1 dual frequency 406 MHz and 121.5 MHz radio location beacon compliant with the requirements of ED-62A instead of the underwater locator beacon and its attachment as specified in paragraph 2-1.16.4.</p> <p>The radio locating device shall be attached to the deployable recorder such that the aerodynamic properties of the recorder are not adversely affected and the risk of damage to, or separation of, the locating device is minimised.</p> <p>In addition to meeting the endurance requirements specified by ED-62A, the 121.5MHz radio shall operate for an additional 102 hours for a total minimum operational duration of 150 hours. For the operational duration in exceedance of ED-62A (between 48 hours and 150 hours of operation), the minimum Equivalent Isotropic Radiated Power (EIRP) for the 121.5MHz radio shall be 5mW.</p> <p><i>NOTE: Other required characteristics of the radio location beacon are outside the scope of this MOPS. Reference should be made to the applicable equipment standard.</i></p>	<p>The automatic deployable package shall be equipped with an ELT that is approved in accordance with ETSO-C126c, type ELT(AD) Class 0 or 1 with capabilities C (crash resistance), H1 (121.5 MHz homing) and be of any generation (capability T.001 or T.018) instead of the underwater locator beacon and its attachment as specified in Section 2-1.16.4.</p> <p>The ELT shall radiate nominal power levels (as required per ETSO-C126c) for any orientation of the deployable package that is stable when laid on a flat horizontal surface.</p> <p>The radio locating device shall be attached to the deployable recorder such that the aerodynamic properties of the recorder are not adversely affected and the risk of damage to, or separation of, the locating device is minimised.</p> <p>In addition to meeting the endurance requirements specified by ED-62A, the 121.5MHz radio shall operate for an additional 102 hours for a total minimum operational duration of 150 hours. For the operational duration in exceedance of ED-62A (between 48 hours and 150 hours of operation), the minimum Equivalent Isotropic Radiated Power (EIRP) for the 121.5MHz radio shall be 5 mW.</p>
3-1.8.3	Refer to ED-112A	<p>Add the following text:</p> <p>If the automatic deployable package (ADP) is designed to be installed with one side exposed to the exterior of the aircraft and if its kinetic energy can reach 44 Joules within 0.5 metre from the release point when the aircraft is standing on the ground, that side of the ADP shall bear a conspicuous label.</p> <p>Note: This label is intended to provide a visual warning to maintenance and servicing crews, as well as to rescue or other personnel at the scene of an accident or incident in the event that the ADFR has not deployed.</p>
3-1.8.4	Refer to ED-112A	Unchanged

Location	Initial ED-112A text	Amending text
3-2.1	<p>CHAPTER 2-3 defines the environmental tests to be performed on the recorder system.</p> <p>Deployable recorders shall satisfy the functional requirements as detailed in Chapter 4 of the applicable function specific Part(s).</p>	<p>Table 2 of this ETSO defines the minimum environmental tests to be performed on the ADFR system.</p> <p>During each test, an unintended deployment of the ADFR shall be considered to indicate that the test has been failed. Unless Table 2 of this ETSO specifies that the deployment shall be performed during the tests, the successful deployment shall be verified after submission of the equipment to the test (this may be achieved by verifying the successful deployment only once after a group of tests has been performed on a single item of equipment).</p> <p>The ADFR system shall satisfy the functional requirements as detailed in Chapter 4 of the applicable function-specific part(s).</p> <p>The verification of deployment aspects may be performed using a dummy automatic deployable package.</p>
3-3.1	Refer to ED-112A	Unchanged
3-3.2.1	<p>The integrity of the crash-protected recording medium contents and the proper operation of the Radio Location Beacon are to be validated when subjected to the following impact shock test.</p> <p>a. Subject the deployable recorder package, to an impact shock applied to the most probable landing attitude in the most damage vulnerable direction. The shock shall be such a level as to simulate a landing velocity of 46.33 m/s (152 ft/s) onto a hard surface such as rock, concrete or steel.</p> <p>NOTE: The definitions of ‘landing attitude’ and ‘most damage-vulnerable direction’ should not be limited to the three primary axes of the recorder.</p> <p>b. The deployable recorder containing the protected memory module shall impact or be impacted by a hard surface (50 mm thick steel plate of dimensions greater than the overall dimensions of the recorder) at a minimum impact velocity of 46.33 m/s (152 ft/s). Figure 3-3.1</p>	<p>The integrity of the contents of the crash-protected recording medium, the proper operation of the radio beacon and the seaworthiness of the automatic deployable package are to be validated when subjected to the following impact shock test.</p> <p>a. Subject the automatic deployable package to an impact shock that is applied to the most probable impact attitude in the most damage-vulnerable direction. The shock shall be at such a level as to simulate an impact speed of at least 46.33 m/s (152 ft/s) onto a hard surface such as a rock, concrete or steel.</p> <p>The equipment manufacturer may demonstrate a higher impact speed for the crash-protected recording medium (that may be specified by the organisation installing the ADFR) and declare it in the installation manual and the declaration of design and performance (DDP). In this case, the proper operation of the radio beacon and the seaworthiness of the automatic deployable package are still required to be demonstrated for the impact speed of 46.33 m/s.</p>

Location	Initial ED-112A text	Amending text
	<p>illustrates an acceptable impact shock test set-up for deployable recorders. Figure 3-3.2 illustrates an acceptable method and set-up for retrieval of the deployable after impact. The mass of the impact plate shall be greater than 10 times the mass of the deployable recorder and experience no yield when subjected to the impact.</p> <p>c. Apart from the test sequence specified in paragraph 3-1.8 a iii, electronic components external to the crash-protected memory may be removed and replaced with representative mass models prior to commencing the impact shock test. For test sequence iii, the radio location beacon shall be installed and the test carried out on the complete recorder.</p>	<p>NOTE: The definitions of ‘impact attitude’ and ‘most damage-vulnerable direction’ should not be limited to the three primary axes of the recorder.</p> <p>b. The deployable recorder that contains the protected memory module shall impact or be impacted by a hard surface (a 50-mm-thick steel plate of dimensions greater than the overall dimensions of the recorder) at a minimum impact velocity of 46.33 m/s (or higher as declared by the manufacturer). Figure 3-3.1 illustrates an acceptable impact shock test set-up for the automatic deployable package. Figure 3-3.2 illustrates an acceptable method and set-up for the retrieval of the deployable after impact. The mass of the impact plate shall be greater than 10 times the mass of the deployable recorder and shall not yield when it is subjected to the impact.</p> <p>c. Apart from the test sequence specified in paragraph 3-1.8.a.iii, electronic components that are external to the crash-protected memory may be removed and replaced with representative mass models prior to commencing the impact shock test. For test sequence iii, the radio beacon shall be installed and the test carried out on the complete automatic deployable package.</p>
3-3.2.2 (except note)	Refer to ED-112A	Unchanged
3-3.2.2 (note)	<p><i>NOTE: This test methodology is the same as the penetration test specified for Emergency Locator Transmitters (ELTs) in ED-62A.</i></p>	<p><i>NOTE: This test methodology is the same as that for the impact test specified for emergency locator transmitters (ELTs) in ED-62B Section 4.5.10. Per ETSO-C126c, the ELT(AD)s fitted to the ADFR are required to pass the ED-62B impact test described in Section 4.5.10.</i></p>
3-3.2.3	Refer to ED-112A	Add the following note to ED-112A Section 3-3.2.3:

Location	Initial ED-112A text	Amending text
		<i>NOTE: Per ETSO-C126c, the ELT(AD)s fitted to the ADFR are required to pass the static crush test, as described in ED-62B Section 4.5.12.</i>
3-3.2.4	Refer to ED-112A	Add the following note to ED-112A Section 3-3.2.4: <i>NOTE: Per ETSO-C126c, the ELT(AD)s fitted to the ADFR are required to pass the ED-62B Section 4.5.14 fire test.</i>
3-3.2.5	Refer to ED-112A	Add the following note to ED-112A Section 3-3.2.5: <i>NOTE: Per ETSO-C126c, the ELT(AD)s fitted to the ADFR are required to pass the ED-62B Section 4.5.14 fire test.</i>
3-3.2.6	Refer to ED-112A	Unchanged
3-3.2.7	Refer to ED-112A	Unchanged
3-3.2.8	The deployable recorder shall be buoyant and, when floating in fresh water or salt water, shall be self-righting and sufficiently stable to maintain the antenna substantially in its normal operating position and to transmit on its 406 MHz and 121.5 MHz frequencies. Transmission of the ELT frequencies shall be demonstrated by testing in fresh and then salt water and confirming the reception of the 406 MHz Alert frequency via COSPAS SARSAT Satellite, and the 121.5 MHz homing frequency via a SAR Homing receiver. This test shall be performed in water conditions that are representative of an open sea state 7 (equivalent to Beaufort Scale force 10).	<p>The automatic deployable package shall be buoyant and, when floating in fresh water or salt water, shall be self-righting and sufficiently stable to maintain the antenna substantially in its normal operating position, and to transmit on its 406-MHz and 121.5-MHz frequencies.</p> <p>The automatic deployable package shall be immersed at the immersion depth for 5 minutes and shall then return to the surface when released.</p> <p>Transmission on the ELT frequencies shall then be demonstrated by conducting testing in fresh water and confirming the reception of the 406-MHz alert frequency via the COSPAS SARSAT Satellite. The 121.5-MHz homing transmission shall be tested in the conditions described in ED-62B Section 5.5.6.</p>
3-3.2.9 a.	Unless it can be shown that the recording medium can withstand the conditions associated with deep sea immersion and that it is unlikely to be damaged as a consequence of collapse of any protective armour, immerse the recorder in sea water at a pressure of 60 MPa (equivalent to a depth of 6 000 m (20 000 feet) for a period of 30 days.	Ignore 3-3.2.9.a.

Location	Initial ED-112A text	Amending text
3-3.2.9 b.	Unless it can be shown that the recording medium and the identification required by paragraph 2-1.16.3 are resistant to the corrosive effects of sea water, immerse the recorder in sea water at a depth of 3 m and nominal temperature of + 25°C for a period of 30 days.	Unless it can be shown that the recording medium and the identification required by Section 2-1.16.3 are resistant to the corrosive effects of seawater, immerse the recorder in seawater at a depth of 3 m and a nominal temperature of at least + 25.0 °C for a period of 90 days.
3-3.2.10		<p>Add a section: Water immersion initiation test</p> <p>This test may be performed on an additional individual ADFR system that is not part of the test sequences defined in 3-1.8.1.</p> <p>The geometry of test set-up (orientation, relative position of the release mechanism and of the hydrostatic sensor) shall be the least favourable one permitted by the installation constraints with regard to the risk of being disabled by immersion.</p> <p>The ELT shall be activated and the system deprived of external power before the test for the duration defined in Section 3-1.7.2, as amended by this Appendix.</p> <p>Submerge it in fresh water at a speed of not less than 1 m per minute. Verify that the ADFR deploys when the hydrostatic pressure sensor is at a depth of between 1.5 and 2.5 m.</p> <p>Perform an aliveness test of the ELT as defined in EUROCAE ED-62B Section 4.3.1.</p>

Table 2 — Environmental test for ADFR systems

Test	EUROCAE ED-14G/ RTCA DO-160G Section	Minimum category/Remarks
Temperature	4.0	Category to be defined by the manufacturer. Deployment shall be tested at the short-time low and short-time high operating temperatures.
Altitude	4.0	Category to be defined by the manufacturer.
Temperature Variations	5.0	A, S1 or S2

Test	EUROCAE ED-14G/ RTCA DO-160G Section	Minimum category/Remarks
Humidity	6.0	C for the components and parts of the ADFR system that are exposed to the outside air, A for the rest of the system. Deployment shall be tested at the end of exposure period, without draining off any condensed moisture.
Operational Shock	7.0	Category to be defined by the manufacturer.
Crash Safety Shock	7.0	Category to be defined by the manufacturer.
Vibration	8.0	R, U or U2 and H or Z A deployment shall be performed during the test, at the most unfavourable vibration condition (e.g. the resonance frequency).
Explosion Proofness	9.0	As required.
Waterproofness	10.0	S for the components and parts of the ADFR system that are exposed to the outside air, Y for the rest of the system including for the water sensor.
Fluids Susceptibility	11.0	F, with at least fuel, hydraulic fluids, lubricating oils, de-icing fluids and fire extinguishants.
Sand and Dust	12.0	S
Fungus Resistance	13.0	F
Salt Spray	14.0	T
Magnetic Effect	15.0	Category to be defined by the manufacturer.
Power Input	16.0	Category to be defined by the manufacturer. A deployment shall be performed under the most unfavourable testing conditions. The unit under test may encompass only the installed components of the ADFR system.
Voltage Spike	17.0	Category to be defined by the manufacturer. The unit under test may encompass only the installed components of the ADFR system.
AF Conducted Susceptibility	18.0	Category to be defined by the manufacturer. A deployment shall be performed during the test under the most unfavourable testing conditions. The unit under test may encompass only the installed components of the ADFR system.

Test	EUROCAE ED-14G/ RTCA DO-160G Section	Minimum category/Remarks
Induced Signal Susceptibility	19.0	Category to be defined by the manufacturer. A deployment shall be performed during the test under the most unfavourable testing condition. The unit under test may encompass only the installed components of the ADFR system.
RF Susceptibility	20.0	Category to be defined by the manufacturer. A deployment shall be performed during the test under the most unfavourable testing conditions.
RF Emission	21.0	Category to be defined by the manufacturer.
Lightning-Induced Transient Susceptibility	22.0	Category to be defined by the manufacturer.
Lightning Direct Effects	23.0	Category to be defined by the manufacturer. The recorder is required to successfully deploy after a direct impact. No unintended deployment shall occur, and no part shall detach.
Icing	24.0	The test shall be performed for Categories B and C. For Category B, 2 cycles are required. The deployment of the recorder shall be tested at the end of first cycle and at the end of the low-temperature phase for the second cycle. For Category C, the deployment shall be tested after the required ice thickness (as declared by the manufacturer) is met and the temperature is stabilised at its lowest value as required by the ED-14G/DO-160G test.
Electrostatic Discharge	25.0	A
Fire	26.0	C + ED-112A Sections 3-3.2.4 and 3-3.2.5.

[Amdt ETSO/16]

Appendix 2 to ETSO-2C517 – Distances Required for the Deceleration of the Automatic Deployable Package

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This Appendix defines the minimum acceptable performance for the deceleration of the automatic deployable package. The objective is to ensure that the collision of the automatic deployable package with the ground will not damage the crash-protected recording medium in two cases that are typical of an accident trajectory. For those cases, the applicant will perform the following tasks:

1. consider the tested impact speed used in the impact shock test (Section 3-3.2.1) V_{impact} ;
2. determine the distance D_{captive} that is required for the automatic deployable package to be released;
3. determine the distance D_{released} that the automatic deployable package needs to decelerate to the tested impact speed once released; and
4. compare the total distance $D_{\text{Decelerate}}$ (distance needed for the deployable package to be released and decelerated by drag forces so that its speed is less than the tested impact speed) with a maximum value D_{max} defined in Table 3.

Note: The applicant may increase the tested impact speed V_{impact} to reduce $D_{\text{Decelerate}}$.

The initial release position, attitude and speed of the automatic deployable package are determined by the platform attitude and speed vector as defined in Table 3 and Figure 1 below and by the orientation of the ADFR relative to the platform. They shall account for any initial speed increment or accelerations that may be provided by the deployment mechanism.

If the ADFR manufacturer does not limit the installation of the ADFR to only one deployment direction relative to the platform (e.g. deployment in the direction of axis z or direction of y axis), the deployment direction resulting in the highest impact speed shall be considered, or cases shall be added to cover the permitted direction domain.

The impact surface is the plane defined by the following conditions:

- its normal vector \vec{n} is specified in table 3 of this ETSO; and
- the component of the automatic deployable package speed along this normal vector \vec{n} is equal to the speed value V_{impact} used for the impact shock test of the crash-protected recording medium (Section 3-3.2.1).

The distance D_{captive} is the distance covered by the platform from the positive indication of a crash until the deployable package is released (3-1.7 f.).

The distance D_{released} is the distance between the initial release position and the impact surface.

The distance $D_{\text{Decelerate}}$ is equal to $D_{\text{Decelerate}} = D_{\text{captive}} + D_{\text{released}}$.

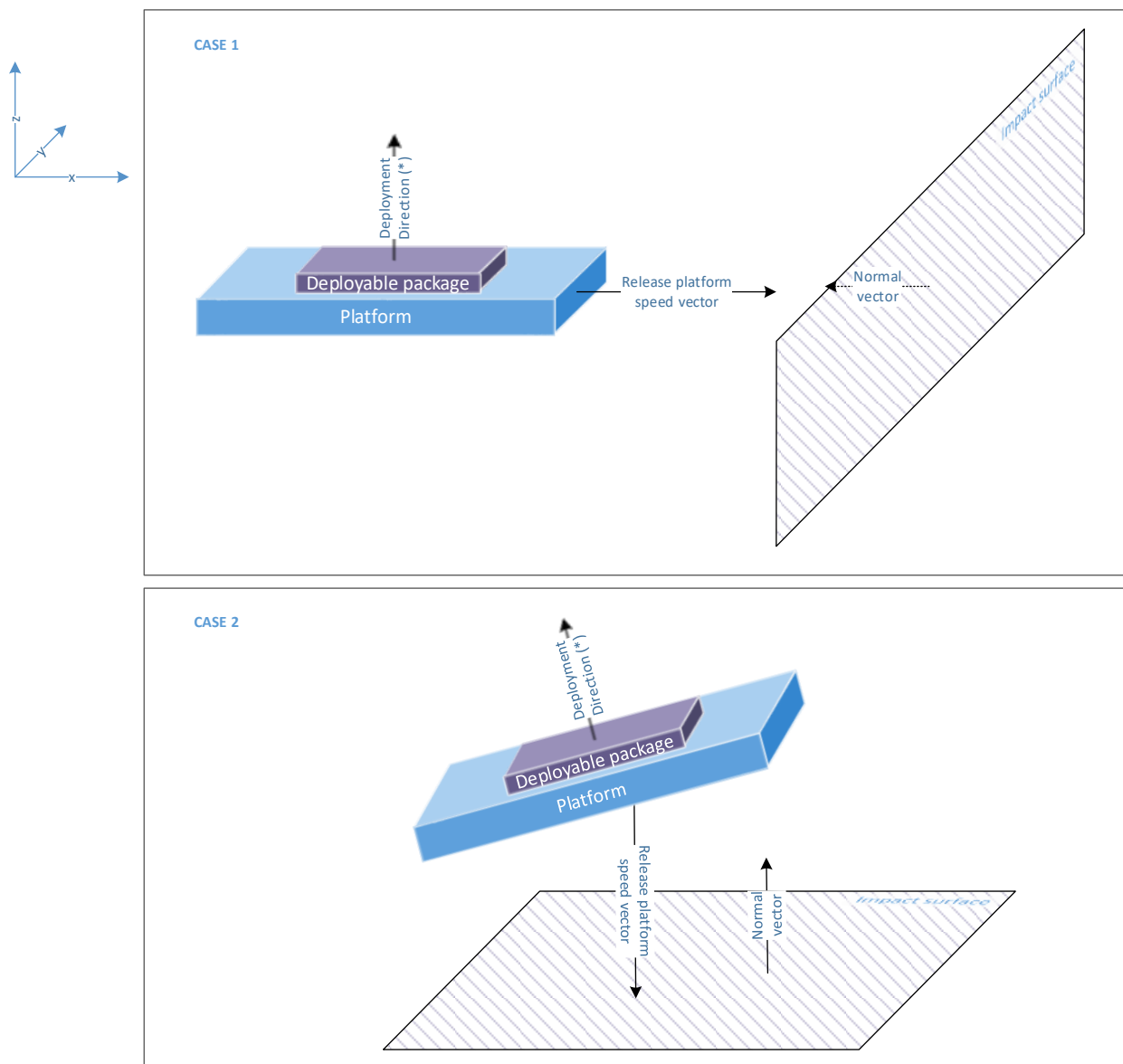
Deceleration requirements

For each deployment case specified in Table 3 of this ETSO, the distance $D_{\text{Decelerate}}$ shall be less than the maximum distance D_{max} .

Note: This condition is used to determine whether recorded data is likely to be retained by the crash-protected recording medium after a collision with terrain, when the ADFR system is installed on a large aeroplane.

Deployment case	Release platform attitude			Release platform speed vector			Impact surface - Normal vector \vec{n}			Maximum distance to reduce the speed component along the normal vector to the tested impact speed value (D_{max}) m
	Pitch	Roll	Yaw	Vx	Vy	Vz	x	y	z	
	°			m/s						
Case 1	0	0	0	150	0	0	-1	0	0	70
Case 2	15	0	0	0	0	-50	0	0	1	20

Table 3: Deployment cases to be considered



(*) Different deployment directions relative to the platform may have to be considered depending on the installation constraints. The figure above represents a case where the deployable package is deployed upwards when installed in the aircraft.

Figure 1: Deployment cases to be considered

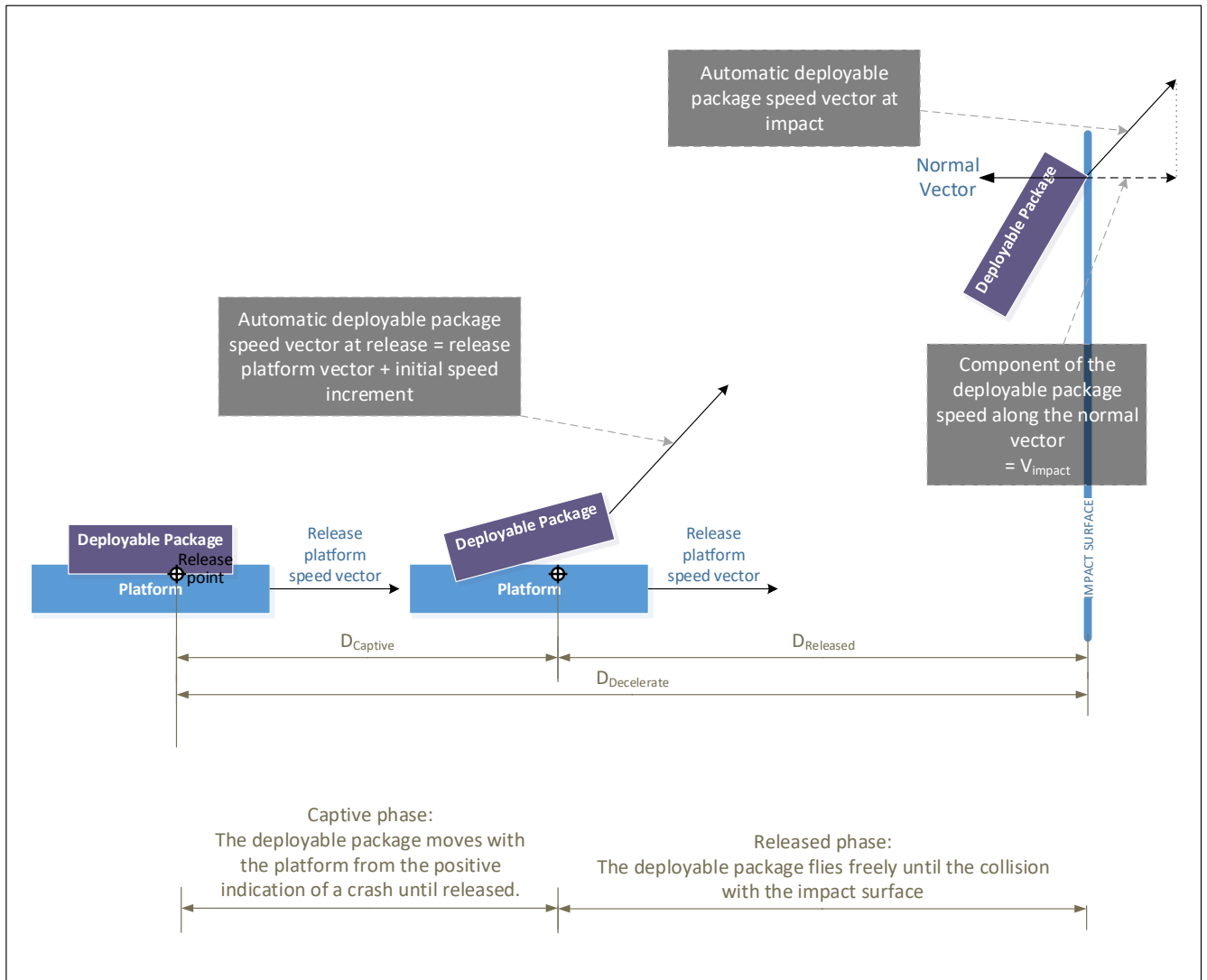


Figure 2: Sequence of the automatic deployable package release

[Amdt ETSO/16]