



TAD 494.6  
AC NO: 21-10

DATE: 20 May 71

# ADVISORY CIRCULAR

## DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION

**SUBJECT:** FLIGHT RECORDER UNDERWATER LOCATING DEVICE

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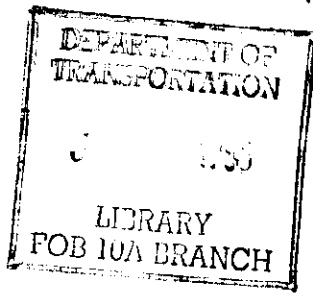
1. PURPOSE. This advisory circular provides one acceptable means (not the only means) of showing compliance with the underwater locating device requirements of FAR 25.1459 and FAR 121.343.
  2. REFERENCE. FAR 25 and FAR 121.
  3. BACKGROUND. FAR amendments 25-25 and 121-66 introduced several changes to the aircraft flight recorder rules. One of the changes requires the installation of a device to assist in locating flight recorders under water. The preamble to the amendments states, "In response to several comments requesting specific standards for the installation and operation of the underwater locating device, the Federal Aviation Administration is preparing an advisory circular which will set forth one acceptable means of compliance." It is anticipated that most applicants will install acoustic beacons (pingers) as the means of showing compliance with the rules. This advisory circular provides one set of acceptable performance standards for acoustic beacons.
  4. ACCEPTABLE PERFORMANCE STANDARDS. Underwater acoustic beacons which comply with the following performance standards are acceptable as a means to assist in the underwater location of flight recorders:
    - a. Operating frequency.  $37.5 \pm 1$  kHz.
    - b. Operating depth. Down to 20,000 feet.
    - c. Pulse length. Not less than 9.0 milliseconds.
    - d. Pulse repetition rate. Not less than .9 pulse per second.
    - e. Operating life. 30 days.
    - f. Acoustic output, initial.  $1,500 \text{ dynes/cm}^2$  peak pressure at 1 meter.
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Initiated by: FS-130

- g. Acoustic output, at the end of 30 days. 1,000 dynes/cm<sup>2</sup> peak pressure at 1 meter.
  - h. Operating temperature. +20°F. to +100°F.
  - i. Actuation. Fresh water and salt water, at all depths from the surface to 20,000 feet, within four hours after immersion.
  - j. Radiation pattern. The free-space rated acoustic output should be radiated over at least 80 percent of a spherical pattern. If more than one beacon is needed to achieve this pattern, beacon approval should include the limitation that the required number of beacons must be installed in certain relative positions.
5. INSTALLATION. The device should be so installed that it will not become separated from the flight data recorder container when subjected to the impact force specified in paragraph 6(d) of this advisory circular.
6. ENVIRONMENTAL TESTS. The beacon should comply with the operational performance standards after it is subjected to all of the following environmental tests in the order given.
- a. Inadvertent actuation (condensation). The beacon should be cold soaked at  $15 \pm 5^{\circ}$  F. for six hours and then immediately placed in a chamber maintained at  $95 \pm 5^{\circ}$  F. and  $95 \pm 5\%$  relative humidity for 18 hours. This complete cycle should be conducted 15 times. During these cycles there should be no actuation of beacon transmissions. The beacon should be tested in the most critical position concerning inadvertent actuation by condensation.
  - b. Storage temperature.  $-65 \pm 5^{\circ}$  F. for 48 hours,  $+160 \pm 5^{\circ}$  F. for 48 hours.
  - c. Vibration. Continuous scan, 5 to 2,000 Hz., .020 inches maximum total excursion 3g maximum acceleration, for one hour in each of the three major mutually perpendicular axes.
  - d. Impact. Half sine wave impact shock, applied in the most critical direction, and having a peak acceleration of 1,000g. The time duration at the base of the half sine wave should be at least 5 milliseconds. The impact force may be applied to the beacon by putting the beacon on a flat surface and then accelerating the flat surface.



U.S. Department  
of Transportation  
**Federal Aviation  
Administration**



# Advisory Circular

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**Subject:** FLIGHT RECORDER AND COCKPIT VOICE RECORDER UNDERWATER LOCATING DEVICES **Date:** 4-19-83 **AC No:** 21-10A  
**Initiated by:** ANM-110 **Change:**

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1. PURPOSE. This advisory circular provides an acceptable means of showing compliance with the underwater locating device (ULD) requirements of the Federal Aviation Regulations (FAR) for recorder ULD's. Like all advisory circular material, it is not mandatory and does not constitute a regulation. It is for guidance purposes and to provide an example of a method which has been found acceptable.

2. CANCELLATION. Advisory Circular 21-10, Flight Recorder Underwater Locating Devices, dated May 20, 1971, is cancelled.

3. RELATED FAR SECTIONS.

- a. Sections 25.1457(g)(3) and 25.1459(d)(3) of the FAR.
- b. Sections 121.343(f) and 121.359(c)(2)(iii) of the FAR.

4. BACKGROUND. Federal Aviation Regulations Amendments 25-25 and 121-66 established requirements for a ULD to assist in locating flight data recorders (FDR) under water. Amendment 121-135 established a similar ULD requirement for cockpit voice recorders (CVR). In addition, Amendment 121-135 permitted a single ULD installation, provided the FDR and the CVR are installed adjacent to each other in such a manner that they are unlikely to become separated during crash impact. In most cases, acoustic beacons (pingers) have been installed as the ULD.

5. ACCEPTABLE MEANS OF COMPLIANCE. An underwater acoustical beacon is acceptable for use as a recorder ULD provided:

a. Test Criteria.

(1) Environmental Tests. The beacon is subjected to the following in the order given:

(i) Condensation. The beacon is cold soaked at  $-9^{\circ} \pm 3^{\circ}$  C. ( $15^{\circ} \pm 5^{\circ}$  F.) for 6 hours, and then immediately placed in a chamber maintained at  $35^{\circ} \pm 3^{\circ}$  C. ( $95^{\circ} \pm 5^{\circ}$  F.), and at a relative humidity of 95  $\pm$  5 percent for 18 hours. This environmental cycle is conducted 15 times. Condensation is not to hamper proper operation, cause corrosion of vital parts, or activate the ULD transmitter.

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(ii) Temperature (Storage). The beacon is stored at a temperature of  $-54^{\circ} +3^{\circ}$  C. ( $-65^{\circ} +5^{\circ}$  F.) for 48 hours, and then at a temperature of  $71^{\circ} +3^{\circ}$  C. ( $160^{\circ} +5^{\circ}$  F.) for 48 hours.

(iii) Vibration. The beacon is exposed to continuous scan vibration for 1 hour in each of the three major mutually perpendicular axes. The scan is from 5 to 2,000 Hz, with a maximum total excursion of 0.020 inches and a maximum acceleration of 3g.

(iv) Pressure. The beacon is exposed to an external pressure of 8,700 psi for a period of 5 minutes. The pressure may be applied as a uniformly distributed force in an incompressible liquid as would be exerted at an ocean depth of 20,000 feet.

(v) Impact. The beacon or beacon installation package, as applicable, is exposed to a half sine wave impact shock having a peak acceleration of 1,000g. The time duration at the base of the half sine wave should be at least 5 milliseconds. Apply the impact shock in the most critical direction. The shock may be applied by placing the beacon or beacon installation package, as applicable, on a flat surface and accelerating the surface.

(vi) Static Crush. The beacon is exposed to a static crush force of 5,000 pounds for 5 minutes. Apply the crush force in the most critical direction. The crush force may be applied by placing the beacon between two flat surfaces and bringing the surfaces together until the 5,000 pound force is developed.

b. Performance. The beacon utilized for the above environmental tests is exposed to the following performance tests upon completion of the environmental tests:

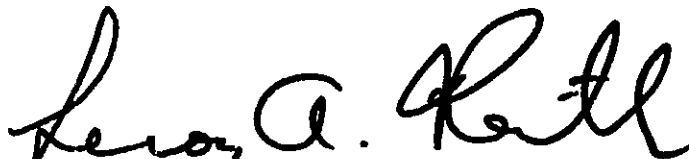
- (1) Output frequency:  $37.5 \pm 1$  kilohertz;
- (2) Minimum pulse length: 9.0 milliseconds;
- (3) Minimum pulse repetition rate: 0.9 pulse per second;
- (4) Minimum initial acoustical output as tested in fresh water: 1,500 dynes per square centimeter peak pressure at 1 meter distance;
- (5) Operating life: 30 days;
- (6) Minimum acoustical output after 30-day operation: 1,000 dynes per square centimeter peak pressure, at 1 meter distance;
- (7) Actuation: Within 4 hours after immersion in fresh water or salt water, at all depths to 20,000 feet;
- (8) Operating temperature range:  $-2^{\circ}$  to  $+38^{\circ}$  C. ( $28^{\circ}$  to  $+100^{\circ}$  F.); and
- (9) Operating depth range: Surface to 20,000 feet.

c. Installation.

(1) The ULD is installed such that it is unlikely to separate from its associated FDR or CVR, or that the ULD, FDR, CVR package of single ULD installations is unlikely to become separated when subjected to crash impacts. The 1,000g impact shock test criteria specified in paragraph 5a(1)(v) have been found acceptable in demonstrating that the beacon and associated recorder or recorders are unlikely to separate when subjected to crash impacts. In lieu of the actual impact test, a crash condition analysis has also been found acceptable that substantiates the ULD package's ability to meet the 1,000g impact shock test parameters specified in paragraph 5a(1)(v).

(2) The installed ULD radiates its rated free space acoustic output over 80 percent of a spherical pattern. If more than one beacon is necessary to achieve that pattern, the installation should include sufficient beacons in specified relative positions.

6. CERTIFICATION OF COMPLIANCE. Compliance with §§ 25.1457(g)(3) and 25.1459(d)(b) and/or 121.343(f) and 123.359(c)(2)(iii) may also be achieved: (1) through use of ULDs as installed by the recorder manufacturer through his compliance with all TSO and AC requirements; or (2) by installation of the ULD by the operator through use of approved manufacturer's field service bulletin and installation kit, provided mounting and clearance are adequate for those recorder installations not presently equipped with the ULD.



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**THIRD CLASS BULK RATE**

- e. Static crush. 5,000 pound force applied for five minutes in the most critical direction. The crush force may be applied to the beacon by placing the beacon between two flat surfaces and then bringing the surfaces together until the 5,000 pound force is developed.



Acting Director  
Flight Standards Service