WEBB RESEARCH CORPORATION

82 Technology Park Drive · East Falmouth, MA 02536-4441 · (508)548-2077 · FAX 508-540-1686

USER MANUAL – APEX PROFILER

APEX-SBE INSTRUMENTS
Serial # 2695 & 2696

IMR Norway Job 1165
Park only with Aanderaa Oxygen & WetLabs FLNTU
Manual Rev 02-23-06
Software Rev 02-19-06

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, reset the profiler by passing a magnet over the marked location on the pressure case. The profiler will run a self-test, transmit for 6 hours with the bladder extended, and then begin its pre-programmed mission.

NOTE: For floats equipped with the optional WetLabs FLNTU sensor, see notes in section IV, part B, regarding timing of RESET such that the profile is complete before sun rise.

The six ARGOS transmissions during self-test and the transmissions during the initial 6 hour period contain data about the instrument and are outlined in (V) ARGOS DATA, part (C) TEST MESSAGE FORMAT.

Procedure:

1. Secure float in horizontal position, using foam cradles from crate.

2. Carefully pry black rubber plug out of bottom center of yellow plastic cowling to verify bladder inflation (per below). **Be sure to replace plug before deployment.**

Purpose of plug is to prevent silt entry if float contacts sea floor.

3. 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 float does not respond as below, the instrument was probably not reset.**

4. The air pump will operate for 1 second.
5. The PTT will transmit 6 times at 6 second intervals. Place the ARGOS receiver/beeper close to the antenna to detect transmissions.
6. The piston pump will begin to operate. The piston will move to the retracted Ballast Position, if not already there, pause 2 seconds and then move to full extension.
7. The oil bladder will expand, this should take 15 - 25 minutes.

8. After the piston pump stops, the air pump will inflate the air portion of the bladder taking 20 - 30 seconds. Verify bladder expansion by inserting finger into hole in cowling.
9. The PTT will transmit at the mission specified ARGOS rate.
10. 6 hours after reset, transmissions will cease, the piston pump will retract and the bladder will deflate, the profiler begins its programmed mission.
11. Reminder - replace black rubber plug in cowling hole before deployment.

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. Deployment

- RESET instrument.
- SELF-TEST starts automatically (see above).
- When piston pump stops, air pump inflates, external bladder is full, PTT will transmit for 6 hours at ARGOS Repetition rate intervals. Normally 45-90 seconds.
- Six hours after reset, the piston pump will retract and bladder will deflate. Deploy before this time is up or reset the instrument again to re-initialize the 6 hour period. The purpose is to have the instrument on the surface and receive test transmissions.
- Pass a rope through the hole in the damper plate.
- Holding both ends of the rope, carefully lower the float 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 float will remain on the surface until the 6 hour interval has expired.

The Flntu Sensor has a protective cap that must be removed before deployment. To remove cap cut black O-ring which holds it in place.

IV. Optional Sensors

Optional sensors are sampled at the same time as the SeaBird CTD, at pressure values listed in the depth table.

A. Optional Aanderaa Oxygen Sensor

In addition to SeaBird model 41 CTD sensor, these APEX carry the (optional) Aanderaa Oxygen Optode 3830. The oxygen sensor communicates with the APEX controller via RS-232C interface, and provides absolute oxygen content in micro molar (µM). Relative air saturation (%) is not returned.

Note: Only the CTD provides temperature data.

NOTE re handling: do not lift or pull on the oxygen optode.

B. Optional WetLabs FLNTU-APX Combination Fluorometer and Turbidity Sensor

WetLabs FLNTU-APEX is an optical sensor, which combines a 470/695 nm chlorophyll fluorometer and 700 nm backscatter sensors.

This sensor is mounted to the lower part of the pressure hull. A cable to the lower end cap provides power and serial communications. It is sampled at the same time as the other sensors, per the depth table.

NOTE: It is vital to remove the protective cap from the FLNTU sensor before deployment.

Raw sensor outputs (designated CHL and NTU) are telemetered as counts. Applying linear scaling constants unique to each sensor, these data can be expressed in meaningful forms of chlorophyll fluorescence and NTUs. For a full explanation, see section 6 “Data Analysis” of the sensor manual: http://www.wetlabs.com/products/pub/eco/flntuk.pdf

For best sensor accuracy, profiles with this sensor should be made before sun rise.

TIMING: WetLabs recommends profiling before local sunrise. The reason is that by dawn the night time cooling induced vertical mixing has stabilized and the phytoplankton population that will be producing the day's growth can be measured with minimal mixing and grazing effects.

Two conditions are required to ensure that profiles are complete before sunrise:
1) The mission cycle (ie UP + DOWN time) must be an integer multiple of 24 hours
2) The float must be activated (RESET) at a specified time relative to local sunrise

NOTE: The floats described in this manual should be reset 4 hours before local sun rise. For example, if sun rise is at 04:00 local, the floats should be reset at 00:00 local.

C. *Testing the optional sensors*

Sensors can be tested by connecting a terminal, with the provided interface cable, as described in the separate APEX Final Test Procedure.

Below are two samples from the Wet Labs Flntu.
The first example is "open"(no objects within three feet of sensor).
The second example is with a fluorescent stick (provided by Wet Labs) held in front of the sensor. An open palm will produce similar "large" values.

I F	command **IF**
WET Labs CHL NTU	open
50 54	decimal output
0032 0036+	hexadecimal
I F	
WET Labs CHL NTU	with fluorescent test stick
3978 4086	
0F8A 0FF6+	

Below is an example of output from the Aanderaa oxygen sensor.
Optode oxygen concentration (dry, in air) should be 200 to 250.
It is followed by optode temperature in degrees C.

I A command **IA**

```
 Sn   O2     T   Aanderaa 3830 Oxygen Optode
 512 213.39  21.39
     535B    085B+
```

V. Multiple down times

Parameter D1 determines the Down time from June 1st – April 9th
Parameter D2 determines Down time form April 10 – May 31
Total mission length D1 + Up time or D2 + Up time must remain divisible by 24 hours. This keeps the float surfacing just before sunrise per FLNTU manufactures recommendation.

VI. Time and Year day

The apex clock is set with command t (case sensitive)
example
t Set clock as hh mm ss. Esc to exit.
18 02 25
18 02 25
+
Year Day is set by command d (case sensitive)
example
d Enter day of year, 1 - 365.
052 Day 052 +

Leap years are not recognized.

VII. Profile Quantity Feature

Parameter PQ, Profile Quantity is a user set value ranging from 1 to 255. PQ will determine how many profile cycles the float will complete. At completion the float will remain at the surface transmitting data from its last profile at the programmed rep rate. The purpose of this parameter is to facilitate recovery of the float. **Profile Quantity is telemetered in byte 29 of test message only.**

VIII. 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 bytes transmitted: 31 per message

Note: Webb Research strongly recommends all users to use ARGOS “Multi Satellite Service”, which provides receptions from 3 satellites instead of 2 for a small incremental cost.

B. DATA FORMAT #41 Aanderaa and FLNTU

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

Format for message number 1 only:

Byte #

- 01 **CRC**, described in section C.
- 02 **Message number**, Assigned sequentially to each 32 byte message (Total number of messages per profile is shown below). 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 & 05 **Serial number**, identifies the controller board number. (This may not be the same as instrument number.)
- 06 **Profile number**, begins with 1 and increases by one for every float ascent.
- 07 **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.
- 08 **Profile termination flag byte 2 -**see section D
- 09 **Piston position**, recorded as the instrument reaches the surface.
- 10 **Format Number** (identifier for message one type)
- 11 **Depth Table Number** (identifier for profile sampling depths)
- 12 **Park Wet Lab CHL & Park Wet Lab NTU sample length**
- 13 **Wet lab Sensor Flag –** OC - wetlab profile data present or 00 - no wet lab profile data
- 14 & 15 **Pump motor time,** in two second intervals. (multiply by 2 for seconds
- 16 **Battery voltage,** at initial pump extension completion
- 17 **Battery current,** at initial pump extension completion, one count = 13 mA
- 18 **Air pump current**
- 19 **Air bladder pressure** measured in counts - approximately 148 counts
- 20 & 21 **Year day**
- 22 & 23 **Time of Day** in two second intervals
- 24 & 25 **Park temperature**, sampled just before instrument ascends
- 26 & 27 **Park salinity**, sampled just before instrument ascends
- 28 & 29 **Park pressure**, sampled just before instrument ascends
- 30 & 31 **Park Aanderaa oxygen concentration**, sampled just before instrument ascends
- 32 Half of two bytes **Park Wet Lab CHL** sampled just before instrument ascends**

Format for message number 2
Byte #

- 01 **CRC**, described in section C.
- 02 **Message number**
- 03 Half of two bytes **Park Wet Lab CHL**
- 04 & 05 **Park Wet Lab NTU** sampled just before instrument ascends
- 06 **Park battery voltage**
- 07 **Park battery current**
- 08 & 09 **Surface Pressure** as recorded just before last descent with an offset of +5 dbar
- 10 **Internal vacuum** measure in counts- approximately 101 counts
- 11 **Park piston position**
- 12 **Battery voltage** at Sbe pump time
- 13 **Battery current** at Sbe pump time
- 14 & 15 2 bytes **1st profile temperature**
- 16 & 17 2 bytes **1st profile salinity**
- 18 & 19 2 bytes **1st profile pressure**
- 20 & 21 2 bytes **1st profile Aanderaa oxygen concentration**
- 22 & 23 2 bytes **2nd profile temperature**
- 24 & 25 2 bytes **2nd profile salinity**
- 26 & 27 2 bytes **2nd profile pressure**
- 28 & 29 2 bytes **2nd profile Aanderaa oxygen concentration**
- 30 & 31 2 bytes **3rd profile temperature**
- 32 Half of two bytes **3rd profile salinity****

Sequence for message 3 and higher
Byte #

- 01**CRC**, described in section C.
- 02 **Message number**
- 03-32 continuing 8 byte sampling sequence described above.

**Note byte pairs may split between messages.

Year day Data formatting change-
Between the year day values of 60 – 304 Profiles pressure samples less than 300 Dbars will also contain:
two bytes **Wet Lab CHL**
two bytes **Park Wet Lab NTU**

the number of these additional samples is indicated in byte 12 of message #1 (27 for a normally profiling float)

Note that Wet Lab CHL & NTU are measured at the conclusion of every park period at park depth.

APEX records a profile during ascent (ie upcast). Bottom pressure may change due to several causes, such variation of insitu density, internal waves, float grounding in shallows, change of float mass, etc. APEX automatic depth adjustment will compensate in most, but not all, cases.

The number of sample points taken is proportional to depth, as per sample depth table below. The first (i.e. deepest) sample is taken at the first point in the depth table above bottom pressure.

Depth Table No. 76

depth table point	depth dbar	depth table point	depth dbar
1	1200	27	160
2	1100	28	150
3	1000	29	140
4	950	30	130
5	900	31	120
6	850	32	110
7	800	33	100
8	750	34	90
9	700	35	80
10	650	36	70
11	600	37	60
12	550	38	50
13	500	39	40
14	450	40	30
15	400	41	20
16	350	42	10
17	300	43	4*
18	250		
19	240		
20	230		
21	220		
22	210		
23	200		
24	190		
25	180		
26	170		

* The SeaBird CTD is not sampled at zero pressure, to avoid pumping the cell dry and/or ingesting surface oil slicks. The shallowest profile point is taken at either 4 dbar or at the last recorded surface pressure plus 5 dbar, whichever value is larger.

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 block number**, begins as 1 and increments by one for every ARGOS message.
- 03 & 04 **Serial number**, identifies the controller board number. (This may not be the same as instrument number.)
- 05 & 06 **Day Year**
- 07 & 08 **Time**, in two second intervals (Hex)
- 09 **Flag (2) byte**
- 10 & 11 **Current pressure,** in bar
- 12 **Battery voltage**
- 13 **Current Bladder pressure,** in counts
- 14 **Flag (1) Byte**
- 15 **Up time**, in hours
- 16 & 17 **Down time1**, in hours
- 18 & 19 **Down time2**, in hours
- 20 & 21 **Park pressure,** in bar
- 22 **Park piston position**, in counts
- 23 **Depth correction factor,** in counts
- 24 **Storage piston position**, in counts
- 25 **Fully extended piston position**, in counts
- 26 **OK vacuum count at launch**, in counts
- 27 **Ascend time**, in intervals
- 28 **Target bladder pressure**, in counts
- 29 **Profile Quantity**
- 30 **Month**, software version number (in decimal).
- 31 **Day**, software version number (in decimal).
- 32 **Year**, software version number (in decimal).

* Flag (2) byte:
1 Deep profile
2 Pressure reached zero
3 25 minute Next Pressure timeout
4 piston fully extended before surface
5 Ascend time out
6 Test message at turn on
7 Six hour surface message
8 Seabird String length error

**Flag (1) byte:
1 Trip interval time
2 Profile in progress
3 Timer done
4 UP/ DOWN
5 Data entry error
6 Measure battery
7 Piston motor running
8 Negative SBE number

D. FLAG BYTE DESCRIPTION

Two memory bytes are used, one bit at a time, to store 16 different bits of program flow information. Both of these bytes are telemetered in the test messages sent at startup and for the initial 6 hour surface period. Only flag byte 2 is sent in the data messages, as part of message number 1. Bit one is set for each deep profile and bit 8 is set each time the last SBE sensor value used an arithmetic round up.

Below is a list of what each bit in each byte signifies.

	bit
Flag (2) byte:	1 Deep profile
	2 Pressure reached zero
	3 25 minute NextP timeout
	4 Piston fully extended
	5 Ascend timed out
	6 Test message at turn on
	7 Six hour surface message
	8 Seabird String length error

	bit
Flag (1) byte:	1 Trip interval time
	2 Profile in progress
	3 Timer done (2 min bladder deflate time.)
	4 UP/DOWN
	5 Data entry error
	6 Measure battery while pumping
	7 Piston motor running
	8 Negative SBE number

The flag bytes are transmitted as two hex characters with four bits of information encoded in each character. Each hex character can have one of 16 different values as shown in the following table.

1	0	0000
2	1	0001
3	2	0010
4	3	0011
5	4	0100
6	5	0101
7	6	0110
8	7	0111
9	8	1000
10	9	1001
11	A	1010
12	B	1011
13	C	1100
14	D	1101
15	E	1110
16	F	1111

Bit 8 is the most significant bit and bit 1 is the least significant bit in the byte.

As an example: if a deep profile ended with the piston fully extended and ascend had timed out, then bits 1, 4 and 5 would be set in the termination byte. This binary pattern, 0001 1001, would be transmitted as the two hex characters, 19.

As another example: if a regular profile ended with the piston fully extended and the 25 minute next pressure had timed out, then bits 3 and 4 would be set in the termination byte. This binary pattern, 0000 1100, would be transmitted as the two hex characters, 0C.

E. *CRC Algorithm in BASIC for 20 bit Id*

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
```

F. Conversion from hexadecimal to useful units

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 STD sensors are converted to hex for compression in the ARGOS transmission as follows:

Temperature:	5 digits, 1 milli-degree resolution.
Salinity:	5 digits, .001 resolution
Pressure:	5 digits, 10 cm resolution.

To convert the hex ARGOS message back to decimal numbers:

	hex →	dec	=	converted	units
Temperature:	3EA6 →	16038	=	16.038	C
Temperature*:	F58B →	02677	=	-2.677	C
Salinity**:	8FDD →	36829	=	36.829	
Pressure:	1D4C →	7500	=	750.0	decibars
Current	0A→	10	=	130	mA
Volts	99 →	153	=	15.7	volts

Voltage (V) = counts/10 + .4 (counts is in decimal number) nominally 15 V and decreasing.
Current (mA) = counts *13 (counts is in decimal number)
Vacuum (inHg) = counts *-0.209 + 26.23 (counts is in decimal number) nominally 5 inHg.

*Note regarding <u>negative</u> temperatures (T °C < 0)
Positive temperature range is 0 to 62.535C (0 to F447 hex)
Negative temperature range is -0.001 to -3.000C (FFFF to F448 hex).
If (hex value) ≥ F448, then compute FFFF - (hex value) = Y
Convert Y to decimal = dec_Y
(dec_Y + 1) / 1000*-1 = degrees C

**The 5 most significant salinity digits are telemetered. The 6 digit salinity number is rounded up and converted to hex. 36.8286 rounds to 36.829 and converts to 8FDD.

IX. MISSIONS

INSTRUMENT #2695

APEX version 02 19 06 sn 2928 041 076
AF00E ARGOS ID number.
060 seconds repetition rate.
231 hours DOWN time 1. (Except as below) D1
111 hours DOWN time 2. (Apr 10 - May 31) D2
009 hours UP.
1200 d-bar park pressure   P1
030 park piston position   P2
012 ascent rate correction. P3
022 storage piston position P4
250 piston full extension   P5
115 OK vacuum count   P8
006 hours ascend time   P9
149 air bladder pressure   PB
140 profile quantity   PQ
025 Initial piston extension.
14:14:34 Day 054

INSTRUMENT #2696

APEX version 02 19 06 sn 2929 041 076
AF421 ARGOS ID number.
060 seconds repetition rate.
231 hours DOWN time 1. (Except as below) D1
111 hours DOWN time 2. (Apr 10 - May 31) D2
009 hours UP.
1200 d-bar park pressure   P1
030 park piston position   P2
012 ascent rate correction. P3
100 storage piston position P4
251 piston full extension   P5
115 OK vacuum count   P8
006 hours ascend time   P9
149 air bladder pressure   PB
140 profile quantity   PQ
025 Initial piston extension.
14:26:02 Day 054

Appendix A: Surface arrival time, and total surface time

Some users may wish to determine surface arrival time, and total surface time, in order to calculate drift vectors.

Although each 31-byte message is time-stamped by ARGOS, there may not be a satellite in view when the float surfaces.

When the float surfaces (ie detects surface pressure recorded before last descent) it will begin ARGOS telemetry. Messages are transmitted in numerical order, starting with message no. 1. When all messages have been transmitted, the cycle starts again at message no. 1.

Elapsed time since surfacing (Te)

Te = (m-1)*n*r
Where: m =   message block number (byte 03 of message 01)
n =   total number of messages to transmit profile
r =   repetition rate

Total number of messages (n) is described in section IV (b), or may be determined from the ARGOS data. Note (n) may be less than specified in user manual if the float is operating in shallow water, causing reduced profile length.

Repetition rate (r) is the time interval between ARGOS transmissions. This value can be determined from section V, or from the ARGOS data.

Approximate time of surfacing

Subtracting Te from the ARGOS time stamp can determine approximate time of surfacing

Example

Below is message 01 in DS format

```
2001-11-02 22:47:54 1 CF 01 05 02
AF 02 2F 00
85 01 01 01
16 92 17 19
9E 94 01 AD
85 09 1F 48
97 9B 00 46
62 24 0E
```

m = message block number (byte 03) = 5
n = total number of messages to transmit profile = 11
r = repetition rate = 62 seconds

Te = elapsed time since surfacing = (m-1)*n*r = (5-1)*11*62 s = 2728 s = 00h 45m 28s

Approximate time of arrival at surface:
ARGOS time stamp - Te = 22:47:54 - 00:45:28 = 22:02:26

Total time spent at surface transmitting (Tsurf):

This is determined by subtracting ascent time from UP time.
Tsurf = (UP time, hr) - (bottom pressure)/(ascent rate 0.08 dbar/s)/3600

Bottom pressure is telemetered as bytes 7 & 8 of message 02.

Example:

For bottom pressure of 2000 dbar, and UP time of 18 hours
Tsurf = (18 hr) - (2000/0.08/3600) = 11 hr

APPENDIX B: Argos ID formats, 28 bit and 20 bit

In 2002 Service Argos notified its users there were a limited number of 20-bit Ids available and to begin preparing for a transition to 28-bit IDs. The 28 bit-IDs reduced from 32 to 31 the number of data bytes in each message. Data provided by Argos will consist of 31 hex bytes per message. Data acquired by use of an uplink receiver will consist of 32 hex bytes per message regardless of format. The first byte, when using an uplink receiver and 28 bit ids, is a 28-bit ID identifier used by Argos and is not represented in the Apex Data formats included in 28 bit format manuals.

The floats represented in this manual are 20 bit Argos id type.

APPENDIX C: Storage conditions

For optimum battery life, storage temperature range is +10 to +25 degrees C. When activated, the floats should be equilibrated at a temperature between -2 and +54 degrees C.
If optional VOS or aircraft deployment containers are used, these must be kept dry, and should be stored indoors only.

APPENDIX D: Returning APEX for factory repair or refurbishment

Contact WRC before returning APEX floats for repair or refurbishment.
All returns from outside USA, please specify our import broker:
Logan International Airport, Boston
c/o DHL-Danzas Freight Forwarding Agents,
Phone (617) 886-5605, FAX (617) 241-5917
500 Rutherford Avenue, Charlestown, MA 02129

Note on shipping documents: US MADE GOODS

APPENDIX E: CTD Calibration and Ballasting records

(included in hard copy only)