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To	SAI Subcommittee ULB Working Group	**Date**	November 11, 2014
From	P. J. Prisaznuk pjp@sae-itc.org tel 1-410-212-0913	**Reference**	14-149/SAI-017 lth

Subject

Draft Circulation
Draft 3 of ARINC Project Paper 677: *Installation Standards for Low Frequency Underwater Locator Beacon (LF-ULB)*

Summary

ARINC Project Paper 677 describes the installation requirements for a Low Frequency Underwater Locator Beacon (LF-ULB) intended for installation on aircraft that operate over water for extended periods of time.

This draft was prepared as a result of several web conferences held from May 2014 through October 2014.

ARINC Project Paper 677 is organized as follows:

1.0 Introduction
2.0 Interchangeability Standards
3.0 Considerations for the LF-ULB and Bracket Design
4.0 Installation
5.0 Maintenance Considerations
Attachment 1 LF-ULB Space Envelope
Attachment 2 LF-ULB Footprint on Aircraft Structure

Technical changes are shown in blue bold text.

Action

This draft will be reviewed at the LF-ULB Working Group meeting to be held February 10-12, 2015 in Sarasota, Florida. Comments on the attached draft should be directed to Paul Prisaznuk before **January 30, 2015**.

cc

DFDR

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DRAFT 3

OF

ARINC PROJECT PAPER 677

INSTALLATION STANDARDS FOR LOW FREQUENCY UNDERWATER LOCATOR BEACON (LF-ULB)

This draft dated: November 11, 2014

1.0 INTRODUCTION

1.1 Purpose

This document describes the installation requirements for a Low Frequency Underwater Locator Beacon (LF-ULB).

1.2 Background

Aircraft in service today are equipped with flight recording devices with Underwater Locator Beacons (ULBs) attached. The detectable acoustic range of the currently used Flight Recorder ULBs is limited due to the transmit frequency of 37.5 kHz.

An initiative was launched to fully investigate Wreckage Localization Technology where, among other things, an LF-ULB transmitting on a frequency of 8.8 kHz was recommended. The device is intended to be installed on the aircraft structure.

SAE International has published Aerospace Standard (SAE AS6254) to cover the Minimum Performance Standard for Low Frequency Underwater Locating Device (ULD) transmitting on the frequency 8.8 kHz.

ICAO Annex 6 Amendment 36 (published November 2012), states that a LF-ULB shall be installed on all aircraft with a maximum take-off mass of over 27,000 kg, operating over water at particular distances to land suitable for making an emergency landing. ICAO Annex 6 Amendment 36 further states that an LF-ULB shall be installed by January 1, 2018.

Therefore, while different acoustic detection means are available to locate aircraft that may be submerged due to an overseas accident, an LF-ULB transmitting on 8.8 kHz is desirable to improve the range of detection.

1.3 Design Objectives

The objective of this document is to define the maximum space envelop (i.e., length/width/depth) and maximum weight of the LF-ULB/bracket considering LF-ULB removal, installation and maintenance aspects.

Additionally, the specification of a common interface of the LF-ULB bracket to airframe structure is provided. This will enable airframe manufacturers and aircraft operators to install different LF-ULBs without changing the aircraft structure or support.

Further, this ARINC Specification provides:

- Maximum acceleration during which the LF-ULB must remain attached to the local structure
- Standards for battery check/change
- Installation guidelines

1.4 Relationship to Other Specifications

The material in this document is not intended in any manner to preclude the need to meet design criteria presented in other industry standards. It is the intent of this document to encourage the use of any standards of good practice which have been developed by the government, the military, and other groups, so long as they are applicable to airline electronic equipment.

1.5 Related Documents

The latest versions of the following documents are applicable to design and installation of equipment intended to meet this standard:

EASA Certification Specifications and Acceptable Means of Compliance for Large Aeroplanes CS-25.561 (b) (3)

EUROCAE ED-14 – *Environmental Conditions and Test Procedures for Airborne Equipment*

FAR 25.561 (b) (3) Airworthiness Standards: *Transport Category Airplanes*

ICAO Annex 6, Part I, Ninth edition, Amendment 36 *(November 15, 2012)*

RTCA DO-160 – *Environmental Conditions and Test Procedures for Airborne Equipment*

SAE AS6254 – *Minimum Performance Standard for Low Frequency Underwater Locating Device (Acoustic) (Self-Powered)*

TSO-C200 – *Airframe Low Frequency Underwater Locating Devices (Acoustic) (Self-Powered)*

ETSO-C200 – *Airframe Low Frequency Underwater Locating Devices (Acoustic) (Self-Powered)*

Note that OEM-provided documents may provide additional guidance (for example, particular vibration requirements provided by the aircraft manufacturer).

2.0 INTERCHANGEABILITY STANDARDS

2.1 The Desire for Interchangeability

One of the primary responsibilities of the Airlines Electronic Engineering Committee (AEEC) is to obtain Industry consensus on pertinent characteristics which affect equipment interchangeability. Airframe manufacturers and equipment suppliers recognize the many advantages of standardization.

As much as users would like to have complete interchangeability of all manufacturers' equipment, this is not always completely practical. Sometimes development of new equipment gets underway before the airline industry has the opportunity to assess system requirements. **Beyond that, airlines recognize that it is often necessary to tailor equipment to an aircraft to a degree which precludes any potential for interchangeability between different aircraft types. Nevertheless, unit interchangeability is desirable where feasible.**

It is a common experience that units or aircraft interfaces will have to be modified to re-establish interchangeability between aircraft derivatives. Manufacturers are urged to bear in mind the airline desire for an easy means to accommodate such modifications.

Because it is not feasible to cover different technical solutions in one common unit, the intention is to standardize the interface to aircraft structure and the maximum weight and volume for installation of the LF-ULB with its bracket.

3.0 CONSIDERATIONS FOR THE LF-ULB AND BRACKET DESIGN

3.1 General

The following design considerations should be taken into account to determine the LF-ULB installation location in the aircraft and to facilitate maintenance activities and the traceability of parts.

3.2 Mass

The mass of the LF-ULB plus associated bracket shall be 4.4lbs (2kg) maximum.

3.3 Mechanical Load

Unless specified otherwise by the authorities, the LF-ULB installation shall be designed to withstand the g loads specified in EASA CS-25.561 (b) (3) and FAR 25.561 (b) (3) as a minimum.

Note: The LF-ULB attachment to the aircraft structure may need to be designed to achieve higher g loads to meet aircraft installation requirements. Designers are advised to consult with the airframe manufacturer.

3.4 Material

Because the LF-ULB is installed outside the electronics bay of the aircraft, the environment can be very corrosive. The installation environment should be considered when choosing the materials, especially when combining different types of materials.

3.5 Identification and Markings

For traceability and configuration reasons, the bracket and the LF-ULB are viewed to be independent parts and therefore shall be labeled with their own identifier.

The necessary content of the identification plate, the amendment plate and identification label are not defined by this document. However, identification and markings are viewed to be important, and they should be coordinated between the LF-ULB supplier and airframe manufacturer. The LF-ULB identification and markings should be visible without removing the LF-ULB or bracket.

3.6 Environmental Conditions

Environmental test conditions are defined in **SAE AS6254** – *Minimum Performance Standard for Low Frequency Underwater Locating Device (Acoustic) (Self-Powered)*.

COMMENTARY

The LF-ULB mounting location requirements are used to determine the appropriate qualification requirements and environmental conditions to be met. Particular aircraft type related tests like Sustained Engine Imbalance may be required.

It is the responsibility of LF-ULB supplier and/or airframe manufacturer to determine the need for any extension to the given requirements of SAE AS6254.

For example, overheat of equipment should not endanger the surrounding structure and/or equipment, or create a fire risk. Coordination between the LF-ULB supplier and the installer is suggested to mitigate any risks.

3.7 Electrical Bonding

To protect the LF-ULB from the effects of indirect lightning, the LF-ULB shall be bonded via its bracket to the aircraft structure.

The bonding path from the LF-ULB to the aircraft shall have low resistance ($\leq$25mΩ) to guide any induced current to the electrical bonding network of the aircraft.

One mounting point to the aircraft structure is recommended to be identified as bonding path, indicated by a grounding symbol.

4.0 INSTALLATION

4.1 General

This section defines a common aircraft installation interface that allows different LF-ULBs with associated brackets to be attached to the aircraft structure without adaptation.

4.2 Electrical Power

No external electrical power is required to operate the LF-ULB. The LF-ULB is considered as self-powered equipment.

4.3 Environmental Conditions

Environmental test conditions are defined in **SAE AS6254** – *Minimum Performance Standard for Low Frequency Underwater Locating Device (Acoustic) (Self-Powered)*.

COMMENTARY

When choosing a LF-ULB mounting location, the entire set of environmental conditions must be considered. Particular aircraft type related tests, such as Sustained Engine Imbalance, may be required and validated for installation.

4.4 Maximum Space Envelope

The available space for the installation of electronic equipment in aircraft is limited, even more so in “protected areas” where moderate thermal and moisture conditions exist.

Taking such installation positions for the LF-ULB/bracket into account, consideration should be given to minimizing the size of the equipment. Table 4-1 defines the maximum LF-ULB envelope intended to be used in all aircraft installations. See Attachment 1.

Table 4-1 – Maximum Space Envelope

LF-ULB plus bracket dimension (max)	English (inches)	Metric (cm)
Length	7.87	20.0
Width	4.72	12.0
Depth	3.94	10.0

Additional space for installation and removal must be considered as a function of the type of bracket used for LF-ULB fixation to the airframe,

For installations where the LF-ULB is moved out/in from sideward (left/right direction), it may be necessary to increase the maximum space needed beyond the dimensions shown in Table 4-1.

4.5 Bracket Footprint

Based on the maximum envelope dimensions defined in Section 4.4 and taking into account the recommended brackets (see Attachment 2), the footprint for mounting the LF-ULB is defined to be 7.87 in x 4.72 in (20.0 cm x 12.0 cm) (length/width).

For bracket installation to the aircraft support plate, the bracket shall provide four screw holes with an appropriate diameter to allow bracket mounting to the airframe

structure by use of aircraft standard screws in compliance with National Aerospace Standard NAS1802-4-xx or equivalent.

COMMENTARY

The “xx” indicates the length of the screws (0.0625 increments) which shall be determined by the equipment installer depending on ULB bracket thickness and aircraft support plate definition.

4.6 LF-ULB Installation Recommendations

4.6.1 Installation Location

The LF-ULB is intended to be installed on the aircraft structure. It should not be installed in wing sections nor in the empennage of the airplane.

4.6.2 Protection from Unintentional Activation

The selection of mounting location and orientation should ensure that the LF-ULB is not likely to activate due to fluids accumulation.

4.6.3 LF-ULB Enclosure

The installation area of the LF-ULB must be free of sound absorbent materials (e.g., honeycomb) to avoid the possibility that LF-ULB transmissions are attenuated significantly.

4.7 Installation Loads

The LF-ULB and the corresponding means of installation shall be designed in such a way that the normal crash survival loads applicable for the aircraft will not lead to separation of the LF-ULB from its installation position.

5.0 MAINTENANCE CONSIDERATIONS

5.1 Accessibility

The LF-ULB shall be installed in such a way that removal and installation can be performed without removal of other aircraft parts or components.

The LF-ULB installation shall not hinder the removal/installation or servicing of other equipment.

Installation of LF-ULB should provide enough space to:

- **Perform required maintenance activities, e.g., check of LF-ULB battery or to perform LF-ULB ping test without removal of LF-ULB from its bracket**
- **Permit the mechanic to work with both hands**

If access openings are necessary, the openings should be large enough to accommodate body and shoulders with the work area being visible and to provide sufficient clearance for the beacon and associated tooling to pass through.

Access to the LF-ULB for removal/installation or maintenance checks should not require:

- **Removal of cabin or cargo floor panel**
- **Removal of any fixed module (e.g., galley, toilet, etc.).**

5.2 Tools

The LF-ULB and the corresponding bracket should be designed to enable installation/removal on aircraft without the aid of special tools.

ATTACHMENT 1 LF-ULB SPACE ENVELOPE

Based on the maximum LF-ULB/bracket size specified in Section 4.4, the figures shown below provide guidance on LF-ULB installation and space considerations.

The figures represent example installation scenarios with appropriate “keep out” space shown above and to the left side of installation intended for maintenance activity. However, this could be implemented equally to the right or below the LF-ULB at the discretion of the installer.

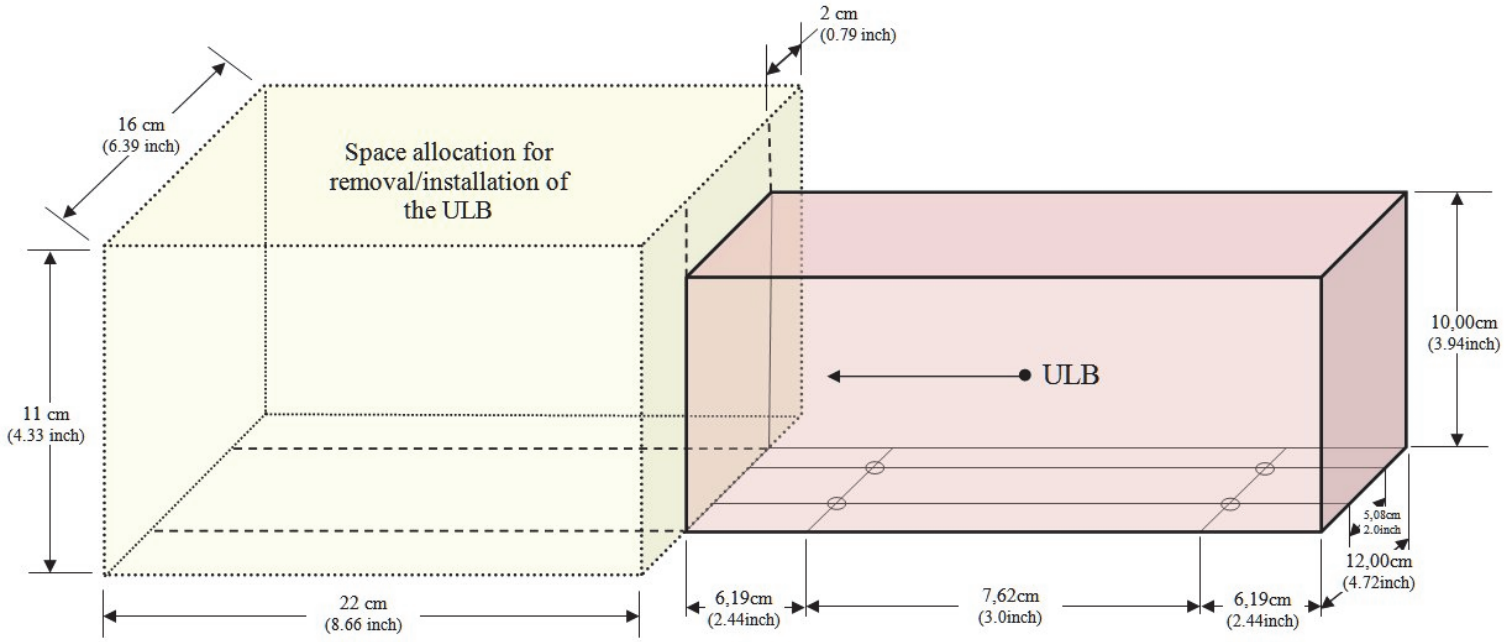


Figure A1-1 – LF-ULB Space Envelope – Side Installation/Removal

ATTACHMENT 1
LF-ULB SPACE ENVELOPE

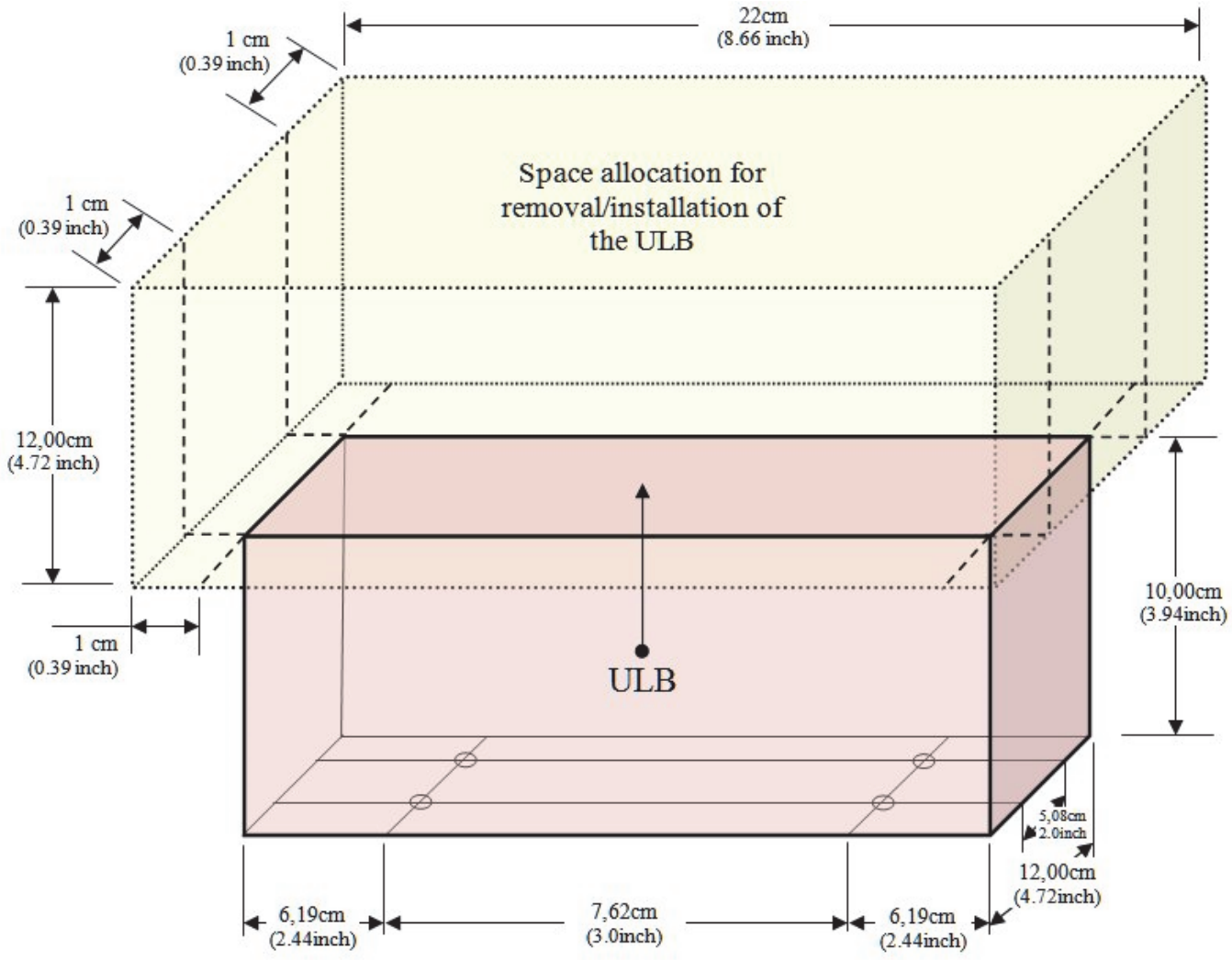
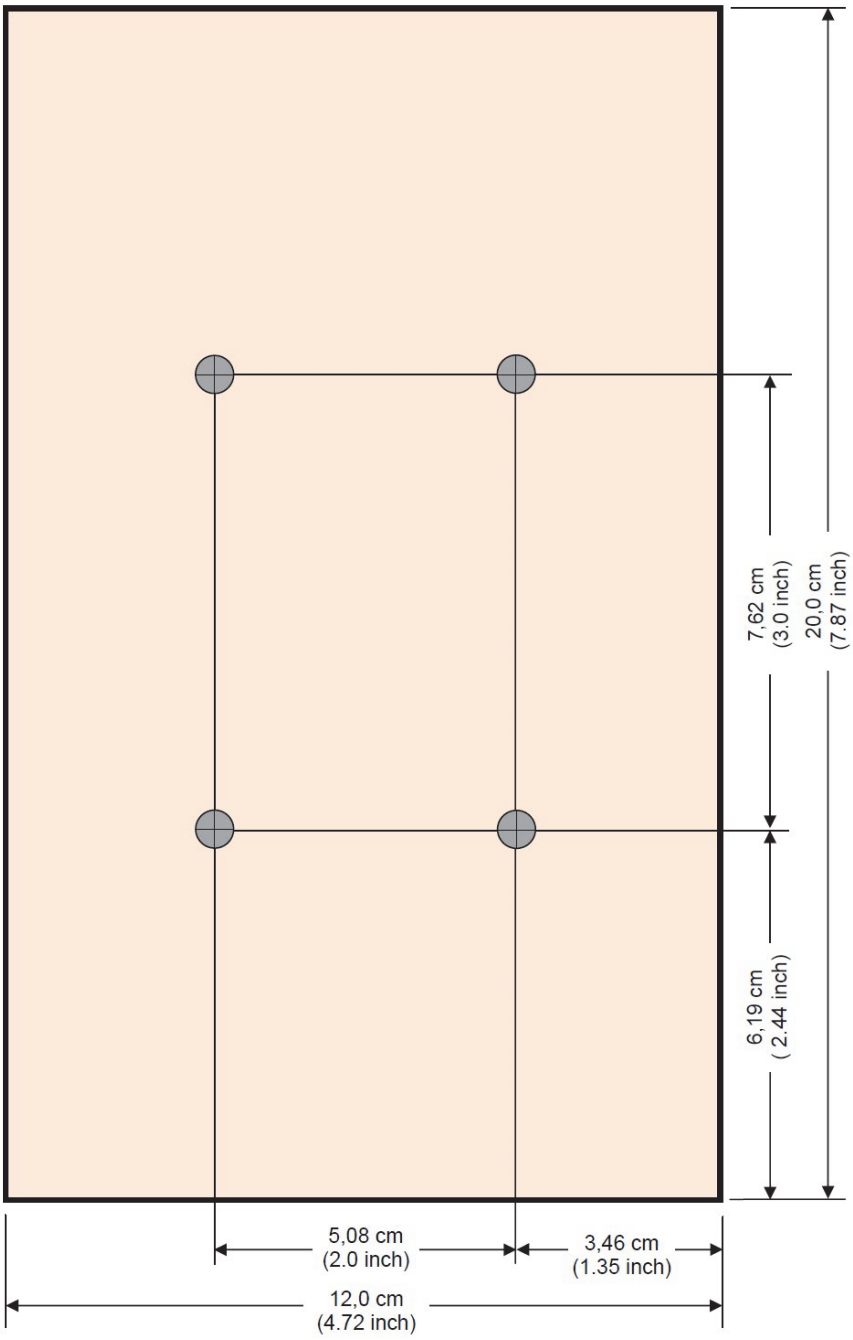


Figure A1-2 – LF-ULB Space Envelope – Top Installation/Removal

ATTACHMENT 2 LF-ULB FOOTPRINT ON AIRCRAFT STRUCTURE

Based on Attachment 1, the footprint of the LF-ULB bracket to aircraft structure is shown in the figure below.

The maximum overall dimensions are shown as 7.87 in x 4.72 in (20.0 cm x 12.0 cm).



Note: Four fixation holes 0.250 in (6.337 mm).

Figure A2-1 – LF-ULB Footprint

APPENDIX A ACRONYMS AND ABBREVIATIONS

AEEC	Airlines Electronic Engineering Committee
EASA	European Aviation Safety Agency
EUROCAE	European Organization for Civil Aviation Electronics
ETSO	European Technical Standards Order
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
ICAO	International Civil Aviation Organization
kHz	kilohertz
LF-ULB	Low-Frequency Underwater Locator Beacon
OEM	Original Equipment Manufacturer
TSO	Technical Standard Order
ULB	Underwater Locator Beacon
ULD	Underwater Locating Device