

EDS OPC-M2 ACCEPTANCE TEST PROCEDURE

Using the MH EDS OPC ATP Test-Set

REVISION HISTORY

REV.	ECO # yyyy-mm-dd	PREPARED	NOTES
-0	2021-023 2021-05-27	PLM / TD SB / JB / SGO	Derived from ATP- <u>OPC1</u> -00 Rev E (OPC- <u>M1</u> Acceptance Test Procedure): Update for corrections to calibration parameters and amend for OPC- <u>M2</u> ; Re-format and correct sequencing issues; Add Document # and ECO #
-1	2022-004 2022-02-04	PLM / SGO	<u>ADDENDUM</u> Initially released as separate document to be incorporated with existing <i>EDS OPC-M2 Acceptance Test Procedure</i> Manual Revision "-0" (above).
-2	2022-025 2022-08-04	PLM / HBS JB / SGO	Amend Test-Set Calibration procedure • Change "Resp-Hi" setting [p. 4, Step 9]: was <u>5</u> mm H ₂ O, is <u>6</u> mm H ₂ O Incorporate information from Rev "-1" Addendum

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EDS OPC-M2 ACCEPTANCE TEST PROCEDURE

Using the MH EDS OPC ATP Test-Set

Before performing the tests described in this document, the operator should be familiar with the **EDS ATP Test-Set User Manual**. These procedures are derived directly from the information in the Test-Set Manual.

REQUIRED TEST EQUIPMENT

1. Mountain High EDS **OPC ATP Test-Set** with all necessary cables, tubing, and fittings.
The OPC ATP Test-Set incorporates a 60 psig Inlet Pressure gauge (right-hand gauge). (Test-Set with 30 psig Inlet Pressure gauge may be used for EDS O2D1 and O2D2 ATP testing)
2. Mountain High EDS ATP **Test-Fixture** (UUT "dock" with Barometer Probe and Battery Contact connector).
3. Source of clean, dry, breathable compressed air.

Documents Referenced

ATP-EDSx-00 EDS ATP Test-Set User Manual (a.k.a., "Test-Set Manual")

ATP-EDSx-01 *EDS ATP Trouble-Shooting Guide*
(this document does not currently exist – consult with senior service personnel for guidance)

Abbreviations/Conventions used in this manual

UUT	"Unit Under Test" – the individual OPC-M2 unit being tested	
[TPSS]	"Test Phase Selector Switch" – Center rotary test-selector switch on Test-Set	
[Start/Stop]	Red button near center of Test-Set front panel	
[SK]	Yellow "Soft Key" button near center of Test-Set front panel	
1/2/3 (a/b/c)	Enumerated lines indicate operator actions	
<i>Italics</i>	Comments or other notes for informational purposes only – no action required	
Bold	Emphasized text indicates parameter values or other information to be carefully distinguished	
<u>Bold underline</u>	Control-switch settings (Test-Set or UUT)	
Test-Set display:	<table border="1"><tr><td><Test-Set Display> <Test Phase Info></td></tr></table> Grey-shaded box mirrors Test-Set display (generally in response to operator actions)	<Test-Set Display> <Test Phase Info>
<Test-Set Display> <Test Phase Info>		

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TEST PHASE ONE (1)

Test-Set Configuration and Calibration

This calibration step only needs to be performed once for each lot of units tested (unless more than 4 hours has passed since testing begun – see Test-Set Manual)

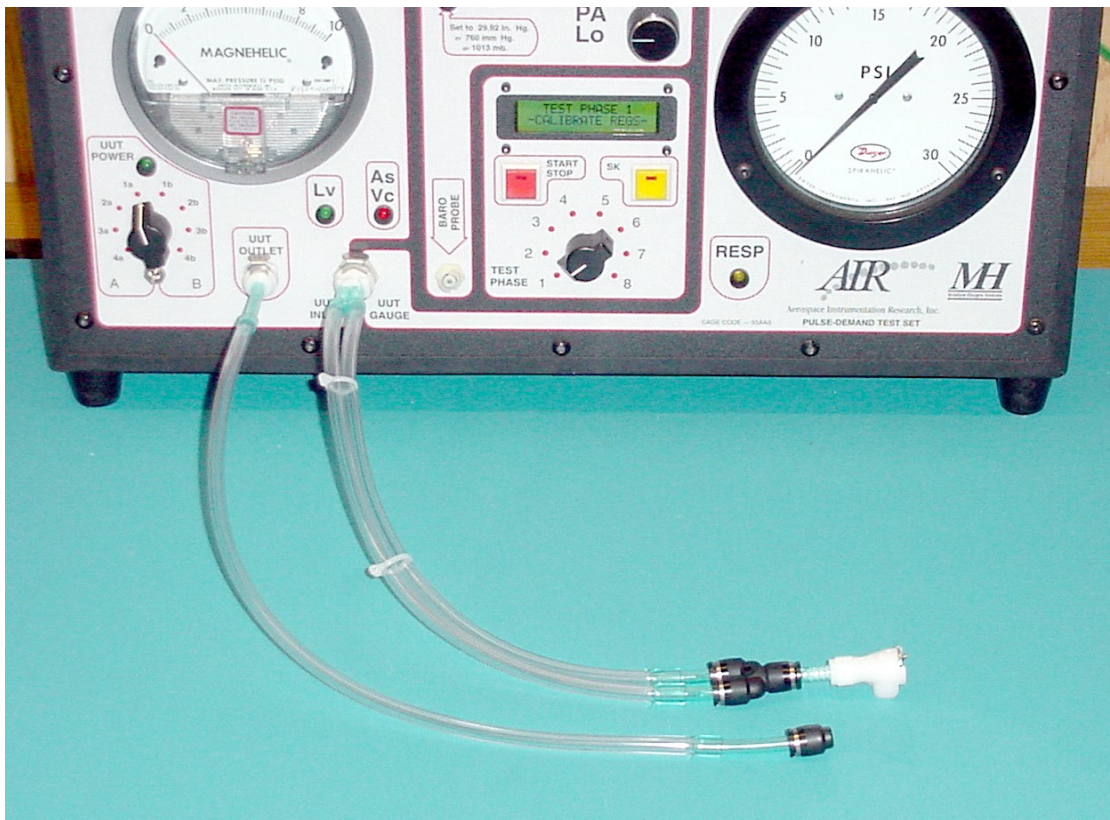
Subsequently, all testing of units in a lot shall begin at **TEST PHASE TWO (2)**.

Test-Set Configuration

1. Connect Test-Set to clean, dry air supply @ **50 - 75 psig (60 psig typical)**.
2. Turn on Test-Set (*right rear of enclosure*)
3. Turn on air supply
4. Connect Test-Fixture UUT Battery-contact power connector to Test-Set.
5. Connect Test-Fixture UUT Barometer Probe tubing to Test-Set.
6. Install 6mm tube-cap onto the Test-Set UUT outlet tube as shown.
7. Install CPC adapter fitting into the Test-Set UUT inlet tube fitting as shown.

If the CPC fitting does not incorporate an internal check-valve, then an additional plug will be required.

note: illustration shows CPC fittings installed on O2D1/O2D2 ATP Test-Set (30 psig Inlet Pressure gauge)



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Test-Set Calibration

8. Set [TPSS] to **TEST PHASE 1:**

Test Phase 1
-CALIBRATE REGS-

9. Press Red [Start/Stop] button:

Calibrate: 1a
SET Hi REGS

(a) Set **Resp-Hi** → 6 mm H₂O

(b) Set **Reg-Hi** → 40 psig.

10. Press flashing Yellow [SK] button:

Calibrate: 1b
SET Lo REGS

(a) Set **Resp-low** → 2 mm H₂O

(b) Set **Reg-low** → 20 psig.

(continued on next page)

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11. Press flashing **Yellow [SK]** button:

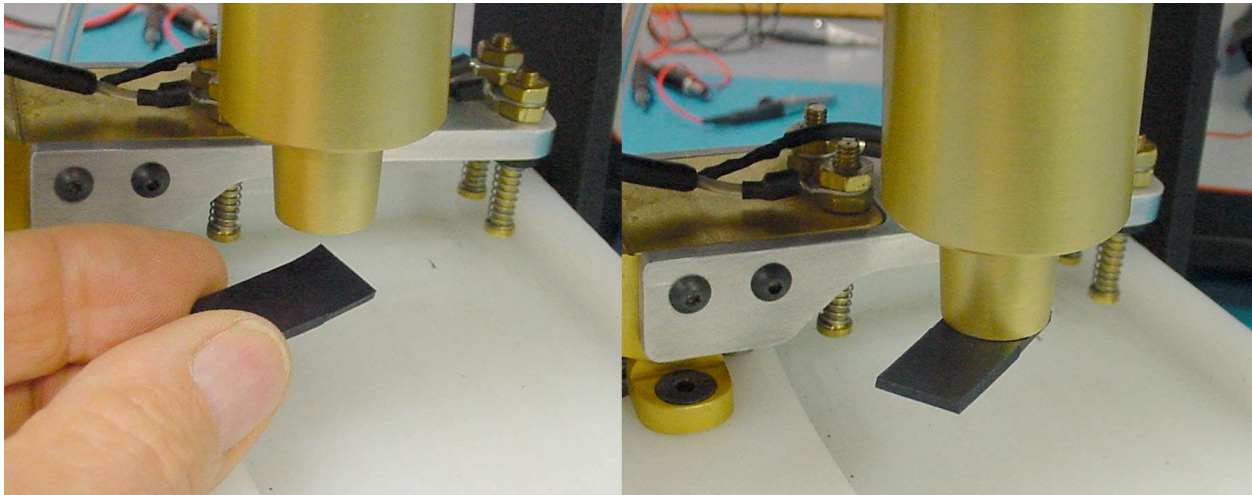
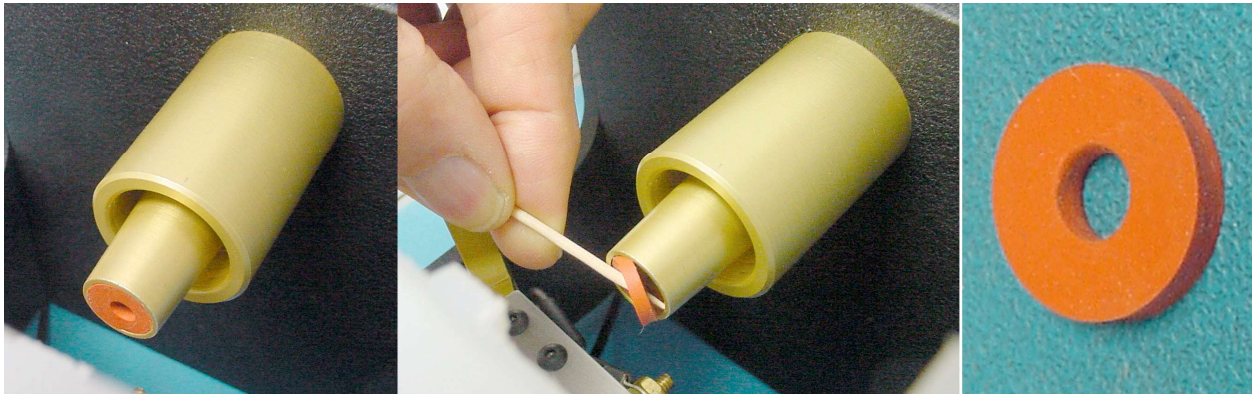
Calibrate: 1c Set PA High
--

- (a) Plug the Test-Fixture Barometer Probe with your finger or rubber pad.
- (b) Verify Altitude Gauge is set to **1013 mbar**.
- (c) Set **PA-Hi** → **8,200 ft** (*Pressure Altitude*).

Inspecting the Barometer-Probe

It may be necessary to inspect the silicone sealing-pad embedded in the Barometer-Probe. It must be clean and have no cuts or chips on either side of the pad.

Note that actual seals may differ in color from that depicted.



12. Press flashing **Yellow [SK]** button:

Calibrate: 1d Set PA Low

- (a) Set **PA-Low** → **7,000 ft** (*Pressure Altitude*).
- (b) Press flashing **Yellow [SK]** button to end test.

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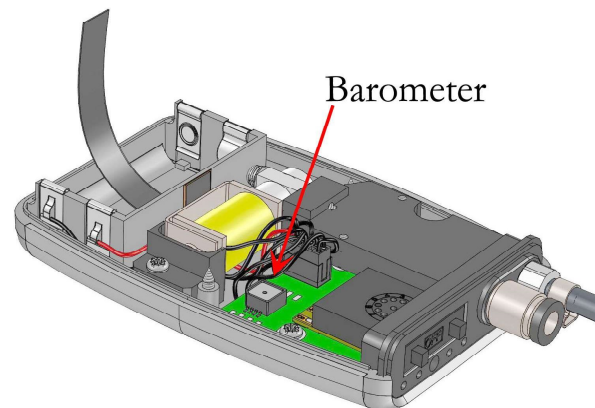
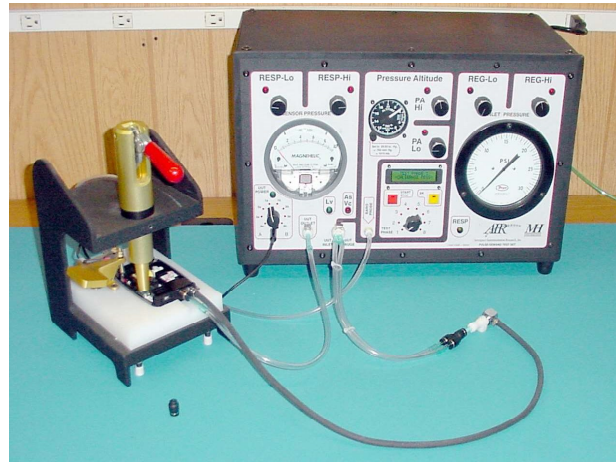
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TEST PHASE TWO (2)

Leak & Weep Test

1. Prepare UUT (Unit Under Test) for testing.
 - (a) As required, remove front cover from UUT so that the Barometer Sensor is exposed.
 - (b) Verify Barometer Probe has proper seal-washer. *(different washers are required depending on which Barometer device is installed on PCB)*
 - (c) Install UUT into Test-Fixture as follows:
 - (i) Raise Barometer Probe
 - (ii) Hold Battery-Contact Arm open and place UUT into Test-Fixture. Verify that UUT is properly seated (flat/level).
 - (iii) Release (lower) Battery-Contact Arm and verify that it is properly engaged with UUT battery contacts
 - (d) Connect Test-Set inlet & outlet tubing to UUT.
 - (e) Lower the Barometer Probe into place against the UUT Barometer Sensor. Verify that all wires are out of the way and that the Probe seats flat and centered on Barometer.

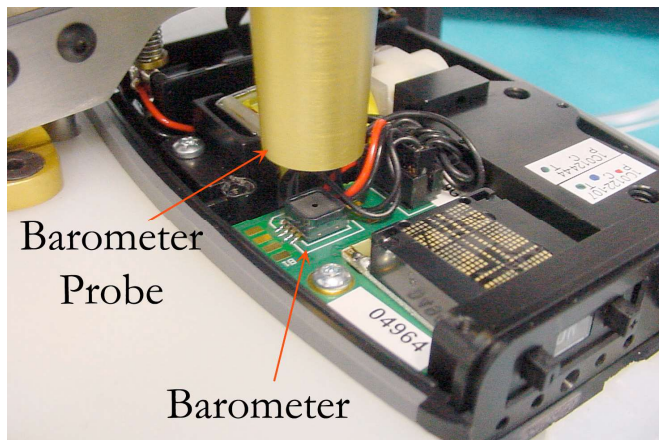
The mode-selector switch on the UUT should remain in the **OFF** position throughout the duration of this test phase.



Locating the Barometer


Engaging the Barometer-Probe


Make sure that all wires are held well clear when engaging the Barometer-Probe. Also make sure that the UUT is properly seated into the test fixture so that the Barometer-Probe engages the Barometer as squarely as possible, meaning well-centered over the Barometer and normal ("flat") to the surface of the Barometer.



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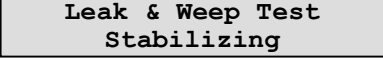
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2. Set [TPSS] to **TEST PHASE 2:** 

3. Press **Red [Start/Stop]** button: 

When **> 4 mm H₂O** is reached ...

Gauge will eventually climb to 5 mm, but will take some time. Test may proceed as soon as 4mm is reached.

4. Press flashing **Yellow [SK]** button: 
(the reading will drop slightly)

Leak & Weep test will pause for a few seconds to stabilize and then automatically begin "counting-down".

The display should show: 

Gauges should lock and hold during this test count-down, otherwise the UUT is leaking.

Press the **Yellow [SK]** button to pause the test; press again to resume (toggle).

(This is generally reserved for diagnostic purposes)

The left gauge should not climb or decay. If it climbs, the valve in the UUT is weeping through from the inlet to the outlet. If it drops, the valve is holding, but there is a leak in the breathing side of the circuit.

The right gauge should not decay. If it drops, there is a leak in the inlet side of the circuit and the valve seat is weeping or there is a leak at the valve O-ring, inlet hose or fittings.

Test will terminate automatically after the count-down is done.

See Trouble-Shooting Guide if leaks are found.

- (a) Record results.

If this test phase is passed, or if the situation can be rectified without technical assistance, then proceed to the next test phase.

Otherwise, set unit aside for trouble shooting.

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TEST PHASE THREE (3)

Respiration Sensitivity Thresholds

The UUT mode-selector switch should be in the **OFF** position before starting this test.

1. Set [TPSS] to **TEST PHASE 3:**

Test Phase 3
Resp Thresholds

2. Set Test-Set UUT power selector switch to position **2a**.

*Note that the Test-Set may also be used to test/verify low-battery threshold operation.
(refer to supplementary documentation or consult with senior service personnel for more information)*

3. Set UUT mode-selector switch to **F20** Position.

Verify unit power-up (*six flashes of the Green O2 and Battery LEDs along with three audible Beeps*).

TEST PHASE THREE (3) - Sub-Phase "a" (Resp High)

4. Press **Red [Start/Stop]** button:

Test Phase 3a
Resp High

UUT should begin responding to respiration pulses issued by the Test-Set.

Note slight pressure drop each time the unit triggers (approx. 2 to 5 psig)

5. Set UUT mode-selector switch to **R/M** position.

Note increase in pressure drop (approx. 8 to 10 psig)

- (a) Verify that the Green O2 LED on the UUT flashes in response to each respiration pulse.
- (b) If the UUT is not responding, then the sensitivity is too high and the unit may need to be re-calibrated. See the Trouble-Shooting Flow-Chart & Guide.

TEST PHASE THREE (3) - Sub-Phase "b" (Resp Low)

Leave UUT mode-selector switch in **R/M** position.

6. Press **Yellow [SK]** button:

TEST PHASE 3b
Resp Low

- (a) UUT now should NOT respond to respiration pulses issued by the Test-Set.
- (b) Verify that an Apnea Alarm is triggered (*4 Flashes of Green O2 LED*). This should occur within 32 Sec. (*between 4 to 8 breaths*). There will be no sound during an Apnea Alarm.
- (c) If UUT responds, then the sensitivity is too low and the unit may need to be re-calibrated. See the Trouble-Shooting Flow-Chart & Guide.
- (d) Record results.

Notes:

- Resp High / Resp Low test-phase is toggled each time **Yellow [SK]** button is pressed.
- The **Resp** indicator light on the Test-Set will illuminate each time a respiration pulse is issued.
- The dip in the pressure gauge is for reference purposes only and not a calibrated test value. See the EDS ATP Test-Set User Manual sections "Test Phase 3" and "Test Phase 6".

If this test phase is passed, or if the situation can be rectified without technical assistance, then proceed to the next test phase.

Otherwise, set unit aside for trouble shooting.

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TEST PHASE FOUR (4)

Flow-Fault Test

Set UUT mode-selector switch to **R/M** position.

1. Set [TPSS] to **TEST PHASE 4:**

Test Phase 4 Flow-Fault Test

 - (a) Allow right side gauge to drop all the way to zero before starting test.

2. Press **Red [Start/Stop]** button:

Test Phase 4a Testing
--

 - (a) UUT should respond with a Flow Fault (*no O2 supply*).

Green O2 light should flash rapidly indicating a Flow Fault.
There will be no sound during a Flow Fault Alarm.

The Flow Fault may not trigger during the first initial pulses. It could take 1 to 10 respiration pulses to exhaust enough air from the inlet tube to reduce the inlet pressure enough to create a Flow Fault condition.

- (b) Record results.

If this test phase is passed, or if the situation can be rectified without technical assistance,
then proceed to the next test phase.

Otherwise, set unit aside for trouble shooting.

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TEST PHASE FIVE (5)

Pressure Altitude Barometer Testing and 'D' Modes

1. Set [TPSS] to TEST PHASE 5:

Test Phase 5
D Mode PA Test

TEST PHASE FIVE (5) - Sub-Phase "a" (PA High)

2. Press **Red [Start/Stop]** button:

Test Phase 5a
Test PA High

3. Set UUT mode-selector switch to **OFF** position.

- (a) Altimeter should read as close as possible to **8,200 ft.**
If this cannot be achieved, then check the Test-Fixture Barometer Probe seal for leaks.
- (b) Move UUT mode-selector switch to **ON** position.
- (c) UUT should respond to each respiration pulse issued by the Test-Set.
- (d) Note gauge drop and **Resp** light on tester.

TEST PHASE FIVE (5) - Sub-Phase "b" (PA Low)

4. Press **Yellow [SK]** button:
(*toggles between sub-phases*)

Test Phase 5b
Test PA Low

- (a) Altimeter should read as close as possible to **7,000 ft.**
If this cannot be achieved, then (as above) check the Test-Fixture Barometer Probe seal for leaks.
- (b) Unit **MUST NOT PULSE** (*being below the preset Pressure Altitude activation point*).
Note that the UUT may continue to pulse for as long as 70 seconds after the drop in Pressure Altitude.
- (c) Record results.

Note:

- PA High / PA Low test-phase is toggled each time **Yellow [SK]** button is pressed.

If this test phase is passed, or if the situation can be rectified without technical assistance, then proceed to the next test phase.

Otherwise, set unit aside for trouble shooting.

NOTICE OF DEVICE BEHAVIOUR THAT AFFECTS TESTING

The OPC-M2 has a very accurate, sensitive barometer that provides an averaged pressure altitude reading once every 16 seconds. These readings are then further filtered by the use of a four (4) sample running-average queue which results in a stable settling time in response to a pressure altitude change in roughly 64 seconds.

Consequently, during the **"D" Mode PA Tests**, the operator may need to wait at least 64 seconds before any large pressure altitude changes applied to the UUT are filtered out and the UUT is able to respond to the applied PA values called out in the test procedure.

This delay may be circumvented for the convenience of testing by taking advantage of the fact that each control switch transition initiates a new barometer reading and updates the running-average queue. Therefore, the operator could perform four (4) control switch transitions (changes) between the **"ON"** and **"R/M"** positions (concluding in the **"ON"** position) in order to bypass the normal 64-second settling window. In other words: **"ON", "R/M", "ON", "R/M", "ON"**.

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TEST PHASE SIX (6)

Asymptotic Test

1. Set [TPSS] to **TEST PHASE 6:**

Test phase 6
Asymptotic Test

2. Set UUT mode-selector switch to **OFF** position.

Important: this step allows the Barometer Sensor to reset to the correct pressure reading when the UUT is restarted.

3. Press **Red [Start/Stop]** button:

Asymptotic Test
-Check Regs-

- (a) The inlet pressure to UUT should read **20 psig** (adjust if necessary).
(b) The altimeter should read **8,200 ft** (adjust if necessary).

4. Set UUT mode-selector switch to **ON** position (*restart*).

- (a) Verify unit power-up. Operator should observe:
- Six flashes of the Green O2 and Battery LEDs.
 - Three audible Beeps.
 - Gauge-dip.

This verifies that the UUT is responding and ready for this test.

- (b) Before proceeding, allow the inlet pressure to re-stabilize at 20 psig (after the observed gauge-dip),

5. Press flashing **Yellow [SK]** button:

Asymptotic Test
Stabilizing

Asymptotic test will pause for a few seconds to stabilize and then automatically begin "counting-down".

The display should show:

Asymptotic Test

"Decaying Bars" depict the test "count-down".

*Pressing the **Yellow [SK]** button during the count-down will pause the test.*

At the conclusion of the test (after eight (8) breaths) the display will prompt for the final reading.

The display should show:

TEST PHASE 6
- Final Reading -

*The inlet pressure gauge should read **12 to 15 psig** at the conclusion of the test.*

- (a) Record final reading.
(b) Press **Red [Start/Stop]** or **Yellow [SK]** button to terminate test.

If this test phase is passed, or if the situation can be rectified without technical assistance, then proceed to preparation for product release.

Otherwise, set unit aside for trouble shooting.

Notes:

- **TEST PHASE SEVEN (7)** is currently reserved.
- **TEST PHASE EIGHT (8)** is for general diagnostics and system confidence testing.

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NOTES