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USER MANUAL – SBE-R1 PROFILER

R1-SBE INSTRUMENTS
Serial numbers: 133, 135, 144

REV DATE: 4/10/98
BSH-P, Contract no. 1292/M54/97/10
WRC Job no. 491

I. ALKALINE BATTERY WARNING

The profiler contains alkaline "D" cells.
There is a small but finite possibility that batteries of alkaline cells will release a combustible gas mixture. This gas release generally is not evident when batteries are exposed to the atmosphere, as the gases are dispersed and diluted to a safe level. When the batteries are confined in a sealed instrument mechanism, the gases can accumulate and an explosion is possible.
Webb Research Corp. has added a catalyst inside of these instruments to recombine Hydrogen and Oxygen into H2O, and the instrument has been designed to relieve excessive internal pressure buildup by having the upper endcap release.
Webb Research Corp. knows of no way to completely eliminate this hazard. The user is warned, and must accept and deal with this risk in order to use this instrument safely as so provided. Personnel with knowledge and training to deal with this risk should seal or operate the instrument. Webb Research Corp. disclaims liability for any consequences of combustion or explosion.

II. Reset and Self Test

Profilers are shipped to the deployment site in Hibernate mode. Shortly before deployment, the profiler is reset by passing a magnet over a marked location on the pressure case. The profiler then runs a self-test, transmits for 6 hours, then begins its pre-programmed mission.

It is preferable to deploy during the 6 hour transmission period, because the external bladder is full, preventing trapped air in the lower endcap. If deployment is delayed, the profiler can be reset again to keep the bladder full. The six ARGOS transmissions during self test and the transmissions during the initial 6 hour period are of the Test Message Format.

Procedure:
- Hold the provided magnet at RESET position marked on the hull for several seconds.
- Note: The internal magnetic reed switch must be activated (held) for at least one second to reset the instrument. (This is to provide a safety against accidental reset during transport.) **Thus, if the ALACE does not respond as below, the instrument was probably not reset.**
- The pump will operate for 1 second, this is best heard with your ear against the pressure case.
- The Sea-Bird pump will operate for 1 second.
- PTT will transmit 6 times at 6 second intervals. Place the ARGOS receiver/beeper close to the antenna to detect transmissions.
- Pump will operate for 16 seconds.
- After a pause, the pump will start again.
- The bladder will expand, this should take 35 - 60 minutes.
- 6 hours after reset, the bladder will deflate, the profiler begins its programmed mission.

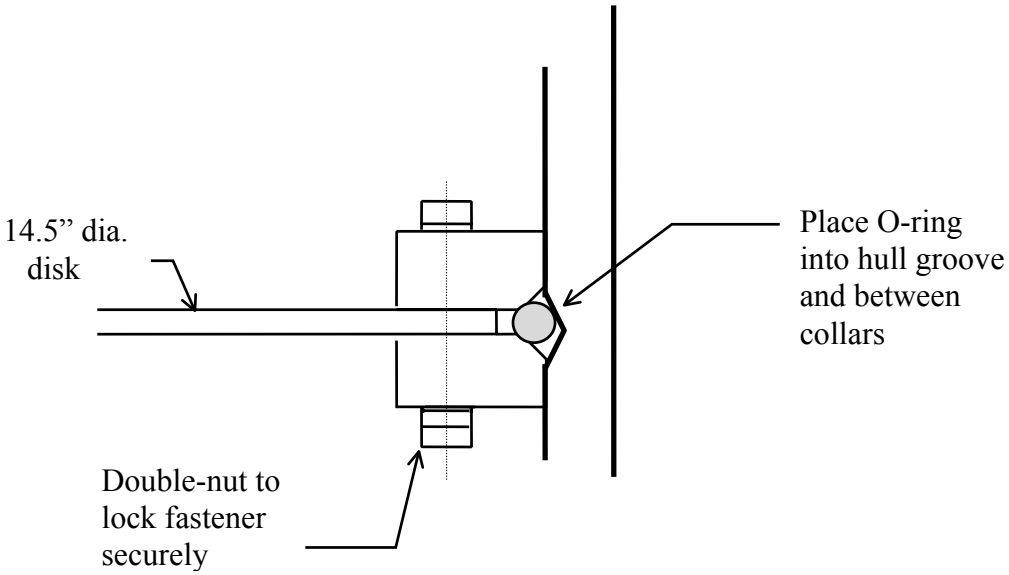
During self test, the controller checks the internal vacuum sensor. If the internal pressure has increased above a preset limit (i.e. hull leakage caused loss of vacuum), the instrument will not pump.

If you do not detect the 6 test transmissions, and if the bladder does not inflate, then the self test has failed and the instrument should not be deployed.

III. Mounting Damper Disk

To aid surface following, a damper disk is mounted to the outside of the pressure case. The damper parts should be ballasted with each instrument, and numbered accordingly.
Below are instructions, which should be provided to the deployment crew:

- Remove the ALACE from the crate and secure horizontally on foam cradles.
- Unpack the appropriate numbered stability disk.
- Remove the titanium hardware and one gray collar.
- Sandwich the clear disk between 2 gray collars.
- NOTE: the chamfered edge of the collar must be toward the O-ring as shown below.
- Install 6 bolts firmly - use 2 flat washers for each bolt, one on each side of collar.
- Using two wrenches, tighten the second nut against the first to lock fasteners in place.
- Note: Be sure to use the hardware particular to each instrument as each ALACE is ballasted to .1 grams.



IV. Deployment

- RESET instrument.
- SELF TEST starts automatically (see above).
- When the external bladder is full, PTT will transmit for 6 hours at ARGOS Repetition rate intervals. Normally 90 seconds.
- Six hours after reset, the internal valve will open and the external bladder will retract.
- It is preferable to deploy ALACE with its external bladder full, this prevents trapped air in the lower endcap cavity. Thus, deploy within 6 hours after RESET.
- Pass a rope through the hole in the stability disk.
- Holding both ends of the rope, carefully lower the ALACE into the water.
- Take care not to damage the antenna.
- Do **not** leave the rope with the instrument, release one end and retrieve the rope.
- The ALACE will remain on the surface until the 6 hour interval has expired.

V. ARGOS DATA

A. SERVICE ARGOS PARAMETERS

The user must specify various options to Service ARGOS. These choices depend on how the user wishes to receive and process data. Typical parameters are listed below:

- Standard location.
- Processing: Type A2 (pure binary input; hexadecimal output)
- Results Format: DS (all results from each satellite pass), Uncompressed.
- Distribution Strategy: Scheduled, all results, every 24 hours.
- Number of bits transmitted: 32

B. DATA FORMAT

Data is sent via ARGOS in 32 byte hex messages. The number of 32 byte messages sent depends on the programmed quantity of temperature measurements per profile. (See section (V) ARGOS DATA, part (E) CONSTANTS.)

Format for message number 1 only:
Byte #

- 01 **CRC**, described in section C.
- 02 **Message number**, the total number of messages for each float data set is given in section D. Messages are transmitted in sequential order starting with 1 and incrementing by one for the data set.
- 03 **Message block number**, begins as 1 and increments by one for every ARGOS message data set. This, combined with the ARGOS repetition rate (section VI), allows the user to track surface drift. Byte 03 will roll-over at 256 and will reset to 1 on each new profile.
- 04 **Serial number**, identifies the controller board number. (Note this may not be the same as instrument number.)
- 05 **Profile number**, begins with 1 and increases by one for every float ascent.
- 06 **Profile length**, is the number of six byte STD measurements in the profile. Total number of bytes of STD data from each profile depends on the sampling strategy chosen. This is described in section (V) ARGOS DATA, part (E) CONSTANTS.
- 07 **Profile termination flag byte**, can have the following values:
  - 00 Pressure reached surface pressure.
  - 01 Programmed ascent time ran out before surface.
  - 02 Pressure reached zero.
  - 04 Pressure unchanged for 17 minutes.
- 08 & 09 **Bottom temperature**, sampled just before instrument begins ascent.
- 10 & 11 **Bottom salinity**, sampled just before instrument begins ascent.
- 12 & 13 **Bottom pressure**, sampled just before instrument begins ascent.
- 14 **Battery voltage**, nominally at 15 volts and decreases throughout the life of the float.
- 15 & 16 **Surface pressure**, as recorded just before last descent with an offset of +5db.
- 17 to 28 6 bytes in sequence:
  - 2 bytes **temperature**
  - 2 bytes **salinity**
  - 2 bytes **pressure**
- 29 to 32
  - 2 bytes **temperature**
  - 2 bytes **salinity**

Format for message number 2 thru 12 that follow:
Byte #

- 01 **CRC**, described in section C.
- 02 **Message number**,
- 03 to 04
  2 bytes **pressure**
- 05 to 28 6 bytes in sequence:
  2 bytes **temperature**
  2 bytes **salinity**
  2 bytes **pressure**
- 29 to 32
  2 bytes **temperature**
  2 bytes **salinity**

Note: As shown above, due to the constraints of 32 bytes per ARGOS message, the measurement for a depth table point is partially reported in a preceding (**temperature** and **salinity**) message and concluded in the following message (**pressure**).

C. TEST MESSAGE FORMAT

The test message is sent whenever an **I2** command is given, the six transmissions during the startup cycle, and during the six hour surface mode period prior to the first dive. Each test message has 32 bytes, in hex unless otherwise noted, with the following format:

Byte #

- 01 **CRC**, described in section C.
- 02 **Message number**, always 01.
- 03 **Message block number**, begins as 1 and increments by one for every ARGOS message.
- 04 **Serial number**, identifies the controller board number. (Note this may not be the same as instrument number.)
- 05 **Profile number**, always 00.
- 06 **Message type flag**, 20 for test message, 40 for 6 hour surface message.
- 07 & 08 **Current pressure**.
- 09 **Battery voltage**, nominally at 15 volts.
- 10 **Internal vacuum**, nominally at 12 inches Hg.
- 11 & 12 **Always zero**.
- 13 **Float status byte**, 08 for float up, 12 for float up and pump done.
- 14 **Hour**, the following is the time from startup (in decimal).
- 15 **Minutes**.
- 16 **Seconds**.
- 17 **ARGOS** repetition rate constant (multiply by 2, add 6 = nominally 90 ± 6 seconds).
- 18 **Up** time, intervals.
- 19 & 20 **Down** time, intervals.

- 21 **Trip** interval time, hours.
- 22 **Deep** pump time duration, minutes.
- 23 **1st** surface pump time, minutes.
- 24 **2cd** surface pump time, minutes.
- 25 **Ascend** time, minutes.
- 26 & 27 **Always zero**.
- 28 **Month**, software version number (in decimal).
- 29 **Day**, software version number (in decimal).
- 30 **Year**, software version number (in decimal).
- 31 **Always** 31, (in decimal).
- 32 **Always** 32, (in decimal).

D. CRC

Because ARGOS data may contain transmission errors, the first byte of each message contains an error checking value. This value is a Cyclic Redundancy Check (CRC), and is calculated as a function of the message content (bytes 2 to 32).

- For each message, calculate a CRC value
- Compare the calculated CRC to the transmitted CRC (byte no. 1)
- If the calculated and transmitted CRC values are not equal, the message has been corrupted and should be deleted before further data processing.

Below is a sample program (in BASIC) to calculate the CRC value for a message. This program can be provided upon request in Basic, Fortran or C.

```
DECLARE FUNCTION CRC% (IN() AS INTEGER, N AS INTEGER)
'CRC routine to check data validity in ARGOS message.
'Bathy Systems, Inc. RAFOS Float data transmission.
'3 December, 1990.
'The 1st of 32 bytes in an ARGOS message is the CRC.
'The function CRC will compute CRC for byte 2 through 32.
'Hasard is used for Random because Random is reserved by BASIC.
'Stored as file CRC in C:\RAFOS\RAF11.
DECLARE SUB Hasard (ByteN AS INTEGER)
DEFINT A-Z
DIM in(32) AS INTEGER
'RAF11F message number 08 HEX ID 11502 01-02-93   CRC is O.K.
A$ = "8F00081C8E47239148A4D2E9743A1D0E070381C06030984C2693492492C964B2"

        N = 32
        FOR I = 1 to N
                in(I) = VAL("&H" + MID$(A$, 2 + I - 1, 2))
        NEXT I
        PRINT in(1); CRC(in(), N);

FUNCTION CRC% (IN() AS INTEGER, N AS INTEGER) STATIC
DIM ByteN as INTEGER
         I = 2
```

```
 ByteN = in(2)
                DO
                        CALL Hasard(ByteN)
                        I = I + 1
                        ByteN = ByteN XOR in(I)
                LOOP UNTIL  I = N
        CALL Hasard (ByteN)
        CRC = ByteN
END FUNCTION

DEFINT A-Z
SUB Hasard (ByteN AS INTEGER) STATIC
x% = 0
        IF ByteN = 0 THEN ByteN = 127: EXIT SUB
        IF (ByteN AND 1) = 1 THEN x% = x% + 1
        IF (ByteN AND 4) = 4 THEN x% = x% + 1
        IF (ByteN AND 8) = 8 THEN x% = x% + 1
        IF (ByteN and 16) = 16 THEN x% = x% + 1
        IF (X% AND 1) = 1 THEN
                ByteN = INT(ByteN / 2) + 128
        ELSE
                ByteN = INT(ByteN / 2)
        END IF
END SUB
```

E. CONSTANTS

The pressure is measured every 6 seconds. Temperature, salinity and pressure are measured and stored at each point in the depth table.

Two hex bytes are stored for each sensor. The decimal numbers from the Sea-Bird sensors are converted to hex as follows:

Temperature: first 5 digits, 1 milli-degree resolution.
Salinity: 5 digits starting with the second digit (first digit is usually a 3).
Pressure: first 5 digits, 10 cm resolution.

Voltage (V) = counts/10 + .6 (counts is in decimal number) nominally 15 V and decreasing.

Vacuum (inHg) = counts *-0.375 + 28.5 (counts is in decimal number) nominally 12 inHg.

Depth Table: (in db)
Bottom, 1580, 1530, 1480, 1430, 1380, 1330, 1280, 1230, 1180, 1130, 1080, 1030, 980, 930, 880, 830, 780, 730, 680, 630, 580, 530, 480, 460, 440, 420, 400, 380, 360, 340, 320, 300, 280, 260, 240, 220, 200, 190, 180, 170, 160, 150, 140, 130, 120, 110, 100, 90, 80, 70, 60, 50, 40, 30, 20, 10, 4 or Surface.

Note: Surface measurement has an offset of 5 db as a stop profiling point so as to leave the Sea-Bird cell full of water while transmitting.

VI. MISSIONS

INSTRUMENT #133
S 2 SBE 41-ALACE V 2.0 SERIAL NO. 0030
H APF version 04 04 98 sn 169

3CBEC ARGOS ID number.
088 seconds repetition rate.
002 hour Trip interval.
168 intervals DOWN.
012 intervals UP.
016 minutes deep pump time.
010 minutes 1st surface pump time.
100 minutes 2nd surface pump time.
253 minutes ascend time.

INSTRUMENT #135
S 2 SBE 41-ALACE V 2.0 SERIAL NO. 0031
H APF version 04 04 98 sn 172

3CC17 ARGOS ID number.
084 seconds repetition rate.
002 hour Trip interval.
168 intervals DOWN.
012 intervals UP.
016 minutes deep pump time.
010 minutes 1st surface pump time.
100 minutes 2nd surface pump time.
253 minutes ascend time.

INSTRUMENT #144
S 2 SBE 41-ALACE V 2.0 SERIAL NO. 0036
H APF version 04 04 98 sn 173

3CC44 ARGOS ID number.
082 seconds repetition rate.
002 hour Trip interval.
168 intervals DOWN.
012 intervals UP.
016 minutes deep pump time.
010 minutes 1st surface pump time.
100 minutes 2nd surface pump time.

253 minutes ascend time.

VII. RECORDS & CALIBRATIONS