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APEX Final Test Procedure for Controller APF-9I

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Description:
This procedure describes how to manually test an APEX float, using a terminal and the provided interface cable. We recommend that all floats be tested upon receipt and/or shortly before deployment. Also, all input commands, and resulting output from the final test should be recorded in a log for future reference.

Applies to: floats with SeaBird CTD (model 41) and controller board version APF9I.
Note a different procedure is available for controller version APF-8C. Refer to the float user's manual for testing of any additional optional sensors.

1. Connect float to terminal (see appendix 1)

Note this test should be performed with floats equilibrated at room temperature (20 to 24°C). Testing outside this temperature range will not cause damage, but will result in internal vacuum values (see section 4) outside of normal range.

Connect leads and press enter. It is not necessary to swipe the magnet. Press **L** a list of parameters will scroll on terminal screen.

Verify parameters such as the phone numbers and telemetry retry interval (which should be set to fifteen minutes). *Take care not to change any parameters. Contact Webb Research with any questions.*

I. Commands to execute float test functions appear in bold below.

Note commands are not case sensitive.

2. Verify Real Time Clock is set correctly (see appendix 2)

All APF-9I controllers should have the real time clock set to the correct GMT time. Note that the real time clock will be automatically synchronized by GPS, after a communication session with the server. Some optional features require the time to be set.
Command **T (ENTER or date in format "mm/dd/yyyy:hh:mm:ss")**
Note: for display of current time, carriage return is required (use ENTER key)

Example:

> T
Real time clock: Thu Feb 07 14:01:01 2008

If not correct, confirm that the clock is set correctly after a communication session with the server.

3. Test high-pressure pump

Check piston position (**I7** or **ID**). Piston was set to 16 counts (or 100 counts for older firmware) for shipment . Note that the piston may not be at 16 counts (or 100 counts) if float has been reset while not connected to a terminal.

Extend pump (**I6** or **IE**).
You will hear the motor running for a few seconds (press ear to hull if ambient noise is high).
The oil pump will displace 4 counts (approx 4 cc).

Screen display will indicate target count value, then actual piston positions until it reaches the target count. *No commands may be entered while pump is running*.

Retract pump (**I5** or **IR)**
EXAMPLE (Output should look similar to that shown below):

> I 7 Piston position: 100 counts
> I 5 Retracting piston 4 counts.
(Feb 07 2008 14:37:37, 147864 sec) PistonMoveAbsWTO() 100->096 099 098 097 096
[17sec, 15.2Volts, 0.137Amps, CPT:705sec]
> I 7 Piston position: 96 counts
> I 6 Extending piston 4 counts.
(Feb 07 2008 14:38:06, 147892 sec) PistonMoveAbsWTO() 096->100 097 098 099 100
[16sec, 15.1Volts, 0.149Amps, CPT:721sec]
> I 7 Piston position: 100 counts

4. Check internal battery voltage and internal vacuum

Open air valve (**I8** or **IO**)
Check internal vacuum and battery voltage (**C**)

Voltage will be displayed first and should be greater than 15.2

Vacuum will then be displayed in counts. Typical value for Apf-9I controller board internal vacuum is **83 +/- 5** counts (negative 5-6 in/Hg), at room temperature (20 to 24°C).

EXAMPLE:
> I 8 Air valve opened.

> I 1 Running air pump for 6 seconds.
Battery: [198cnt, 15.3V] Current: [67cnt, 270mA]
> C Battery [197cnt, 15.2V] Current [5cnt, 24.2mA] Barometer [83cnt, -6.0"Hg]

Voltage must be 15.2 V or higher.

Vacuum must be greater than 78 and less than 87 counts (5-6 in/Hg).
Vacuum must be less than "ok vacuum threshold" listed in mission parameters.

5. Pneumatic system test

Note: a large change in ambient temperature (such as moving floats from a heated space to cold outdoors) will interfere with this test. Keep floats in stable temperature environment (+/- 2 °C) during this test.

Close air valve (**I9** or **IC**)
Activate air pump (**I1** or **IA**) – this causes pump to run for 6 seconds.

Check air bladder pressure (**C**)
It should be greater than internal vacuum (previously read with command (**C**) by approximately 20 to 30 counts.

Repeat (**I1** or **IA**), followed by (**C**), until vacuum count is 124 or higher.
This should require an additional eight (8) to twelve (12) repetitions of command (I1)

The air bladder will expand after each (**I1** or **IA**) and (**C**).
Vacuum count will remain constant at first, then increase, as shown in example below.

Important: after vacuum count reaches 124, DO NOT repeat command (**I1** or **IA**)

Wait at least five (5) minutes.
Check air bladder pressure (**C**)
Vacuum count should be equal to last measured value, within (-1) to (+2) counts.

If vacuum count has decreased by more than 2 counts, this indicates an air leak – DO NOT deploy float.

Open air valve (**I8** or **IO**).

EXAMPLE: (Output should look similar to that shown below):
> I 9 Air valve closed.
> I 1 Running air pump for 6 seconds.
Battery: [198cnt, 15.3V] Current: [78cnt, 314mA]
> C Battery [197cnt, 15.2V] Current [5cnt, 25.8mA] Barometer [103cnt, -0.2"Hg]
> I 8 Air valve opened.

> I 1 Running air pump for 6 seconds.
Battery: [198cnt, 15.3V] Current: [66cnt, 266mA]
> C Battery [197cnt, 15.2V] Current [5cnt, 24.2mA] Barometer [83cnt, -6.0"Hg]
> I 9 Air valve closed.
> I 1 Running air pump for 6 seconds.
Battery: [198cnt, 15.3V] Current: [77cnt, 310mA]
> C Battery [197cnt, 15.2V] Current [5cnt, 25.8mA] Barometer [103cnt, -0.2"Hg]
> I 1 Running air pump for 6 seconds.
Battery: [197cnt, 15.3V] Current: [77cnt, 310mA]
> C Battery [197cnt, 15.2V] Current [5cnt, 25.8mA] Barometer [103cnt, -0.1"Hg]
> I 1 Running air pump for 6 seconds.
Battery: [197cnt, 15.3V] Current: [77cnt, 310mA]
> C Battery [197cnt, 15.2V] Current [5cnt, 25.8mA] Barometer [104cnt, 0.1"Hg]
> I 1 Running air pump for 6 seconds.
Battery: [197cnt, 15.3V] Current: [77cnt, 310mA]
> C Battery [197cnt, 15.2V] Current [5cnt, 25.8mA] Barometer [105cnt, 0.3"Hg]
> I 1 Running air pump for 6 seconds.
Battery: [197cnt, 15.3V] Current: [77cnt, 310mA]
> C Battery [197cnt, 15.2V] Current [5cnt, 25.8mA] Barometer [106cnt, 0.7"Hg]
> I 1 Running air pump for 6 seconds.
Battery: [197cnt, 15.3V] Current: [77cnt, 310mA]
> I 1 Running air pump for 6 seconds.
Battery: [197cnt, 15.3V] Current: [77cnt, 310mA]
> I 1 Running air pump for 6 seconds.
Battery: [197cnt, 15.3V] Current: [78cnt, 314mA]
> C Battery [197cnt, 15.2V] Current [5cnt, 26.6mA] Barometer [116cnt, 3.4"Hg]
> I 1 Running air pump for 6 seconds.
Battery: [197cnt, 15.3V] Current: [80cnt, 322mA]
> C Battery [197cnt, 15.2V] Current [5cnt, 26.6mA] Barometer [121cnt, 4.9"Hg]
> I 1 Running air pump for 6 seconds.
Battery: [197cnt, 15.3V] Current: [82cnt, 330mA]
> C Battery [197cnt, 15.2V] Current [5cnt, 27.4mA] Barometer [126cnt, 6.4"Hg]
> I 8 Air valve opened.
> C Battery [197cnt, 15.2V] Current [5cnt, 24.2mA] Barometer [83cnt, -6.0"Hg]

6. Test SeaBird CTD

Command (**SS, SP, ST, SN).** Note that you do not need to hit *return* after entering commands.
SS After several seconds terminal will display Pressure, Temperature, and Salinity values.
ST After several seconds the terminal will display Pressure and Temperature.
SP After several seconds the terminal will display Pressure only.**SN** serial number of SBE sensor

EXAMPLE - (some software versions may vary slightly from this example)

> s s SBE41 P,T,S: 0.33 decibars, 23.3539C, 0.0115PSU
> s s SBE41 P,T: 0.33 decibars, 23.3539C
> s p SBE41 P: 0.34 decibars

> s n SBE41 serial number: 2642

P should be zero (+/- 1.5) dbar,
T should be ambient temperature, ℃
S should be approximately zero

You will hear the CTD impeller spin - a low whir.
If the cell is very dry there may be a buzzing sound, this is not a problem. Adding a small amount of deionized water will quiet the impeller.

*Command (**SF)** will display Seabird CTD firmware version and serial number. The specific version may vary, but should be 2.0 for the older version or 3.0 for the newer version.*

> s f SBE41 firmware version: [3.0]

7. Run Self-Test

Verify that the automated Self-Test passes. This test passing is the criteria for starting a mission. If the Self-Test fails, the mission will be aborted. This test consists of an internal pressure tests as well as Seabird communication and configuration checks. A final pass/fail is displayed at the end of the intermediate results. *This test must pass.*

Command (**IS**) will execute the SelfTest. Results are displayed.

> **I S** Executing SelfTest().
< intermediate results display>
Selftest() passed.

8. Hibernate float

Re-verify all parameters and Hibernate (**L** then **Q**)

The float is now dormant, and will begin its programmed mission when reset with magnet. The magnet should be held in place until their is audible indication of mission startup.
Disconnect interface cable.

Example:

>l (see Appendix 1 for example display output)
>q Mission not active - hibernating

- end of procedure –

OPTIONAL Satellite transmission test.

Description: Transmit to Iridium to verify data reception.

Prerequisite: All units have passed this test at factory. Customers may repeat test if they wish.

Place float outside, with clear view of sky, in a secure location.
Connect float to terminal, and start Procom (using 9600 baud-rate).
Make sure that the 'Data / Capture File …' menu option is selected to record all output.
Press the ENTER key to wake the float, then verify response from entering the following commands:

>**c** (to check the battery voltage, current & vacuum)
>**i 7** (to check the piston position)
>**D 3** (to set the logging verbosity to level 3)
>**l** (to check the primary & alternate phone numbers)
>**p** (to check the pressure table)
>**t** (to check the real time clock settings)
>**h i (**to check
>**h s** (to check that the ICCID and MSISDN numbers are correct)
>**e** (to start the mission activation sequence)

The mission activation sequence consists of several stages, including acquiring the current GPS almanac. This may take several minutes in total, during which time the float will attempt to logon to the remote iridium server. If text similar to: "Telemetry cycle complete … ConnectionAttempts=4 Connections=4" is generated (where the connection number may vary) then the satellite transmission test has succeeded. At this point, enter the following:

>**k** (to kill the mission)
>**q** (to exit command mode)

Finally, save the captured file (e.g. float with id 4710 might have the captured file stored under floats\1600s float jobs\1670 CSIRO(66)\logs and manuals\1670.2\Iridium Test\4710.cap).

Appendix 1

CONNECTING A TERMINAL

The user can program and test the instrument, communicating via a 20 mA current loop.
The current loop has no polarity. One conductor is through the hull ground, the other side is via a connector or fitting which is isolated from the hull.

Note: an RS232 to current-loop converter is provided with the communications cable.
This converter requires a 12 VDC supply.

SeaBird CTD sensor:
Attach one alligator clip to the anode, and the other to the pressure port.

Connect the provided comm. cable to computer's RS232 port. Run a communications program such as Procomm or Hyperterminal.

Settings: 9600 N81, full duplex
Flow control: none

Capture a log file to record the communications. If in doubt about a test, email the log file to your chief scientist and/or Webb Research.

Begin communication session by pressing **ENTER**. A message will displayed followed by the command prompt waiting for keyboard input. Use the (**L**) command to list float mission status.Note that specific float firmware versions may vary slightly depending upon the features implemented.
Example:

```
(Aug 14 2009 18:06:10,  146688 sec) Apf9Init()          Asynchronous wake-up detected (ie., wake-up not initiated by alarm signal).
Entering Command Mode [ApfId 6839, FwRev 061709]

>L
APEX version 061709  sn 6839
User: iridium
Pwd:  0xafb3
Pri:  ATD0061362325009                          Mhp
Alt:  ATD0061362325509                          Mha
INACTV ToD for down-time expiration. (Minutes)  Mtc
 13800 Down time. (Minutes)                     Mtd
 00600 Up time. (Minutes)                       Mtu
 00540 Ascent time-out. (Minutes)               Mta
 00360 Deep-profile descent time. (Minutes)     Mtj
 00360 Park descent time. (Minutes)             Mtk
 00360 Mission prelude. (Minutes)               Mtp
 00015 Telemetry retry interval. (Minutes)      Mhr
 00060 Host-connect time-out. (Seconds)         Mht
  2000 Continuous profile activation. (Decibars) Mc
  1000 Park pressure. (Decibars)                Mk
  2000 Deep-profile pressure. (Decibars)        Mj
   066 Park piston position. (Counts)           Mbp
   000 Compensator hyper-retraction. (Counts)   Mbh
   016 Deep-profile piston position. (Counts)   Mbj
   010 Ascent buoyancy nudge. (Counts)          Mbn
   022 Initial buoyancy nudge. (Counts)         Mbi
   001 Park-n-profile cycle length.             Mn
   124 Maximum air bladder pressure. (Counts)   Mfb
   096 OK vacuum threshold. (Counts)            Mfv
   227 Piston full extension. (Counts)          Mff
   016 P-Activation piston position. (Counts)   Mfs
     2 Logging verbosity. [0-5]                 D
  0002 DebugBits.                               D
  1725 Mission signature (hex).
```

If the float is reset while in hibernation, it will begin its programmed mission. In this case, to stop the mission, one must connect the float to a terminal and kill the mission via the (**K**) command.

II. Appendix 2 Command Summary

The following commands are available when a terminal is connected.
This example assumes a SeaBird CTD sensor is installed. The
Menu form may vary slightly depending on float software version and optional sensors.
*Typing "**?**" or "**I?**" will scroll the commands available for verification.*

Menu selections are not case sensitive.
? Print this help menu.
A Initiate pressure-activation of mission.
C Calibrate: battery volts, current, & vacuum.
D Set logging verbosity. [0-5]
E Execute (activate) mission.
F FLNTU module agent.
F? FLNTU module agent menu.
G Get a full P T S O Optics scan.
I Diagnostics agent.
I? Diagnostics menu.
K Kill (deactivate) mission.
L List mission parameters.
M Mission programming agent.
M? Mission programming menu.
O Execute optics measurement.
P Display the pressure table.
Q Exit command mode.
S SeaBird CTD agent.
S? SeaBird CTD agent menu.
T Get/Set RTC time. (format 'mm/dd/yyyy:hh:mm:ss')

Immediate mode test functions.
> I ?
Menu of diagnostics.
? Print this menu.
a Run air pump for 6 seconds.
b Move piston to the piston storage position.
c Close air valve.
d Display piston position
e Extend the piston 4 counts.
g Goto a specified position. [1-254] (counts)
o Open air valve.
r Retract the piston 4 counts.
s Execute the SelfTest().
t Argos PTT test.
z Calculate ToD down-time expiration.
1 Run air pump for 6 seconds (deprecated).
2 Argos PTT test (deprecated).
5 Retract the piston 4 counts (deprecated).
6 Extend the piston 4 counts (deprecated).
7 Display piston position (deprecated).
8 Open air valve (deprecated).
9 Close air valve (deprecated).