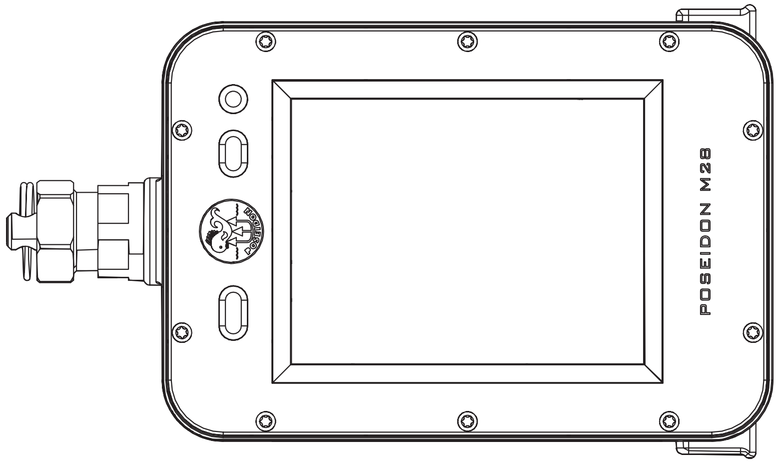
POSEIDON SE7EN

Appendix 3, version 1.2



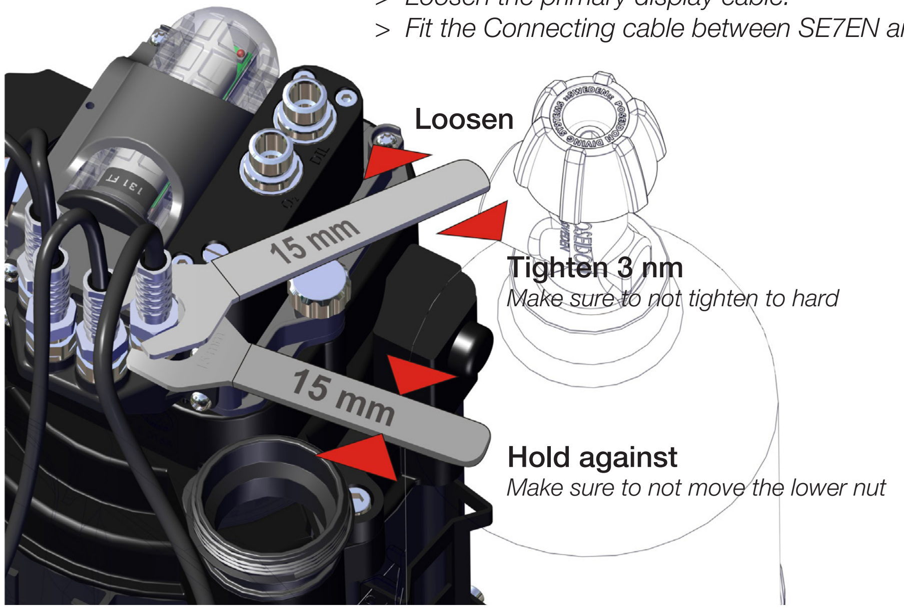
SE7EN connected to M28

Appendix 3 - SE7EN connected to M28
Pre-dive procedures

The Poseidon SE7EN is a compact and very powerful life-support system that offers an unprecedented new experience in recreational or technical diving. But it is also a complex assembly of high technology that includes sensors, actuators, computers, and software that need to operate reliably in an underwater environment, for the important purpose of keeping a diver alive and healthy. For the same reasons that good pilots use pre-flight checklists to ensure their flying machine has a high probability of successful take-off, flight, and landing; so does the rebreather diver need to formalize the process leading up to a dive. The SE7EN design team has gone to extraordinary measures to automate the pre-dive procedure and the operation of the rig during a dive. This chapter explains the pre-dive test procedures, including manual actions that are required by the user, and how to interpret the results of the automated tests, should any of them fail to complete successfully.

How to connect M28 to SE7EN rebreather with Connecting cable.

> *Loosen the primary display cable.*
> *Fit the Connecting cable between SE7EN and M28.*



! DANGER:
Failure to properly and completely conduct the Pre-Dive tests and to ensure that the rig is operating correctly could lead to permanent injury or death. Do NOT skip the Pre-Dive Procedure. Your life depends on it.

Initial Pre-dive procedures

Gas supply cylinders

Before the dive, make sure there is enough diluent (air) and oxygen to carry out the dive you plan to do. The EU version of the Poseidon SE7EN comes with a 3-liter / 183-cubic inch aluminum diluent (air) cylinder (with black valve knob) with a rated fill pressure of 204 bar / 2958 psi. Filled to its maximum allowed working pressure, it holds 612 liter / 21.6 cubic feet of air. Because this cylinder is your open-circuit (OC) bailout gas in the event of an emergency, Poseidon strongly recommends that this cylinder be full at the start of each dive. The included oxygen cylinder (white valve knob) has the same capacity and pressure rating as the diluent cylinder, but the recommended maximum filling pressure of oxygen is limited to 135 bar / 2000 psi for reasons of fire safety.

Attach both the diluent and oxygen cylinders using the procedures described in Chapter 1. Do not turn the cylinders valves on initially, as this will result in wasted gas during certain portions of the pre-dive tests. As described below, the cylinders should be turned on when the pre-dive checks reach Test number 44 and 45. The pre-dive tests will fail if the pressure in the diluent cylinder is less than 51 bar / 739psi, or the oxygen cylinder is less than 34 bar / 493 psi. Similarly, if starting a dive with only a marginal amount of gas above these minimum safety limits, these gas pressure limits will be reached soon after the start of the dive, leading to an unsatisfying diving experience.

CO_2 Absorbent Cartridge

Follow the procedures described in Chapter 1 for installation of a new SofnoDive® 797 CO_2 absorbent cartridge. When conducting a repetitive dive, it's critical to keep track of the hours of personal use for the cartridge once it is installed. The absorbent cartridge must be changed whenever the oxygen cylinder is re-filled. While many people experience a strong reaction to CO_2 buildup (as would result from diving with a depleted or missing cartridge) in the form of un-naturally rapid breathing rate, disorientation and the onset of a strong headache, some people do not experience these symptoms. Do not risk CO_2 poisoning! Change the cartridge every three hours of use or whenever the oxygen cylinder is recharged, whichever comes first.

!

WARNING:
Always replace the CO_2 Absorbent cartridge with a new, un-used absorbent cartridge whenever the oxygen cylinder is re-filled. This will minimize the risk of CO_2 poisoning!

Intact Breathing Loop Verification

Inspect all breathing-hose connections to ensure that they are properly attached. The attachment nuts should be hand tight and the nuts should be screwed down flush against the receiver manifolds in all 8 locations (two at the top of the gas processor; four at the shoulder ports; and two at the mouthpiece). Also at this time, make sure the right counterlung dump valve is fully closed (turned all the way clockwise). This is important for the pre-dive routine that automatically follows power-up.

Negative-Pressure Loop Test

Before powering-up the electronics, it is important to check the integrity of the breathing loop. A positive-pressure loop test is conducted later on, as part of the normal power-up and automated pre-dive test procedure. However, it is possible that some leaks in the breathing loop will fail only when the external ambient pressure exceeds the pressure inside the breathing loop (and thus will not be detected during a positive-pressure loop test). For this reason, it is important to conduct a manual negative-pressure loop test before starting a dive.

To conduct a manual negative-pressure loop test, first secure the exhalation counterlung overpressure checkvalve by tightening it inward to its full extent using a clockwise rotation (when viewed standing in front of the valve and looking at the valve). Place the mouthpiece switch lever to closed-circuit (CC) position and inhale any residual gas within the breathing loop, exhaling it through the nose to remove it from the breathing loop. Repeat this procedure several times until you have pulled as strong a vacuum on the breathing loop as you can, and then quickly switch the mouthpiece to OC position to hold the vacuum inside the breathing loop. The breathing hoses will contract until no more breathing gas can be pulled from the loop.

With the mouthpiece in the OC position, observe over a period of a minute or two whether the breathing hoses expand from their contracted state, and the counterlungs show signs of relaxing or inflating slightly. If they do, then there is a leak somewhere in the breathing loop. This could be caused by any number of reasons including but not limited to any of the following:

- Improper hose connection (hose not connected or incompletely connected)
- Missing or failed o-ring in a hose connection or a Shoulder Port connection
- Tear in a counterlung or hose
- Failed overpressure checkvalve
- CO_2 cartridge lid not in place; or o-rings damaged or missing
- Mouthpiece o-rings damaged or missing
- Cracks into the O-rings for the eModule

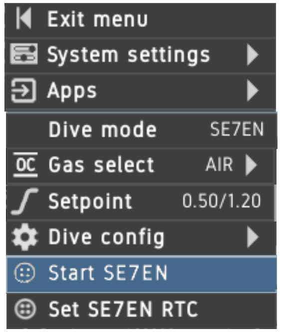
!

IMPORTANT:
The functionality of a fully closed-circuit rebreather depends upon an air-tight breathing loop. Do NOT dive the rig until it passes the negative loop pressure test.

Electronics Power-Up

Insert the battery following the procedures described in Chapter 1, which will automatically power-up the electronics. If the battery is already inserted, the electronics can be powered-up by following the instructions under the header M28 power up.

SE7EN Power-Up through the M28



The M28 can be individually powered-up by a brief push at both buttons simultaneously (Figure 2-1), the SELECT command, a green LED vill become visible, followed by a Poseidon welcome screen and further to the “land veiw”. Use the two buttons to navigate to the app “Dive” . Select “Dive mode” and further select “Start SE7EN”. The electronics will now initiate the pre dive test (Figure 2-3) if the battery is inserted into the SE7EN. Please consult the M28 main manual for further information concing menus etc.

What happens next depends on how the system is initially powered up. If it is powered-up by battery insertion with a turned on M28, then the first screen displayed shows the SE7EN mode display (Figure 2-2) for a few seconds before switching automatically to initiate the PreDiveTest mode. (Figure 2-3). The firmware version number is shown in the upper left area underneath the open circuit bail out icon together with the unit serial number. Because the SE7EN and the M28 are designed to accept firmware updates, knowing the specific version number of the firmware is extremely important when diagnosing problems.

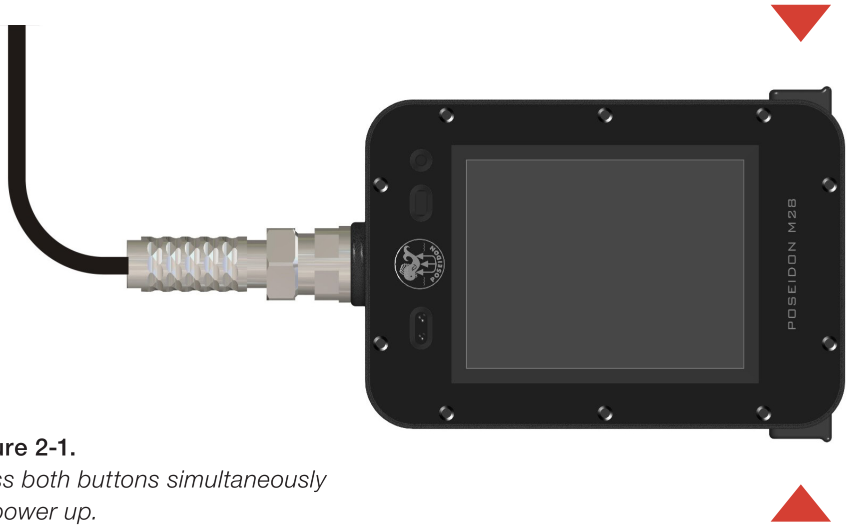


Figure 2-1.
Press both buttons simultaneously for power up.

Button function

Press enter to menu,
scroll up or down and press enter to select.

On no choice after 30 seconds, it returns to the previous view.

DOWN

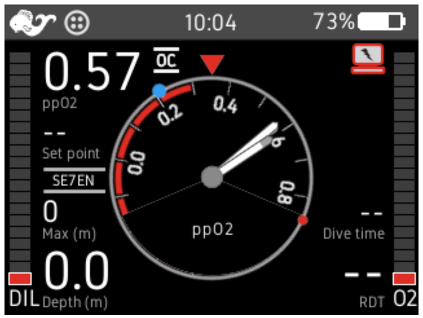


Figure 2-2. *Initial display during a few seconds before the M28 enters the PreDiveTest mode, regardless of previous mode.*

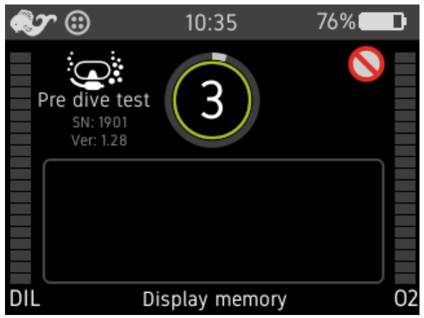


Figure 2-3. *PreDiveTest display where the number in the circle represents the test number together with an explanatory text at the bottom of the screen.*

The Poseidon SE7EN electronics system conducts over fifty automated and semi-automated tests during the pre-dive routine. This procedure verifies a wide variety of parameters, and takes about three minutes to complete. A full description of all of the tests is included in Appendix 1 of this Manual, but a general description – including tests that require intervention – is included here.

Note that if the depth is greater than zero, the system automatically shifts into Dive Mode, and alerts the diver to abort the dive due to a failure to complete the pre-dive routine.

!

DANGER:
Do not attempt to breathe on the Poseidon SE7EN during the automated pre-dive routine. Oxygen control is disabled during portions of this routine, so doing so involves a risk of hypoxia. Do not attempt to conduct a dive until the system has successfully completed the pre-dive routine.

Power-up self test (Test 1 - 38)

The first series of tests (numbers 1–38) are referred to as Power-Up Self-Tests (or PSTs). They are internal checks on the functionality of all of the various sensors, computers, actuators, and alarm systems in the Poseidon SE7EN. You will see and hear the rig as it tests the HUD light and vibrator, and the battery lights and speaker systems. Similarly, you may also hear the rig opening and closing some of the gas control valves. A very brief summary of these PSTs is as follows:

- Test 1: Confirms the main data logger is functional
- Tests 2–9: verify the ROM, RAM and EEPROM function in all four processors
- Test 10: verify the Bluetooth functionality
- Test 14: Confirms the battery data logger is functional
- Test 15: Confirms the firmware version is consistent across all four processors and with M28 unit.
- Test 16: Confirms the power consumption calculations are functioning properly
- Tests 17–20: Confirm the power-draw of the backlight and alarms are correct
- Test 22: Vibrator current test
- Test 23: Mouthpeice CC test
- Tests 24-27: Solenoid current test
- Test 29: Speaker current test
- Tests 30-31: Cylinder HP sensor validation
- Tests 34-35: PO_2 sensor validation test
- Test 38: Depth/temperature sensor validation

Test numbers 1–16 conduct precise measurements of the power consumption of individual components, such as the various alarms and solenoid valves. While the test is running, the test number is displayed in the circle, and the outer circle represents a progress bar. The thin inner green circle represents the remaining time available for each individual test to complete before it times out. Different tests require different amounts of time to complete; some require less than one second, others require 4–12 seconds to complete. Certain tests that involve some action by the diver allow for up to 2 minutes to complete, if necessary.

Figure 2-5. *Test 17 (Backlight Power consumption), displaying test number in the center circle, progress is shown through the inner green circle moving counter clockwise.*

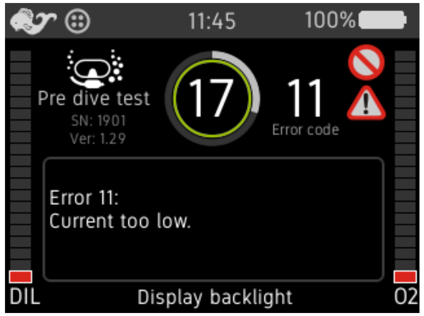


Figure 2-6. *Test 17 failure, with flashing error code.*

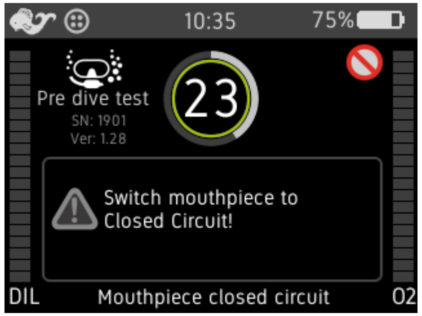


Figure 2-6B.

Closed Circuit mouthpiece position (Test 23)

Test 23 (mouthpiece CC position test) is automatically passed provided the mouthpiece was left in the CC position following the previous steps. If, for some reason, the mouthpiece is not in the CC position when Test 23 appears on the screen, the audio alarm with two frequency tones will activate and a message prompting the diver to switch the mouthpiece to the CC position (Figure 2-6B). The system allows the diver up to two minutes to make this switch. The "Closed-Circuit" icon will continue to display until Test 43, when the mouthpiece needs to be switched to the open-circuit (OC) position.

If the mouthpiece appears to be in the closed-circuit position, but Test 23 does not pass, then make sure that the mouthpiece switch is fully in the CC position. If the test still will not pass, then make sure the HUD is positioned correctly on the mouthpiece, and is not twisted or otherwise moved from its proper position. If no amount of repositioning of the mouthpiece lever or HUD allows the system to pass Test 23, then contact an authorized Poseidon Service Center.

Two things are worth noting in Figure 2-5. First, the inner green circle indicating how much time remains before the PST is complete, or how much time is left for the diver to complete some required action. Second, the icon with the diagonal line through it in the upper-right corner of the screen is the "Do Not Dive" symbol, which is displayed throughout the entire pre-dive process. As long as this symbol is displayed, the dive should not be started.

If a test fails, the routine is halted at the failed test, an error code is shown to right of the circle containing the test number. In the box below the circle a text message tells the reason for the failed test and the user will be prompted to shut down the unit of not by pressing either of the buttons for YES or NO. (see Figure 2-6). If the wet-switch is connected (i.e., wet), then the rig will not power-down, and the system will inject excessive oxygen intermittently, in case a diver is breathing on the loop.

When one of the PSTs fails, consult Appendix 1 to understand further what the failed test means. In most cases, the first thing to try is to run the automatic pre-dive routine again by following the the steps under electronics power up on page 92. If the same test fails again with the same error code, power down the electronics, then eject and re-seat the battery (see Chapter 1). If the automatic pre-dive routine persistently fails any of these tests, contact a Poseidon Tech Center for assistance. In general, repeated failure of any one of these automated tests indicates a problem with the Poseidon SE7EN that will not be serviceable by the user.

!

DANGER:
Do not attempt to conduct a dive until the system has successfully completed all of the pre-dive tests. Diving in spite of a failed pre-dive test is extremely dangerous, and could lead to serious injury or death.

Pre-Dive Tests

Once the PST has completed the SE7EN enters Pre-Dive mode.
A very brief summary of these pre dive tests is as follows:

- Test 40: Decompression status verification
- Test 41: Scrubber installed confirmation
- Test 43: Mouthpiece OC test
- Tests 44-45: Sufficient oxygen and diluent to go diving test
- Test 48: Sufficient battery power to go diving test
- Test 49: Positive pressure loop test (PPLT)
- Test 50: Mouthpiece CC test
- Test 53: O2 calibration test
- Test 54: Open Circuit regulator test
- Test 55: Service interval test

Tissue tension (Test 40)

As discussed in Chapter 1, the Poseidon SE7EN stores decompression data in two places: the battery, and the main backpack computer. This allows a diver to switch to a spare battery while maintaining decompression in the rebreather unit, or switch rebreather units and transfer the active decompression data with the battery.

Test 40 (Tissue Tension Test) compares the stored decompression information in both the battery and in the main backpack computer. If the two decompression states do not exactly match exactly test 40 will fail. Failure of this test is a notification to the diver that the system has detected this discrepancy between the two sets of decompression data. This discrepancy will be displayed on the screen in the message area, and the diver will be prompted to acknowledge the error.

> **!**
> **IMPORTANT:**
> **It is always best to make sure that the decompression data is consistent between the battery and the rebreather. Confirming a deco reset in the pre-dive routine following a failure of Test 40 will likely lead to reduced allowable dive time on the next dive (depending on the nature of the data discrepancy).**

If the change of battery is intentional the diver can confirm this by pressing the YES button, the system will resolve the decompression difference by selecting the most conservative value for each compartment of the decompression algorithm. If it is not intentional, the diver should press the NO button and then re-start the pre-dive routine with the correct battery installed.

Canister Good confirmation (Test 41)

When using the SE7EN, test 41 requires the user to confirm by the wet switch wet/dry sequence that:

A They have a canister installed

B It contains sufficient unused absorbent to complete the dive.

Figure 2-6C.
Test 41 (Canister Good confirmation).

On the M28, this becomes visible on the display (figure 2.6C) when the question 'Have you installed a good Canister?' is shown on the screen. The diver is then prompted to select "YES" or "NO" by pressing the appropriate button. NOTE: This test is not automatic and is intended as a reminder for the diver. By confirming test 41, the diver acknowledges that he/she has installed a canister prior to powering up the Poseidon SE7EN.

Open circuit mouthpiece position (Test 43)

Test 43 (mouthpiece OC position test) is automatically passed provided the mouthpiece was left in the OC position following the previous steps. If, for some reason, the mouthpiece is not in the OC position when Test 43 appears on the screen, the audio alarm with two frequency tones will activate and the text "Switch mouthpiece to Open Circuit" will appear in the information field (Figure 2-7). The system allows the diver up to two minutes to make this switch. The "Open-Circuit" icon will continue to display until Test 50, when the mouthpiece needs to be switched to the closed-circuit (CC) position.

If the mouthpiece appears to be in the open-circuit position, but Test 43 does not pass, then make sure that the mouthpiece switch is fully in the OC position. If the test still will not pass, then make sure the HUD is positioned correctly on the mouthpiece, and is not twisted or otherwise moved from its proper position. If no amount of repositioning of the mouthpiece lever or HUD allows the system to pass Test 43, then contact an authorized Poseidon Service Center.

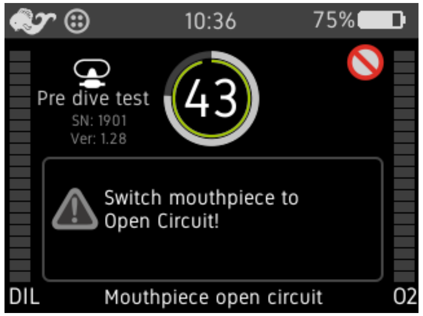


Figure 2-7.
Test 43 Switch mouthpiece to OC position, displaying information to the user that the mouthpiece must be placed in the Open-Circuit position.

> **!**
> **IMPORTANT:**
> **Do NOT adjust the mouthpiece position again after completing Test 43, until instructed to do so at Test 50. In order to complete Test 49 (positive pressure loop test) successfully, the mouthpiece must remain in the Open-Circuit (OC) position.**

Oxygen and diluent cylinder supplies (Test 44 & 45)

Tests 44 and 45 determine whether the Oxygen and Diluent cylinders, respectively, are turned on and have sufficient gas to conduct a dive. Following proper procedure, both cylinders will have been in the off position when Test 44 is reached (if not, gas will be wasted during Tests 24–27, which verify that the four solenoid valves draw the correct amount of power when held open).

Each of these two tests will allow up to two minutes to turn on each cylinder. The bottom one, two, or three segments of the respective cylinder pressure bar graphs will flash until sufficient pressure is detected (Figure 2-8). When the system detects sufficient oxygen pressure, it then waits until it detects sufficient diluent pressure. Provided the oxygen cylinder pressure is greater than 34 bar / 493 psi, and the diluent pressure is greater than 51 bar / 739 psi, the automated pre-dive check will pass and the pre-dive test routine will continue. There is no upper limit for cylinder pressures for these two tests. However, it should be noted that the high-pressure sensors themselves have an upper limit to the pressure they can correctly read. The high-pressure sensor for the oxygen cylinder is limited to 207 bar / 3097 psi, and the sensor for the diluent is limited to 300 bar / 4410 psi. Exposing either sensor to a pressure in excess of these limits may yield unpredictable results. Also, oxygen pressures in excess of about 135 bar / 2000 psi pose a substantially increased risk of fire.

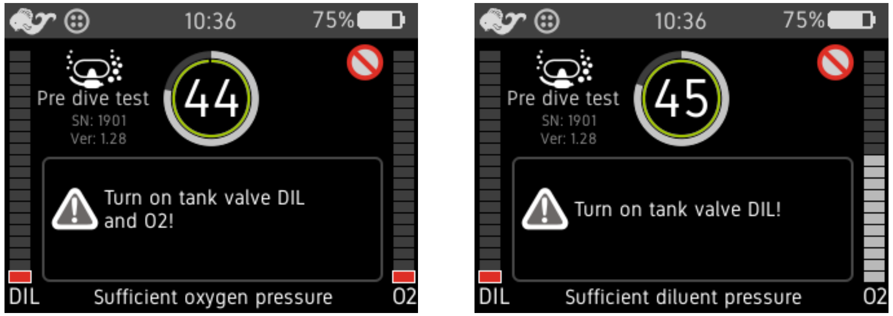


Figure 2-8. *Tests 44 and 45, confirming sufficient gas supply pressures.*

DANGER:
Always open the oxygen cylinder valve slowly. Rapid pressurization increases risk of fire. Opening the valve slowly reduces this risk. Carefully maintaining clean oxygen regulators, cylinders, and valves before, during, and after your dives will further reduce this risk.

WARNING:
Once both cylinders have been turned on during Tests 44 and 45, do NOT turn them off again until after completing the dive. If they are turned off before completing the pre-dive routine, then Tests 49 and/or 53 will fail. If they are turned off before the dive, the dive will be cut short. This is particularly true for the diluent cylinder, which provides breathing gas in the event of an emergency open-circuit bailout.

Battery power verification (Test 48)

Immediately after passing the two gas pressure tests, the pre-dive routine tests whether there is sufficient battery power to begin a dive (Test 48). The amount of power required depends on how recently the battery was subjected to a Learn Cycle during charging (see Chapter 1). If the Learn Cycle occurred recently, then the system is able to predict the remaining battery life relatively accurately, and Test 48 will pass if the battery has at least 20% charge remaining (approximately 5–6 hours of typical dive time, or 4 hours of night-diving time). The amount of charge required to pass this test increases by 0.5% per day since the last Learn Cycle, such that after 160 days with no Learn Cycle, Test 48 will not pass.

This test will pass or fail immediately. If it fails, the only remedies are to re-charge the battery (and/or subject it to a Learn Cycle), or replace the battery with another one with greater charge (subject to decompression data discrepancies, as discussed previously for Test 40).

Positive pressure loop test (Test 49)

One of the most basic pre-dive tests for any rebreather is to make sure that the breathing loop is intact and not leaking. Water entry into the breathing loop can cause serious problems if mixed with the CO_2 absorbent material in the cartridge. As discussed earlier in this Appendix, a manual negative pressure loop test can help detect leaks in the breathing loop.

Another common test is the Positive Pressure Loop Test (PPLT), which is similar to the Negative Pressure Loop Test, except the test is performed by pressurizing the breathing loop with positive pressure. Like the Negative Pressure Loop test, this test could very easily be performed manually. However, one of the features of the Poseidon SE7EN – the placement of the depth sensor within the breathing loop – allows this test to be performed automatically (Figure 2-9). Test 49 actually performs four separate tests, only one of which is the PPLT. The other three are:

- Verifies depth sensor is sensitive to small pressure changes
- Verifies that both metabolic oxygen solenoid valves are injecting gas
- Tests for leaks in all four solenoid valves.

Before reaching this test (indeed, before Powering-up the electronics), it's important to make sure that the over-pressure relief valve on the bottom of the right (exhale) counterlung is adjusted to the full clockwise position. As mentioned previously, the mouthpiece should be in the OC position, and the oxygen cylinder should be turned on. Also, the counterlungs should be no more than half inflated and the over pressure valve (OPV) should be fully closed (turned clock wise).

!

IMPORTANT:
Make sure the over-pressure relief valve on the bottom of the right (exhale) counterlung is adjusted to the maximum cracking pressure (turned all the way in the clockwise direction). Also ensure that the mouthpiece is in the OC position, that the oxygen cylinder valve is turned on, and the counterlungs are not already inflated. Otherwise, Test 49 will fail. Make sure that nothing pushes against the OPV, that will cause the Test 49 to fail.

The sequence of events for Test 49, and the various corresponding tests that are conducted, are as follows. First, the system injects oxygen into the breathing loop until the counterlungs are both full, but not tight (detected by the depth sensor as a slight pressure increase). This is why it's important that the counterlungs not already be fully inflated prior to starting Test 49 (which can occur if the cylinders are turned on and the mouthpiece is in the OC position during tests 24–27). This initial inflation is done via one of the two metabolic oxygen solenoid valves, thereby ensuring that this solenoid valve is actually injecting gas when it is supposed to.

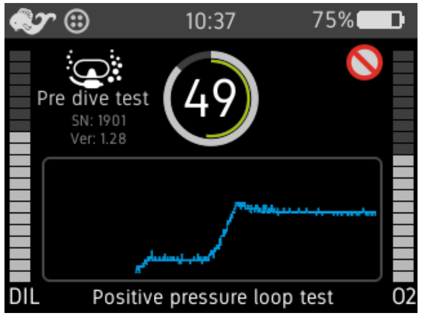


Figure 2-9.
Test 49 - Positive pressure loop test.

Once the counterlungs are fully inflated and the depth sensor detects a slight increase in pressure, the system pauses and monitors internal loop pressure for 20 seconds. If any of the four solenoid valves are leaking, the pressure inside the breathing loop will gradually rise. Assuming no increase in loop pressure is detected during this 20-second period, the second metabolic solenoid valve is used to inflate the breathing loop to a higher internal pressure. When this happens, the counterlungs will be tightly inflated, and the internal pressure should be slightly less than the cracking pressure of the over-pressure relief valve on the bottom of the right counterlung, when that valve is adjusted to its maximum cracking pressure. The system then monitors the loop pressure for the next 20 seconds to determine whether the pressure decreases, as by a leak in the breathing loop.

IMPORTANT:
While Test 49 is being conducted, be careful not to manipulate the counterlungs too much, or do anything that might affect the internal loop pressue, independently of the gas injected by the metabolic solenoid valves. The test can be performed while wearing the rebreather, as long as there is not too much motion or instability of the counterlungs. It's recommended that you don't let the mouthpiece and loop rest against the counter lungs during test 49, as this might cause the test to fail.

Closed circuit mouthpiece position (Test 50)

The mouthpiece should have been left in OC position following Test 43, as indicated in the information field. At Test 50 (Figure 2-10), the information text “Switch mouthpiece to Closed Circuit” appears, the HUD vibrates, the HUD and battery LEDs flash, and the audio speaker sounds. All of this indicates that the mouthpiece should be placed in the Closed-Circuit (CC) position. As soon as the mouthpiece is in the Closed-Circuit position and is detected by the HUD, the test will pass. The system allows 2 minutes for this test to be completed, before timing out.

As with the Open-Circuit mouthpiece position (Test 43), if the mouthpiece appears to be in the closed-circuit position, but Test 50 does not pass, then make sure that the mouthpiece switch is fully in the CC position. If the test still will not pass, then make sure the HUD is positioned correctly in the mouthpiece, and is not twisted or otherwise adjar from its proper position. If no amount of repositioning of the mouthpiece lever or HUD allows the system to pass Test 50, then contact an authorized Poseidon Service Center.

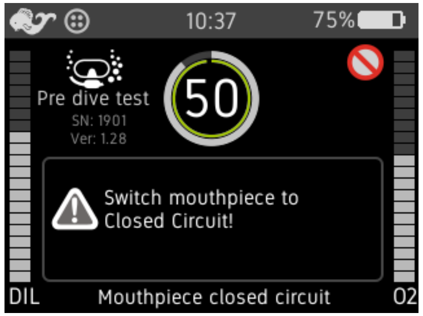


Figure 2-10.
Test 50 – Closed-Circuit mouthpiece position.

IMPORTANT:
Do <u>NOT</u> adjust the mouthpiece position again after completing Test 50, until Test 54 prompts for switching back to OC mode. In order to complete Test 53 (oxygen sensor calibration) successfully, the mouthpiece must remain in the Closed-Circuit (CC) position.

Oxygen sensor calibration (Test 53)

Test 53 (Figure 2-11) calibrates the oxygen sensors. Part of this test is to ensure that the oxygen supply is really oxygen, and that the diluent supply is what it is configured to be. The system will start by injecting pure oxygen directly on the primary oxygen sensor for 20 continuous seconds, thereby flooding the entire oxygen sensor chamber with enough oxygen to also calibrate the secondary sensor. The use of oxygen to perform Test 49 (PPLT) helps this test complete properly, because the breathing loop will have already been pre-charged with oxygen. After the calibration constants for oxygen are established, the system then injects diluent (air) via the diluent calibration solenoid valve. In doing so, this test simultaneously calibrates the sensors, confirms the correct gas mixtures are in the respective cylinders, and confirms that the calibration solenoid valves are mechanically functional.
This procedure can be followed on the display where graphs are plotted.

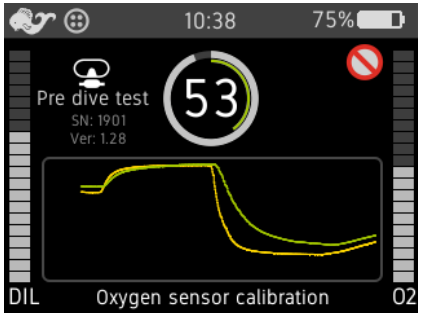


Figure 2-11.
Test 53 – Oxygen Sensor calibration.

This test is by far the most important of all the pre-dive tests, as it is determining whether the oxygen sensors are providing true values for the partial pressure of oxygen (PO_2). Failure of this test can occur for a number of reasons, all of which the user should be familiar with. Most causes relate directly to the oxygen sensors themselves – either bad or aged sensors failing the test, or the presence of condensate on the sensors from a prior dive. If Test 53 fails persistently, verify that the gas cylinders are connected to the correct regulators, and make sure they contain the correct gas mixtures. If the test continues to fail, one or both of the oxygen sensors may need replacing. When changing oxygen sensors, it's very useful to keep track of which oxygen sensor was placed in which position, by noting the individual oxygen sensor serial numbers.

Open circuit regulator function (Test 54)

After completing Test 53, the information field will have the text “Switch mouthpiece to Open Circuit” indicating the need change the mouthpiece back to OC mode. When the mouthpiece is switched, the sentence Breath through the mouthpeice are shown on the screen. This prompts the diver to test the function of the open-circuit regulator. After inhaling several breaths from the regulator, the test passes.

Service interval check (Test 55)

The final test (Test 55; Figure 2-12) is also the simplest. This test merely ensures that the rebreather unit does not require servicing. Each rebreather unit must be brought to a qualified Poseidon Service Center at least once every two years, to receive updates and make any necessary repairs or adjustments. When Test 55 is displayed, the information field will say “Service in X weeks” which is the number of weeks remaining before servicing will be required. When this value gets low, return the rebreather to an authorized Poseidon service center for maintenance. Upon passing Test 55, the pre-dive routine is complete.

Once the service date is due, the diver is prompted to acknowledge with YES or NO that he/she has understood that service is needed. A grace period of 4 weeks is added.
The service due date can also be seen through the RBConfig PC software.

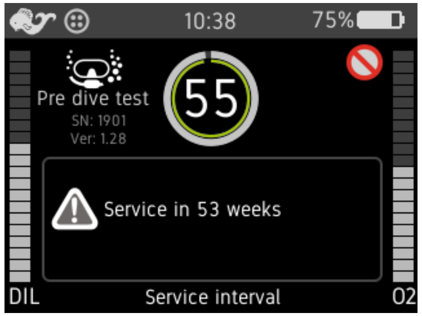


Figure 2-12.
Test 55 – Service interval check.

Prebreathe

Directly after Pre-Dive has completed, the diver will be prompted to perform a prebreathe. This is shown in the information box in the main screen. When the user switches the mouthpiece to CC mode, the remaining prebreathe counter will count down from 300 seconds. If the user switches out of CC then the counter will pause. Once the counter has counted down to zero, the rig enters ready to dive mode. It will stay in this state for 30 minutes. If the dive is not started in this time, then it goes back to prebreathe mode. Prebreathe mode is not mandatory and can be terminated without penalty by starting the dive. 30 minutes after the end of a dive , the rig will once again enter prebreathe mode. Note that during prebreathe mode, the rig will fire the diluent and oxygen solenoids for 2 seconds close to the start of each prebreathe session, if the diver is not breathing from the loop at this stage the unit may issue an alarm.

The reason for using the solenoids at this stage is that if a diver has turned off either of the cylinders, this will result in a large pressure drop which will prompt the diver to turn the cylinder on. If a closed cylinder is detected during prebreathe then the appropriate bar graph will flash.

Figure 2-13. *Prebreathe.*

Ready to dive

Under normal circumstances the Poseidon SE7EN will successfully complete all Pre-Dive checks in about three minutes, and a screen will appear on the display that looks like that shown in Figure 2-14, with a PO_2 value between 0.3 and 0.9 (usually the number is towards the higher end of this range because the loop is partially filled with oxygen during Tests 49 and 53), a depth of 0, a dive time of 0, and a remaining dive time clock showing 199 minutes.

Figure 2-14. *Ready-to-dive.*
At this point,the pre-dive tests are completed, and the system is ready to dive.

Poseidon SE7EN Pre-dive checklist

Start-up Procedure

1 Cylinders **OFF**, **CLOSE OPV, OPEN-CIRCUIT** mode.

2 **Insert** the battery.

3 Test 44, 45: turn cylinders **ON**.

4 Test 50: **CLOSED-CIRCUIT**.

5 Test 54: **OPEN-CIRCUIT**, test bailout regulator function.

Test	Confirm and Restart
1-38,55	Needs Servicing (if persistent)
40	Use correct battery
43,50,54	Verify mouthpiece position
44,45	Turn cylinders on / Refill cylinders
48	Recharge Battery / Replace battery
49	Counterlungs half-full or less
53	Verify Oxygen Sensors

Post-Dive Procedure

1 Mouthpiece in **OPEN-CIRCUIT**.

2 Both cylinders **OFF**.

3 Wet-switch **DRY**.

4 Purge ADV.

Figure 2-14. *General Start up and Post-Dive Procedure.*

Pre-dive checklist

Check for damage, dirt and deteriorations during assembly.

- ☐ 1 Check that the SE7EN battery and M28 battery are charged.
- ☐ 2 Inspect electronics module, handset, cables, electric connections, HUD, pneumatics hoses and oxygen sensors.
- ☐ 3 Mount top plate on top of scrubber, check O-rings (2 O-rings).
- ☐ 4 Mount end plate in the bottom of scrubber, check O-rings and sponge (3 O-rings).
- ☐ 5 Install scrubber into cartridge housing, tighten the four screws by hand.
- ☐ 6 Attach BC and harness to cartridge housing.
- ☐ 7 Mount counterlungs.
- ☐ 8 Check valve.
- ☐ 9 Check hoses, mouthpiece, T-valves and attach.
- ☐ 10 Check pressure, analyze, and attach filled gas cylinders.
- ☐ 11 O2_________%_________psi/bar
  Diluent________%_________psi/bar
  Helium________%_________psi/bar
- ☐ 12 Attach electronics module, tighten the two screws by hand.
- ☐ 13 Mount the two first stages.
- ☐ 14 Attach IP diluent supply hose to mouthpiece, tighten.
- ☐ 15 Attach HUD on to mouthpiece.
- ☐ 16 Attach LP diluent supply hose to inflator.
- ☐ 17 Close OPV on right counterlung.
- ☐ 18 Negative loop pressure test.
- ☐ 19 Insert smart battery and conduct power-up self-tests (see Start up procedure).
- ☐ 20 Prebreathe. It is very important to pre-form a full prebreathe for a minimum of 5 minutes, while pinching your nose or wearing a mask.

Figure 2-15. *General Pre-Dive Checklists.*

Appendix 3 - SE7EN connected to M28
Dive procedures

!

DANGER:
Do NOT attempt to use the Poseidon SE7EN rebreather without proper training! This Manual is NOT an adequate substitute for training from a qualified Poseidon SE7EN instructor. Failure to obtain proper training prior to using the Poseidon SE7EN could lead to serious injury or death.

Monitoring alarms

The most important responsibility of anyone diving the Poseidon SE7EN is to monitor the alarm systems. There are three separate alarm systems: the Head-Up Display (HUD; located on the mouthpiece), the battery module (located on the main electronics module, behind the diver's head), and the Primary Display. Each of these systems is intended to get the attention of the diver or the diver's companions through visual, audio, and tactile signals, and convey clear information to the diver concerning the status of the SE7EN.

!

DANGER:
NEVER ignore or otherwise discount any of the alarm signals on the Poseidon SE7EN. Failure to respond appropriately to any of the alarm signals could lead to serious injury or death.

HUD vibrator

Perhaps the most important alarm signal on the Poseidon SE7EN is a customized version of the patented Juergensen Marine DIVA^{TM} vibrator system, located in the HUD mounted on the mouthpiece. There are two ways this tactile alarm may be triggered. The first (and by far the most important) alarm is a continuous pulsing vibration signal On-Off-On-Off...etc. This signal has one and only one meaning: "Change the Mouthpiece Valve position NOW!"
In most cases, this signal will be triggered in association with an open-circuit bailout situation, thereby instructing the diver to switch the mouthpiece from closed-circuit mode to open-circuit mode. Once the mouthpiece has been properly switched, the vibrator signal will stop.
Occasionally, this signal will be triggered when the system is unable to detect the position of the mouthpiece; perhaps because it is not completely set in one position or the other (open or closed). If the HUD vibrator signal continues even after switching the mouthpiece, first make sure the mouthpiece is completely switched to the new position. If the vibration continues, then switch the mouthpiece back to its original position, again making sure it is completely rotated. If the HUD vibrator signal persists, then terminate the dive immediately in open-circuit mode.

In rare cases, the vibrator is intended to prompt the diver to switch from OC position back to CC position. This will only occur when the diluent supply is low, and the loop PO_2 is known to be safe. The important thing is to adjust the mouthpiece position whenever it vibrates.
The other HUD vibrator signal consists of a short (1/2-second) "blip" that is triggered every 2 minutes whenever the RED HUD LED is flashing (see below), as an alert to view the Primary Display. Do NOT change the mouthpiece position in response to a short, singular "blip" of the HUD vibrator.

!

WARNING:
In the event that there is insufficient diluent supply to effect a safe ascent to the surface in open-circuit mode while the HUD vibrator is activated, then continue the ascent to the surface in closed-circuit mode.

HUD Light

The HUD incorporates a RED LED light (Figure 3-1a), designed to signal that there is a possible problem (Red). Under normal diving conditions, the GREEN LED light (Figure 3-1b) is fading in and out continuously when the unit is in closed-circuit and there is no alarm. The RED light will periodically blink to serve as a reminder to the diver to monitor the Primary Display. Whenever a problem has been detected by the system or when any of the dive parameters are not within safe limits, the HUD light will flash continuously RED (and the vibrator will "blib" every 60 seconds). In either case, the purpose of the HUD light is to alert the diver to look at the primary display for further information.

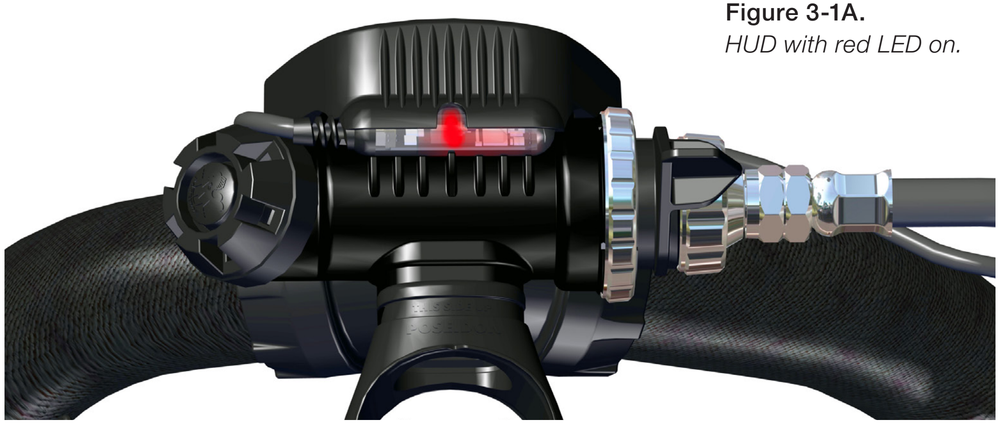


Figure 3-1A.
HUD with red LED on.

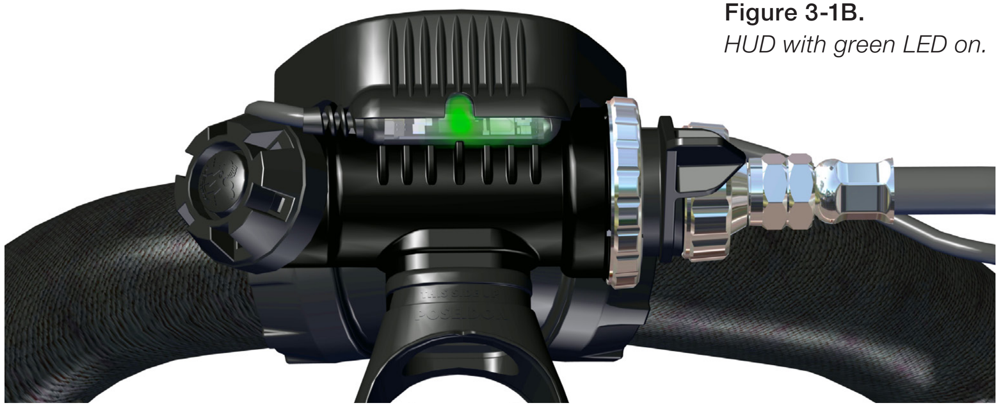


Figure 3-1B.
HUD with green LED on.

Audio alarm

One of the two alarm systems located in the battery module is the audio alarm. It emits a loud staccato tone that alternates between two frequencies as a signal to abort the dive. Whenever the audio alarm is triggered, the diver should immediately terminate the dive and commence a safe ascent to the surface, while monitoring the Primary Display. The audio alarm will continue to sound whenever the mouthpiece is not in the correct position, or when the diver fails to ascend in an abort situation.

Buddy alert light

Also contained in the battery module is the buddy alert light. This consists of two separate high-intensity red LED lights that flash whenever the HUD Light is flashing. The purpose of this alarm is to alert other nearby divers of a potential problem.

Monitoring the M28 primary display

Most of the information concerning the status of the dive and the various system parameters is communicated to the diver via the M28 Primary Display. It consists of a 2,8" TFT Color display and provides the diver with important information concerning sensor readings, system messages, decompression status, and other data during the course of the dive. It is extremely important that all Poseidon SE7EN divers understand how to read the information contained in the Primary Display, particularly concerning various alarm conditions.

Before even turning the Poseidon SE7EN electronics on, it is useful to understand the general layout of the Primary Display, and the logic behind how the information is organized. The display is arranged in different regions, each presenting different kinds of information. The most important region is the upper-right corner of the screen (1 in the illustration), which contains icons for alarm conditions. Under normal circumstances, this region should be blank. The alarm condition icons (described in more detail below) are designed to symbolically represent the nature of the problem, and most of them will flash when activated. This should be the first part of the screen that a diver should glance at when monitoring the Primary Display, as it will be immediately obvious if there are any alarm conditions, and what they are.
The battery icon will reflect the lowest value of M28 battery or the SE7EN battery. If the M28 is detached from the SE7EN it will only indicate the M28 battery value.

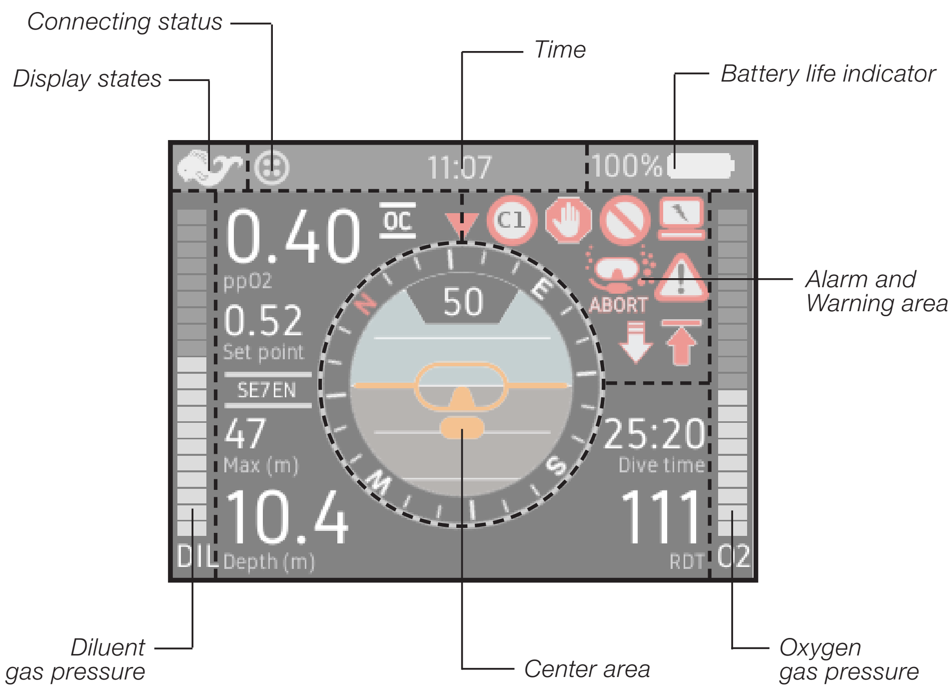


Figure 3-2. *LCD display layout.*

The next most important region is the upper-left part of the screen, where the current PO_2 value is displayed (2 in figure 3-2). The lower half of the screen includes basic information about depth (on the left side, 3), and time (on the right side, 4). The left and right edges of the screen (5) include bar graphs that represent the current capacity of the diluent (left side) and oxygen (right side) cylinders, as a percentage of total cylinder capacity. Finally, the center circle of the screen (6) includes several user changeable instruments such as ascent rate, compass and other features. When the Poseidon SE7EN electronics are started the display has the capability of showing many things but in the figure 3-3 the main symbols, icons and graphical elements is described in detail.

> **!**
>
> **DANGER:**
> **If the Primary Display screen is ever blank while diving the Poseidon SE7EN, immediately commence an abort to the surface in Open-Circuit mode (regardless of whether the HUD Vibrator is activated). Failure to do so could lead to serious injury or death.**

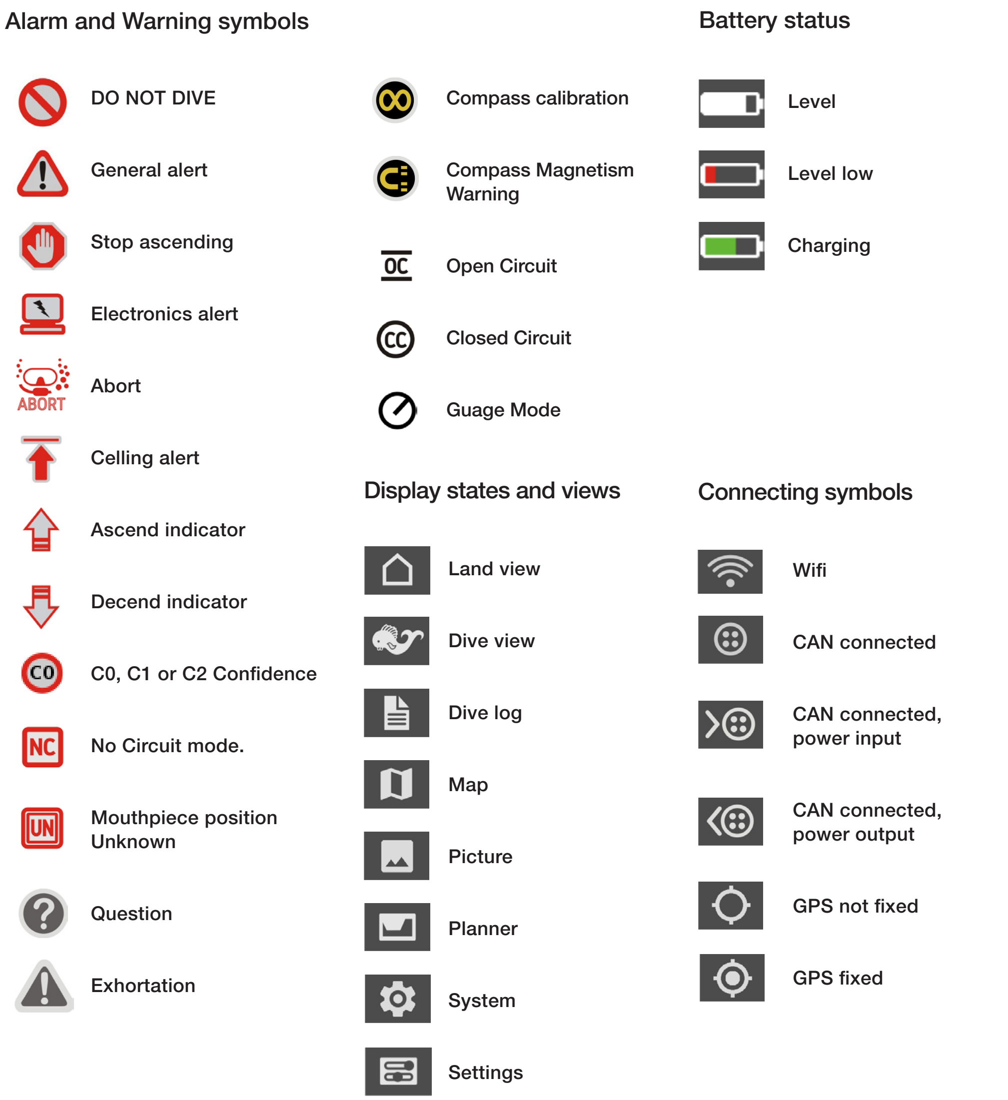


Figure 3-3. *Symbols.*

Units of measure

The Poseidon SE7EN is capable of displaying parameter values in either metric or imperial units. Both screens at the top of the next page show the same information, except that the left screen shows the depth and temperature values in imperial units, and the right screen shows the values in metric units. Depth units are indicated by an “ft” or “m”; and temperature units are indicated by a ºF or ºC.

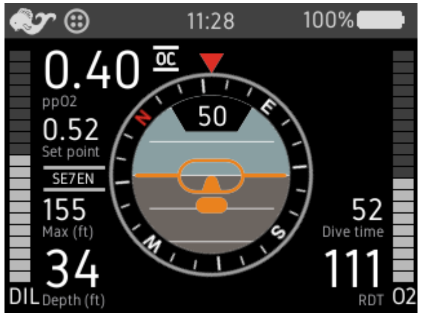


Figure 3-4. *Imperial units.*

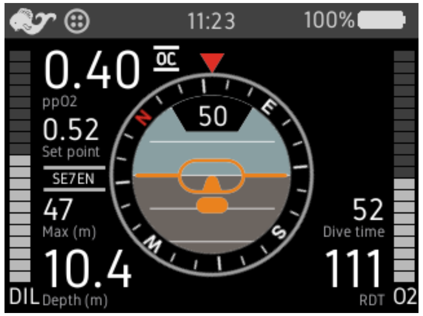


Figure 3-5*. Metric units.*

What follows is a more detailed description of each of the screen elements, and what they mean. It is important that all Poseidon SE7EN divers become familiar with these symbols and values, what they mean, and how to respond when they are not displaying appropriate values (or are flashing).

Alarm signal area

As mentioned previously, the upper-right corner of the screen is the alarm signal area, and under normal circumstances it should be completely blank. It was designed this way so that a quick glance at the screen would be all that is necessary to know whether any alarm conditions are active. A blank field in the upper-right corner of the screen means all systems are functioning properly, and all parameters are working correctly. In most cases, the signals will flash when activated, further drawing attention.

Figure 3-6. *Alarm signal area.*

Abort! and open circuit alerts

The most important alert symbols on the screen are also the largest: The ABORT! and Open-Circuit symbols. The ABORT! symbol is a large word ABORT! in inverted font color. Whenever this is displayed, the dive should be immediately terminated. There are two possible abort scenarios, either OC or CC. If accompanied by the Open-Circuit Alert icon (image of a diver’s mask, second-stage regulator, a series of bubbles on either side of the diver’s face, the diver must immediately terminate the dive and commence a safe ascent to the surface in open-circuit mode. If the Abort icon is displayed alone without the image of the divers mask the diver must immediately terminate the dive and commence a safe ascent to the surface on closed circuit.

Refer to page 112 how to manage OC ABORT.

Figure 3-7. *Abort! and open circuit alerts.*

DO NOT DIVE alert

In the Alarm Signal Area is a icon with a diagonal slash through it. This symbol is the “DO NOT DIVE” Alert, and it indicates that the system is not currently ready to be used for diving. This symbol will always be activated when the Poseidon SE7EN electronics are first turned on, while the pre-dive routine is being conducted.

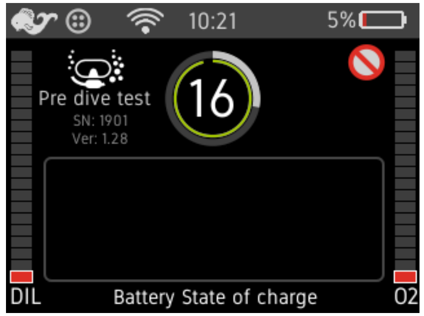


Figure 3-8. *DO NOT DIVE alert.*

General alert

The triangle symbol with an exclamation point, located in the Alarm Signal Area will flash in synchrony with any other parameter(s) on the screen that is/are inappropriate or out of acceptable range. This signal is intended to catch the diver's attention, and prompt the diver to scan the other elements on the screen to see which value(s) is/are also flashing. As long as one of the other displayed values on the Primary Display is flashing, the General Alert symbol will also flash.

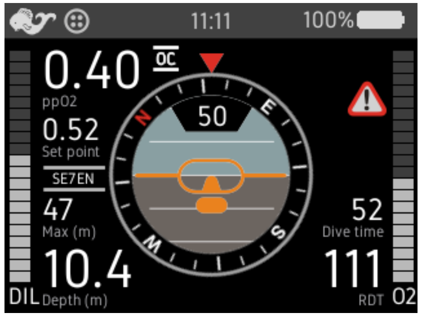


Figure 3-9. *General alert.*

Electronics alert

The General Alert symbol is a small icon that resembles a personal computer with a lightning bolt on the screen. This symbol indicates that a problem has been detected with the electronics, such as a network failure, an unexpected system re-boot, or other detected errors. The specific cause is recorded in the logged data. If the Electronics alert symbol is shown during a dive of after the completion of a Pre Dive test, ABORT the dive or DO NOT DIVE.

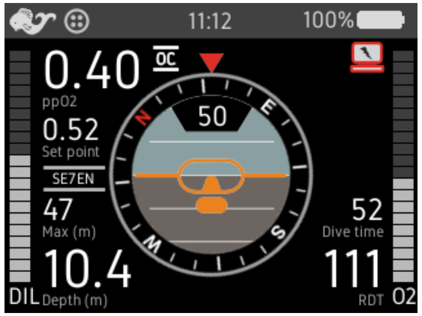


Figure 3-10. *Electronics alert.*

Decompression ceiling alert

In the Alarm Signal Area is the Decompression Ceiling Alert. This symbol will flash when the diver has incurred a decompression obligation. With the 40m recreational battery installed the Poseidon SE7EN is not intended for decompression diving, so the dive should be terminated whenever this icon is displayed. The diver should ascend towards the surface at a slow and controlled rate, watching the Primary Display for the Stop Alert and additional decompression information (see below).

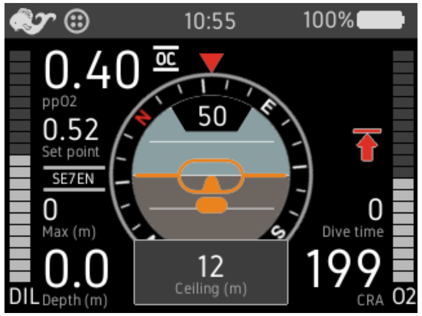


Figure 3-11. *Decompression ceiling alert.*

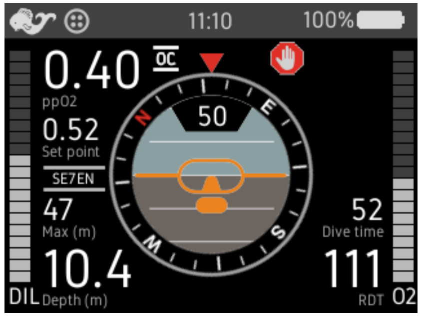


Figure 3-12. *Stop alert.*

Stop alert

The octagonal shape with a flat palm in the center, located in the Alarm Signal Area, is displayed in one of two circumstances: either the diver is ascending too rapidly, or the diver has reached the decompression stop depth ("ceiling"). In either case, the appropriate response is to immediately stop ascending, and the diver should maintain the current depth until the symbol disappears.

!

IMPORTANT:

It is the sole responsibility of each and every Poseidon SE7EN diver to understand all of the alarm systems and conditions, monitor them throughout every dive, and respond appropriately to any alert status.

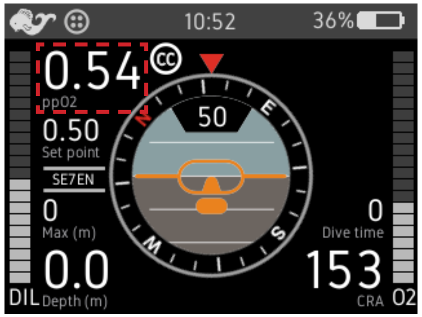


Figure 3-13. *PO_2 value.*

PO_2 value

The oxygen partial pressure (PO_2) in the breathing loop is displayed prominently in the upper left corner of the Primary Display. This is perhaps the most important number on the entire screen, as maintaining an appropriate oxygen partial pressure in the breathing gas is critical to ensure safe diving. The displayed PO2 represents the value from one of the two sensors that the the unit has most confidence in. If the value departs substantially from the current PO_2 setpoint, the value will flash. If the value becomes dangeously high or dangerously low, the diver will be prompted to switch to open-circuit mode and terminate the dive. An absolute low PO2 alarm will be triggered at 0.30 Bar.

PO_2 setpoint

Below the PO_2 value the PO_2 setpoint vill be displayed. Normally, this value will be the same as the current PO_2, because the system will normally maintain the correct PO_2 (i.e., Setpoint PO_2). In some cases, however, the value may be slightly different.

Figure 3-14. *PO_2 Set point value*

The Poseidon SE7EN incorporates a dynamic PO_2 setpoint value, which means the setpoint changes depending on depth and decompression status. Two setpoint settings control what the range of setpoint values will be during the dive. A “surface” setpoint value (default/minimum 0.5 bar / atm) establishes the PO_2 setpoint when at the surface, and a “deep” setpoint (default 1.2 bar / atm) establishes the PO_2 setpoint when at a depth greater than of 15 m / 50 feet. Between these two depths, the setpoint changes in small increments between these two values. Thus, when the depth is less than 15 m / 50 ft, the setpoint will be some value between the “surface” setpoint and the “deep” setpoint, proportional (but not linearly so) to current depth. This dynamic setpoint method helps prevent excessive PO_2 “spikes” during descent, and excessive oxygen wastage during ascents from no-decompression dives.

There are two exceptions to the dynamic setpoint method described above. The first is that whenever a decompression ceiling exists, the setpoint will not drop below 0.9 bar / atm during ascent. The second involves the Hyperoxic Linearity test on the primary oxygen sensor, as described below.

Hyperoxic linearity test

One of the important new features in the Poseidon SE7EN is the Hyperoxic Linearity test. When the oxygen sensors are calibrated during the pre-dive routine (Chapter 2), the linearity of the oxygen sensor response is only validated up to a PO_2 value of 1.0 bar / atm (i.e., 100% oxygen at sea level). Most rebreathers assume that the sensor response remains linear at higher values (operational PO_2 setpoint values often exceed 1.0 bar / atm). However, in certain situations the sensors may not be linear above 1.0 bar / atm, which can lead to a very dangerous situation. For example, if the sensor is not capable of responding to PO_2 values greater than 1.2 bar / atm, and the PO_2 setpoint is 1.2 bar / atm, the control system may flood the breathing loop with dangerously high levels of oxygen while attempting to achieve a PO_2 value that the sensors are not capable of registering.

To overcome this problem, the Poseidon SE7EN performs a test on the primary oxygen sensor the first time a depth of 6 m / 20 ft is achieved. The test injects a short burst of oxygen directly onto the primary sensor to ensure the sensor response is linear up to a PO_2 value of 1.6 bar / atm. If the test passes, then the dynamic setpoint performs as described previously (i.e., using up to the “deep” PO_2 setpoint value when the depth exceeds 15 m / 50 ft.). However, if the Hyperoxic Linearity test fails, then the maximum allowable setpoint is set at 1.0 bar / atm. The reason for this is that the primary oxygen sensor is known to be linear to at least 1.0 bar / atm, based on the successful completion of the pre-dive calibration process. Thus, as long as the PO_2 does not exceed 1.0 bar / atm, the response value is known with confidence.

Using the default “surface” and “deep” PO_2 setpoint values, a setpoint of 1.0 is not achieved until the depth exceeds 6 m / 20 ft, so there is no consequence on dives shallower than this depth, even if the Hyperoxic Linearity test is never performed. Until the Hyperoxic Linearity test passes successfully, the PO_2 setpoint value will be limited to 1.0 bar / atm.

Oxygen sensor confidence

One of the most sophisticated features of the Poseidon SE7EN is the automatic oxygen sensor validation system, which monitors the reliability of the oxygen sensors throughout the dive. Through a series of algorithms, the system assigns a confidence rating to current oxygen sensor readings, based on several factors including primary sensor validation, dynamic response of sensors, and a comparison between primary and secondary sensor values. If, for some reason, the system loses confidence in the oxygen sensors, then every few seconds an error will be displayed momentarily on the Primary Display where the PO_2 value is normally displayed – in a manner similar to how the PO_2 Setpoint is displayed. If there is no confidence in the oxygen sensors, then "C0" is displayed. Other levels of confidence based on various factors include "C1", "C2", and "C3". The last of these ("C3") is normal, and means the system has high confidence in the sensors. The other levels ("C0", "C1" & "C2") generate errors, and will trigger appropriate alarms.

Figure 3-16. *Oxygen sensor confidence alerts: C0, C1, C2.*

The difference between "NC" ("no circuit") and "UN" ("unknown") depends on whether the mouthpiece is reporting that neither closed-circuit nor open-circuit is currently established ("no circuit"), or whether the mouthpiece is not reporting any position information at all ("unknown"). In the former case, the problem is likely due to the mouthpiece switch being in the wrong position, one or both of the magnets inside the mouthpiece being damaged or corrupted, or a problem with the magnet sensors in the HUD. The latter case would arise if the HUD was unable to communicate reliably with the SE7EN or report that the mouthpiece is in both open and closed position at the same time. In any case, if the displayed value of the mouthpiece position is not what it should be, first check the actual position of the mouthpiece, make sure it is firmly and completely in one position or the other, and attempt to wiggle the HUD slightly.

Figure 3-17. *Closed Circuit mode.*

Figure 3-18. *Open Circuit mode.*

Mouthpiece position

Directly to the right of the PO_2 value the mouthpeice position is communicated:

- "CC" (mouthpiece is in the Closed Circuit position)
- "OC" (mouthpiece is in the Open-Circuit position)
- "NC" (mouthpiece is not fully in either position), or "UN" (mouthpiece position is unknown).

Figure 3-19. *No Circuit mode.*

Figure 3-20. *Mouthpiece position Unknown.*

IMPORTANT:
When the mouthpiece is in the "CC" position, the PO_2 control system maintains the loop PO_2 at whatever the current PO_2 setpoint is, and decompression calculations are based on the current PO_2 value. When the mouthpiece is in the "oc" position, the PO_2 control system maintains the loop PO_2 at whatever the PO_2 of the current diluent is at the current depth, and decompression calculations are based on the diver breathing the current diluent in open-circuit mode. When the mouthpiece is in the "NC" or "UC" positions, the PO_2 control system maintains the loop PO_2 at whatever the current PO_2 setpoint is, and decompression calculations are based on the diver breathing the current diluent in open-circuit mode.

Current depth

Below the PO_2 value, on the left side of the screen, is the current depth reading. This value is shown in either metric or imperial units, depending on which mode is selected. In metric mode, the value is show to the nearest tenth (0.1) of a meter below 100 meter, and from 100 meter to the nearest meter; when in imperial mode, the value is shown to the nearest foot. This value will flash whenever the maximum rated depth is exceeded.

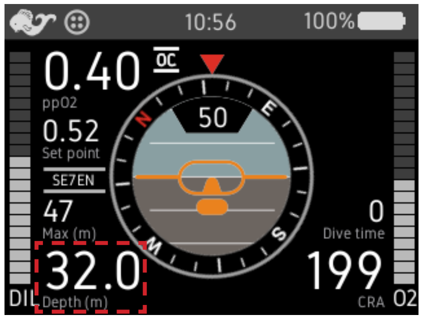


Figure 3-21. *Current depth.*

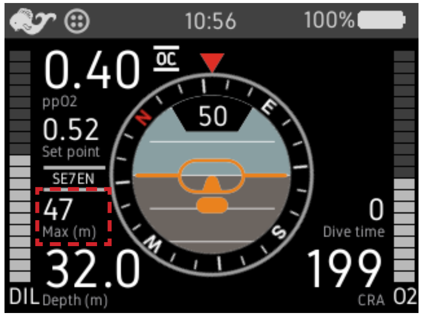


Figure 3-22. *Maximum depth.*

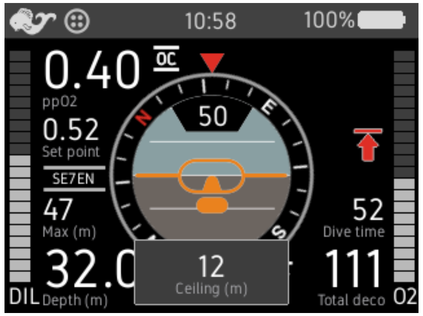


Figure 3-23. *Display indicating "ceiling" to which it is safe to ascend & total decompression time.*

Maximum depth / Ceiling

The maximum depth achieved during the dive is displayed above the current depth, in the lower-left part of the Primary Display. Ceiling is shown in an information box center in the lower part of the display.

If the maximum depth is flashing, the configurable depth limit alarm is triggered. Can be change in the SE7EN register list, see the part "Changing settings in your SE7EN through the M28"

Remaining dive time (RDT)

The Remaining Dive Time (RDT) value, shown as the large number on the right side of the Primary Display, is based on various factors, including the remaining no-decompression time at the current depth, oxygen supply, remaining battery life, and oxygen toxicity units (OTUs). The OTU's will be logged and can be monitored through the PC tool. It represents the number of minutes remaining at the current depth before one of these parameters is exceeded ("199" is displayed if more than 199 minutes remain). When the value falls below 5 minutes, it will flash. If a decompression ceiling is incurred, this value changes to represent the total decompression time – ascent time plus decompression stop(s).

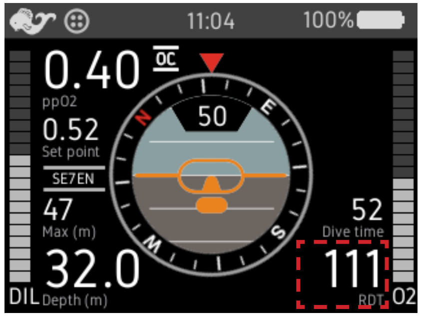


Figure 3-25. *Remaining dive time (RDT).*

WARNING:
Do not allow the Remaining Dive Time to reach zero! The value will begin to flash when several minutes remain, when an ascent should commence. Allowing the Remaining Dive Time to reach zero could place the diver at significant risk.

WARNING:
The Poseidon SE7EN rebreather is in recreational mode not intended for use on planned decompression dives. Although the Primary Display will provide a limited amount of information to allow completion of safe decompression, this information is provided ONLY as a guide when limits have been exceeded.

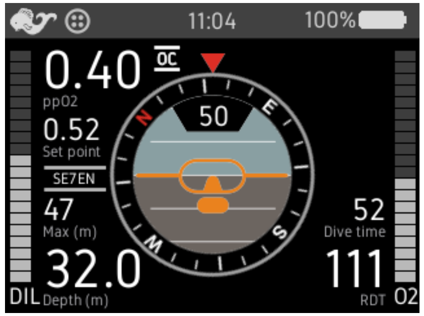


Figure 3-26. *Elapsed dive time.*

Elapsed dive time

The number of minutes that have elapsed during the dive (i.e., the total dive time) is displayed in the lower-right part of the Primary Display above the RDT value. This value represents the total elapsed time since the start of the dive. It begins incrementing only when a dive has started, and stops incrementing when the dive ends. If a subsequent dive is conducted without allowing the unit to power-down, then the elapsed dive time resets at next dive start. Between the dives, the number indicates time of the last dive.

Ascend/descend arrow

Located in the alarm area, is a symbol that can display an up-arrow, or a down-arrow. When the up-arrow is displayed, the diver should immediately begin a safe, controlled ascent. The up-arrow does not necessarily mean that the dive must be terminated – it may only indicate that the diver is approaching the no-decompression limit at the current depth; in which case ascending a certain amount may cause the up-arrow to stop flashing (i.e., when the depth is shallow enough that the diver has ample remaining no-decompression time at the current depth).

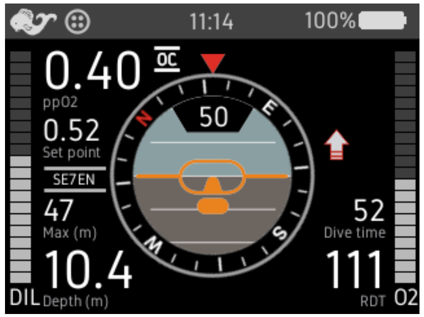


Figure 3-27. *Ascend arrow.*

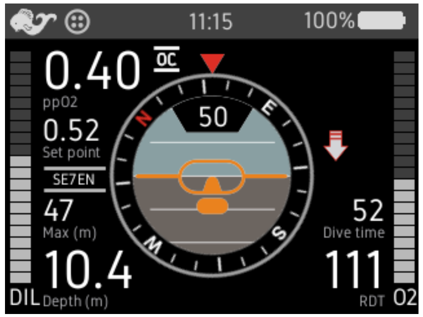


Figure 3-28. *Descend arrow*

In the unlikely event that a diver incurs a decompression obligation (i.e., the Decompression Ceiling Alert is displayed), and the diver then ascends above the depth at which the Decompression Stop Alert is displayed, the down-arrow will flash. In this situation, simply descend gradually until the down-arrow no longer flashes, and remain at that depth until the Decompression Stop Alert no longer displays.

Battery life indicator

In the top right corner of the Primary Display, is the Battery Life Indicator. This indicator serves as a “fuel gauge” for remaining battery life. If the remaining battery life is less than 20%, this indicator will flash, and the screen will indicate that the dive should be terminated. The more time that has elapsed since the last battery Learn Cycle, the greater percentage of battery charge is needed to ensure 20% remaining power.
When the M28 computer is attached to the SE7EN the symbol incates which one of the M28 battery and the SE7EN battery which has the least amount of capacity.

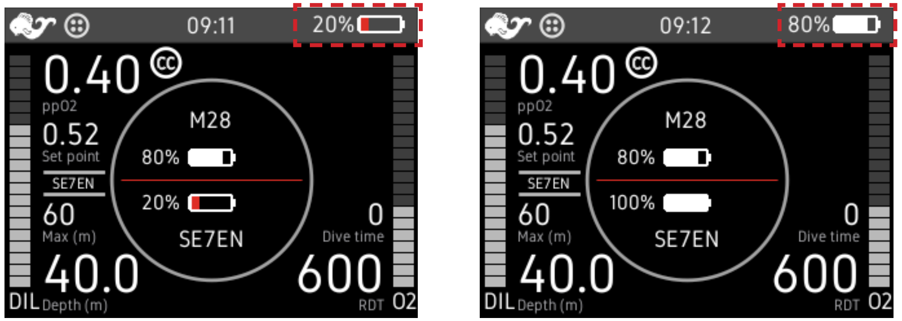


Figure 3-29. *Battery life indicator.*

> **!** **DANGER:**
> **Do NOT ignore the remaining battery life indicator. If the battery fails, the entire life-support system (including alarms) may cease to function. Failure to abort to open-circuit and terminate the dive could lead to serious injury or death.**

Temperature

In the “center view” is the water and loop temperature reading. This value is displayed in units of centigrade when in metric mode, and units of fahrenheit when in imperial mode.

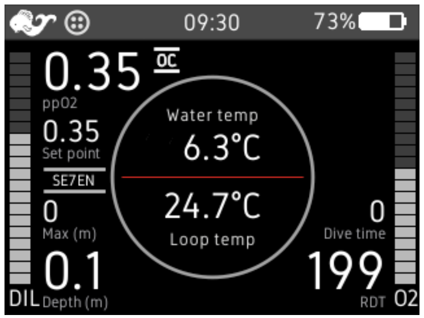


Figure 3-30. *Temperature.*

Cylinder pressure indicators

Along either side of the Primary Display are the two cylinder pressure indicators, represented as bar graphs. The graph on the left side of the screen is for the diluent supply, and the graph on the right side of the screen is for the oxygen supply. Each segment in the bars represents approximately 10% of the total gas supply for each cylinder. When the pressure in either cylinder drops below 26 bar for Oxygen and 40 bar for diluent, the remaining segments of the corresponding bar graph will flash together with the alert icon. The full-scale (100%) value of each of these bar graphs is established through the config menu of the M28 computer.

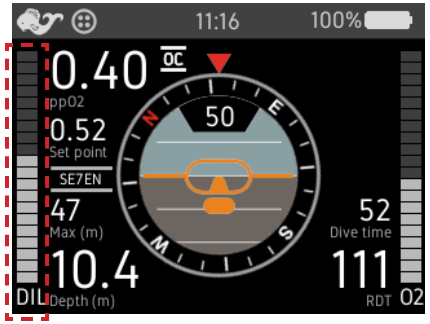


Figure 3-31.
Diluent cylinder pressure indicator.

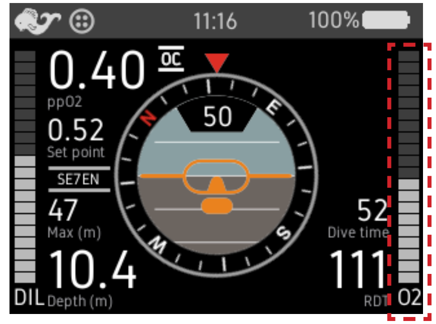


Figure 3-32.
Oxygen cylinder pressure indicator.

Figure 3-33. *Ascent rate indicator.*

Ascent rate indicator

By using the push buttons of the M28 the diver can access the ascent rate indicator. The indicator shows both ascent and descent values.

Managing open circuit bail out with M28

In case your M28 shows an ABORT to Open Circuit you are mandated to follow the instruction and warning and go to OC by changing your mouthpeice position.

The Dive Menu

During normal conditions diving in Closed circuit the menu in M28 SE7EN mode will only show a menu structure that consists of Settings, Apps, Setpoint and Dive config. When aborting to OC the menu content will change and also contain a new item “Gas Select”.

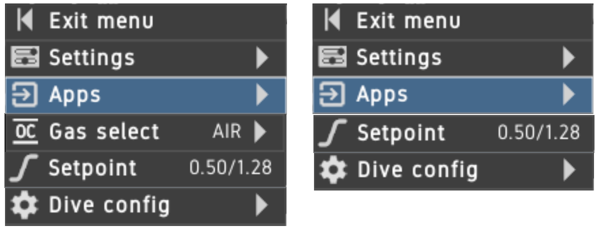


Figure 3-34. *OC and CC mode menu*

Managing gases

Per predefault the selected OC gas will alwas be your SE7EN predefined diluent. When in OC, meanwhile performing a bailout, the diver now also have the possibility to alter the OC bailout gas to any of the confugured gases by acessing the menu structure and selecting OC Gas select. Then select any of the predefined and eneabled gases in the list. The selection can always be verified from the DIve veiw by altering the center icon, see figure 3-35.

This selection will remain as long as you stay in the OC mode. If you decide to go back to CC the gas will automatically be restored to your SE7EN predefined diluent. This means that if you again decide to go to OC you need to alter the OC Gas to what you intend to breathe at this stage.

If you by coincidence select a gas with a to high or to low PO2 at the existing depth the M28 will warn you by overlaying a message window covering parts of the center icon saying GAS to HIGH/LOW ppO2.

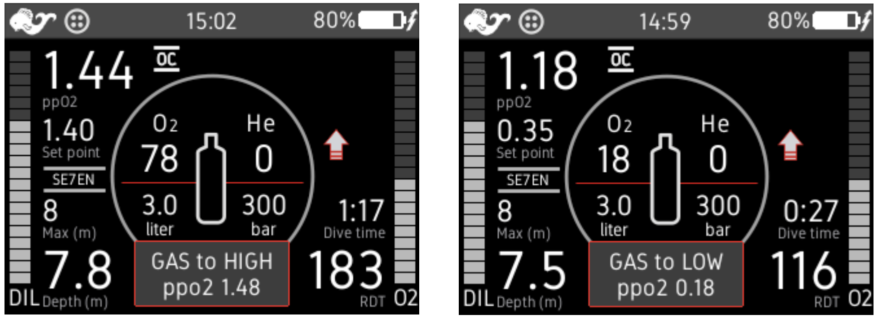


Figure 3-35. *Gas to HIGH/LOW*

Changing settings in your SE7EN through the M28

With the M28 its easy to alter the settings within the SE7EN unit meanwhile on land and connected to the SE7EN. Simply enter the system menu and select “Edit SE7EN reg”. Once selected you can change several parameters that previously only were able to be altered through the rbConfig tool.

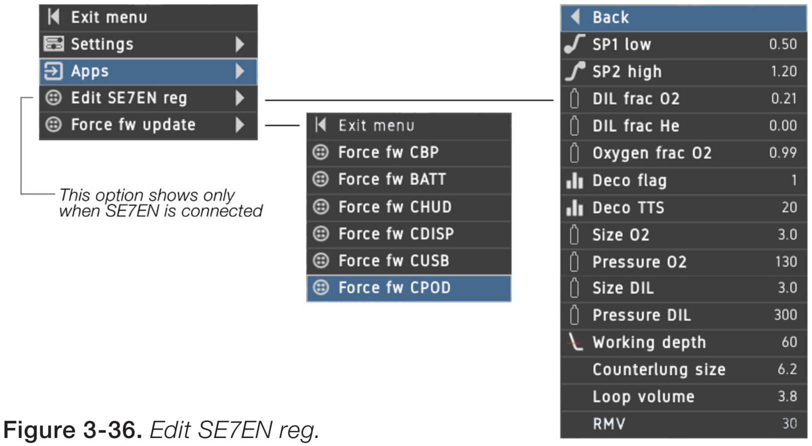


Figure 3-36. *Edit SE7EN reg.*

The alterations and changes that you do through the M28 in the SE7EN settings will not take effect until you have restarted the SE7EN and completed a full pre dive test sequence.

System monitoring

Merely understanding how to read and interpret the information presented on the Poseidon SE7EN Primary Display is only the first step. All divers must learn to monitor the Primary Display and alarm systems regularly throughout the dive. In addition to the parameters monitored during an open-circuit scuba dive (e.g., depth, cylinder pressure, decompression status), a closed-circuit rebreather diver must also monitor other variables, such as the PO_2 of the breathing gas and the remaining battery life. The SE7EN is designed to make the task of monitoring these parameters as easy and straightforward as possible, and alarm systems have been incorporated to alert the diver when these parameters drift out of safe range. Nevertheless, it is vitally important to the safety of the diver that good system monitoring habits be developed.

Monitoring the PO_2 value

The most critical parameter to monitor on any closed-circuit rebreather is the oxygen partial pressure in the breathing loop. The most dangerous aspect of closed-circuit rebreathers is the fact that the oxygen concentration in the breathing gas is dynamic and can change. Considering the lack of reliable physiological warning symptoms for impending hypoxia or CNS oxygen toxicity, and the severity of these maladies while underwater, the importance of frequent PO_2 monitoring should be obvious. Fortunately, the Poseidon SE7EN is designed to not only monitor the PO_2 value in the breathing loop, but also validate that the oxygen sensor readings are correct and accurate. Although there are many alarm systems built into this system, it is always good practice for divers to regularly monitor the PO_2 value on the Primary Display screen, to ensure that it is within limits, and that the value itself is not flashing.

Monitoring gas supplies

The next most important parameters to monitor are the gas supplies, represented as bar graphs on the left and right sides of the Primary Display. In particular, it is important to make sure that the Air (“Dil”) pressure graph is not flashing. The electronics system will constantly calculate whether there is enough air supply remaining to allow a safe open-circuit bailout to the surface. If there is not enough air to allow a safe open-circuit bailout to the surface, the “Up Arrow” will be displayed on the Primary Display, indicating that the diver should ascend to a shallower depth.

The oxygen supply pressure should also be monitored to ensure there is a sufficient quantity of oxygen remaining in the oxygen cylinder to complete the remainder of the dive in closed-circuit mode. Because these values change very slowly throughout the course of a typical rebreather dive, there is a tendency to ignore them. As with other important parameters, there will be warnings issued in case the oxygen supply pressure gets too low; but nevertheless, the diver should be in the habit of monitoring this value regularly.

Monitoring remaining dive time

As mentioned previously, the Remaining Dive Time (RDT) value is based on several different factors. The value displayed represents the amount of remaining time (in minutes) for the most limiting factor. If the limiting factor is remaining battery life, the value will count down consistently, regardless of depth. However, if the limiting factor is remaining oxygen supply, the value could increase or decrease depending on the rate at which the diver is consuming oxygen. The value can change even more dramatically (and suddenly) when the limit is based on remaining no-decompression time. This is because a diver with only a few minutes remaining at a depth of 30 meters (for example) may well have many more minutes remaining at a shallower depth. Conversely, the remaining minutes may suddenly decrease sharply when depth increases. Thus, it’s extremely important to monitor this value throughout the dive; particularly after increases in depth.

Note that the RDT value is NOT an exact value, and it should be regarded as a “recommended” remaining dive time, rather then an absolute remaining dive time. In the event that a diver inadvertently exceeds the no-decompression limits and the dive requires decompression stop(s), the RDT value changes to display the remaining total decompression time, as described previously.

Breathing underwater

Counterlung placement

When properly adjusted, the Poseidon SE7EN should rest easily on the diver's back. It should not feel awkward or loose, but rather it should be reasonably snug and comfortable. Specific strap adjustments will depend on what style of harness is used, but each counterlung comes with a set of three straps that can be looped around the harness shoulder straps, securing both counterlungs firmly to the diver's upper chest and shoulders. When properly positioned, both counterlungs should curve over the tops of the shoulders, such that the top ends are in line with the diver's back. They should hug the diver's body closely, and not float up or shift position as the diver swims in different orientations.

Counterlung strap adjustments

Besides the three large straps for attachment to the harness, each counterlung has several additional straps used to adjust positioning. At the top of each counterlung is a single adjustable strap that curves behind the diver's back and attaches to the corresponding cylinder strap. This counterlung strap is used to adjust the positioning of the top of each counterlung. At the bottom of each counterlung are two more adjustable straps. The longer of these angles straight down for attachment to a crotchstrap or a waist strap, and is used to keep the bottom of the counterlung securely down. The shorter strap angles laterally and attaches to the corresponding strap on the other counterlung. These two keep the counterlungs held together.
It is well worth the time spent in shallow water making adjustments to these various straps until the counterlungs fit comfortably and closely to the upper chest and shoulders. The better the counterlung adjustment, the easier the breathing will be when underwater.

Tips on breathing

Breathing underwater on a closed-circuit rebreather, such as the Poseidon SE7EN, is somewhat different from breathing on land, or breathing with conventional scuba gear. As the diver exhales, the counterlungs both expand. As the diver inhales. the counterlungs contract. The direction of gas flow through the breathing loop is governed by the two check-valves in the bottom portion of the mouthpiece. The incorporation of two separate, over-the-shoulder counterlungs on the SE7EN helps to minimize the effort required to breathe underwater, but there are a few tips that make breathing easier.

The most important thing is to maintain an optimum volume of gas in the breathing loop. If there is too much back-pressure when exhaling (often felt in the cheeks), or if the overpressure relief valve on the exhale (left) counterlung "burbs" gas at the end of an exhaled breath, then the loop has too much gas, and some should be vented (e.g., by exhaling through the nose). If the counterlungs "bottom out" and/or the Automatic Diluent Valve (ADV) in the mouthpiece is triggered on a full inhalation, then there is not enough gas in the breathing loop. This condition should be corrected automatically by the ADV.

Tips on buoyancy control

Controlling buoyancy while diving with a rebreather is considerably different from buoyancy control with conventional open-circuit scuba. To begin with, whereas a scuba diver needs to manage buoyancy characteristics of two separate factors: the Buoyancy Control Device (BCD), and the exposure suit (i.e., a wetsuit or a dry suit). A rebreather diver must manage both of these, as well as the breathing loop of the rebreather. A complete discussion of buoyancy control with closed-circuit rebreathers is beyond the scope of this Manual. However, the following tips might be useful.

Although most divers probably do not realize it, fine trim for diving with conventional scuba gear is achieved through breathing. On each inhalation, the diver's lungs expand and buoyancy is increased. The opposite occurs on exhalation. However, this does not occur with a rebreather (the Poseidon SE7EN included), because the buoyancy increase caused by expanding the lungs on an inhaled breath is offset by the decreasing volume of the counterlungs (and vice versa). This may at first be disconcerting for an experienced scuba diver trying a rebreather for the first time, because an inhalation done subconsciously to slightly increase buoyancy has no effect. However, with practice, it becomes advantageous to be able to hover in the water with perfect buoyancy, while breathing continuously.

The quickest and easiest way to fine-tune buoyancy with a rebreather is via addition and removal of gas to or from the breathing loop. To increase buoyancy slightly, a small amount of gas can be added to the breathing loop via the ADV (either by manually engaging the purge button, or by making an especially deep inhaled breath). For minor adjustments in buoyancy, it is usually easier to control it with your breath rather than the purge-button since it could easally give a bit too much gas. To decrease buoyancy slightly, one need only exhale through the nose to vent gas out of the breathing loop (except when certain kinds of full-face masks are used).

New rebreather divers often have the most difficulty in very shallow water, where a slight change in depth yields a proportionally large change in displacement (and, hence, buoyancy). This is especially true when the diver begins to ascend, which causes the counterlungs to expand, leading to increased buoyancy, leading to further ascents, and expanding loop volume. This can lead to a "run-away" ascent that can be difficult to control. For this reason, it's useful practice for rebreather divers to be in the habit of venting gas through the nose whenever ascending; particularly from very shallow depths.

Venting water from the loop

Even if a diver is very careful to prevent water from entering the breathing loop, there will always be some water collecting due to condensation. Most of this will form on the "exhalation" side of the breathing loop, between the mouthpiece and the CO_2 absorbent cartridge, and will generally collect in the exhalation (right-hand) counter lung. Sometimes, water will collect in the exhalation hose, immediately downstream of the mouthpiece. If this water is sufficient to cause gurgling noises with each breath, it can be poured into the exhalation counter lung by looking upward and holding the hose in such a way so as to dump the water towards the right-hand shoulder port. In most cases, the water that collects inside the exhalation counter lung will not disrupt the function of the Poseidon SE7EN in any way, so it can be safely ignored. However, sufficient quantities of water could be returned to the breathing loop if the diver becomes inverted, so it may be desirable to vent this water from the breathing loop altogether.

To do this, the diver should first become negatively buoyant, or attach to a secure object on the bottom. The breathing loop volume should be increased to at least 75% of maximum capacity by manually adding diluent via the ADV. The loop vent valve at the bottom of the exhalation counter lung should be rotated counterclockwise maximally to minimize the cracking pressure. While in an upright orientation, the diver should then compress both counter lungs by squeezing them against the chest with the elbows and upper arms, while simultaneously exhaling through the mouth and depressing the loop vent valve to open it. If done correctly, water will be expelled from the loop vent valve first, followed by a stream of gas bubbles. After the water has been flushed, the loop vent valve can be tightened by rotating clockwise, and the breathing loop volume and PO_2 can be restored to normal.
A small amount of condensation may also collect in the inhalation portion of the breathing loop, between the CO_2 absorbent cartridge and the mouthpiece. Normally, this will only be a small volume of water, and most will be absorbed by water trap.

Managing ascents

During an ascent from a rebreather dive, the oxygen partial pressure in the loop will begin to drop (due to the dropping ambient pressure). The oxygen control system will likely begin to compensate for this by injecting oxygen; however, during somewhat faster ascents, the solenoid valve may not be able to keep up with the drop in loop PO_2 caused by the drop in ambient pressure. This is not of great concern, unless the PO_2 gets so low that it triggers alarm conditions; but it represents one more reason why it's always good practice to ascend at a slow and controlled rate.

During the ascent, loop gas will be vented from the breathing loop due to expansion. For this reason, dives involving many ascents and descents (up and down) can lead to excessive loss of both diluent (during descents, in re-filling the breathing loop) and oxygen (during ascents, while trying to maintain the set-point).

Ending the dive

After surfacing and exiting the water, the Poseidon SE7EN electronics will continue to function indefinitely, ensuring a life-sustaining gas mixture is maintained in the breathing loop, until the following four conditions have all been met: the depth is "0"; the back of the Primary Display (where the wet switch contacts are located) has been dried; the pressure in the diluent regulator and hoses has been vented; and the mouthpiece valve has been placed in the Open-Circuit position. Once these four conditions are met, the system will vent the oxygen gas supply system, and power down the electronics.

The recommended sequence of steps for the proper post-dive shut-down procedure is as follows:

- Ensure mouthpiece is the Open-Circuit position (as it should always be when not in use).
- Turn off BOTH gas supply cylinders.
- Thoroughly dry the back face of the Primary Display, in the vicinity of the wet-switch contacts.
- Vent the diluent gas from the system by pressing the manual purge button on the ADV.

!

WARNING:
Always place the mouthpiece valve in the Open-Circuit position whenever it is not in use. Doing so seals the breathing loop and prevents water ingress into the breathing loop. Excess water in the breathing loop can form a caustic if it comes in contact with the absorbent material.

!

IMPORTANT:
Be certain that the oxygen cylinder is turned OFF prior to completing the steps necessary for the post-dive shut-down procedure. When the electronics shut down, the oxygen gas supply system is vented. If the cylinder valve is open, the system will not properly vent.

!

IMPORTANT:
Do NOT remove the battery while the electronics system is active. Failure to complete a proper shut-down procedure will cause the battery CPU to remain active, and drain the power supply unnecessarily.

Safe diving with the Poseidon SE7EN

- NEVER hold your breath when breathing underwater!
- ALWAYS change the CO_2 absorbent cartridge whenever the oxygen cylinder is refilled or replaced.
- ALWAYS remove the sponge from the top and bottom of the CO_2 absorbent cartridge after every dive and squeeze as much moisture out of the sponge as possible. It is extremely important to allow this sponge to dry as much as possible before starting a new dive.
- If you feel the mouthpiece vibrate for more than a brief pulse, then change the mouth-piece position NOW!"
- If you hear the audio alarm, IMMEDIATELY check the LCD display and prepare to terminate the dive.
- If the Heads-Up Display light on the mouthpiece is STEADY ON, then ASCEND at a safe and controlled rate to the surface.
- If the Heads-Up Display (HUD) light on the mouthpiece FLASHES, then STOP, look at the LCD screen. A short single flash is a reminder to you to keep track of your PO_2, which is shown in the upper left field of the display. If there is a problem, the HUD light will continue to flash, and there may be a symbol in the upper right field of the display flashing to indicate the nature of the problem. For example, the directional arrows advise you to go up (ascend) if you need to end the dive or if you need to go shallower; or go down (descend) if you have ascended above a required decompression ceiling. Other fields on the display may flash to indicate what the problem is. More information on the functionality of the display is presented in Chapter 3.
- When in doubt, bail out - switch to open-circuit (OC) and ascend in a controlled manner to the surface.
- The default setpoint control algorithm is designed to allow for hands-off control of the system PO_2 during all phases of a dive. The Poseidon SE7EN uses a proprietary method that begins with a default control setpoint on the surface of 0.5 bar and gradually increases PO_2 to a maximum automatic value of 1.2 bar at a depth of 15 m / 50 ft. Beyond this depth the system will automatically control to a setpoint of 1.2 bar to the maximum operating depth of the rig at 40 m.

Update SE7EN firmware through the M28

Through the development of the M28 we have enhanced the functionality of the SE7EN in many ways. One of the new features within the M28 makes it possible to update the firmware of the SE7EN from the M28. This might be a rarely used feature but a handy tool if you have to field replace a part of the SE7EN and experience inconsistent firmware versions within the SE7EN. Before performing any of the options below, make sure that your M28 is equipped with the latest firmware. Refer to www.poseidon.com/products/computers/m28

Option 1

The firmware control within the M28 is even more sophisticated. If you during predive encounter a fw compability test error you can simply press both buttons of the M28, select “fw update” located at the bottom of the menu. When selecting this function all inconsistent parts of the firmware will be updated. A firmware update window will also be visible during this process.

Option 2

This option can be used to update specific parts of the SE7EN or M28 accessories. This function can be used when connected to the SE7EN or when you connect any of the Poseidon products directly to the M28. Before any firmware can be updated the physical product needs to be connected and then the “Power out” option needs to be enabled. To enable the “power out” function goto the “SYSTEM” app and press both buttons. Select “Connect” and then “Power out” and the CAN connect icon will be visible in the connecting status area.

To access and use the forced firmware update function use the buttons and select the “System” app. Once in the app press both buttons to access the system menu. Select “Force fw update”. You can now see a number of options, they are all listed and explained below:

- Force fw CBP
  Select this option if you want to update the internal firmware of the E-Module in the SE7EN
- Force fw BATT
  Select this option if you want to update the firmware in the SE7EN battery module.
- Force fw CHUD
  Select this option if you want to update the firmware in the SE7EN HUD.
- Force fw CDISP
  Select this option if you want to update the firmware in the SE7EN DISPLAY (LCD type).
- Force fw CUSB
  Select this option if you want to update the firmware in the M28 charger cable. Please note that the charger cable needs to be connected to any USB power source when performing the update.
- Force fx CPOD
  Select this option if you want to update the firmware in the CPOD.

Once you select to update a certain part of the system a firmware update window will be visible on the M28 so you can follow the update procedure. If you want to abort an ongoing update procedure, simply press both buttons on the M28.

Appendix 3 - SE7EN connected to M28 Dive procedures DECO 40 / DECO TRIMIX 48 / DECO TRIMIX 60 / DEEP 100

1. Introduction

The SE7EN can support decompression diving. To be able to perform decompression dives, you need two things: 1) the appropriate training, and 2) a decompression-enabled battery module.
The decompression battery module is available in four versions: Blue, Yellow, White or Black.

- The *Yellow* battery module allows decompression dives to a maximum depth of 40m with air in the on board diluent gas.
- The *Blue* battery module allows decompression dives to 48m with normoxic trimix minimum 16% oxygen content in the on board diluent gas.
- The White battery module allows decompression dives to 60m with normoxic trimix minimum 16% oxygen content in the on board diluent gas.
- The Black battery module allows decompression dives to 100m with hypoxic trimix minimum 1% oxygen content in the on board diluent gas.

The decompression diving battery modules give you the opportunity to do both recreational no-decompression diving and technical diving without changing the battery or SE7EN firmware.

The five different battery modules, referred to as the “Recreational 40m”, “Deco 40m”, “Deco 48m Trimix”, “Deco 60m Trimix” and “Deep 100m” batteries, each have different hardware keys. They are all independent from each other and are not sensitive to firmware changes.

!

WARNING:
The battery is your personal decompression diving key, do not lend it to anyone who is not properly trained in its use.

Only properly trained divers are allowed to use either of the decompression-enabled battery modules with a SE7EN rebreather.

!

WARNING:
Diving to 60m affects the canister duration. The canister has been tested for a duration of 120 minutes at 60m. According to EN 14143:2013 the canister duration is to be determined via a full dive profile. This is proven within the formal testing of the Poseidon SE7EN by an accredited laboratory. Conducting a 100m dive with 10minutes bottom time, using a prepacked canister (Sofnodive 797) it was determined that such a dive profile is within the canister duration. The dive was carried out using a 11/69 Trimix, following the WeDive plan. Test conditions were as follows; Water temp 4°C, and a breathing rate of 40lpm producing 1.6 l CO_2 per minute at STPD (Standard Temperature & Pressure, Dry).

Figure 3-37. *The Poseidon SE7EN Battery range.*

2. Assembly Technical 60 m Counterlungs to BCD / Harness / Regulators

Attach the counterlungs to the shoulder straps of your BCD/Harness using the velcro straps on the back side of each counterlung.

Upper counterlung shoulder strap to tank band connection.

Connect the small male plastic clip on the upper part of the counterlung to the female plastic clip attached to the tank strap on the same side as the counterlung.
Adjust the position of the counterlung using the strap on each male plastic clip.

The counterlungs on the Poseidon SE7EN are designed to attach to the backpack straps and to be moveable along the straps. An upper adjustable-length quick connect buckle anchors the top end of the counterlungs to the gas processor (Figure 1-16). Three velcro straps on the back of each counterlung (Figure 1-16) attach the counterlungs to the shoulder straps of the backpack. The SE7EN is provided with a lower D-ring and a crotch strap that connect to the bottoms of each counterlung. Using this system the user can fix the counterlungs as high or low on the harness straps as desired to reduce the work of breathing.

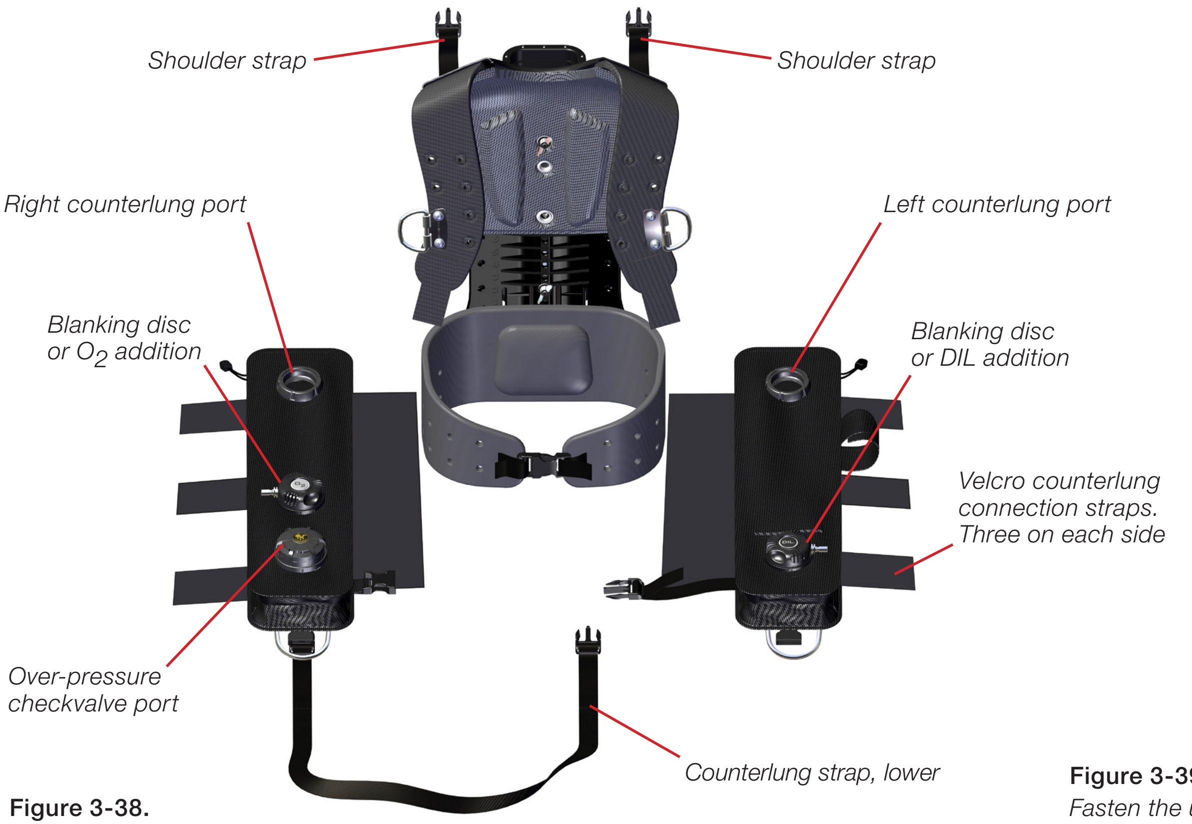


Figure 3-38.
Lay out both left and right hand counterlungs and their water diversion manifolds.

Figure 3-39.
Fasten the upper counterlung position with the adjustable-length quick-connect buckle. Attach the three velcro retainer flaps to the Platform harness straps.

Rear CC hoses to counterlung

T-connections.
Connect the T-connection to the top port in each counterlung.
Refer to chapter 1 section 4 and 5 for more information about how to connect the T-connections and CC hoses.

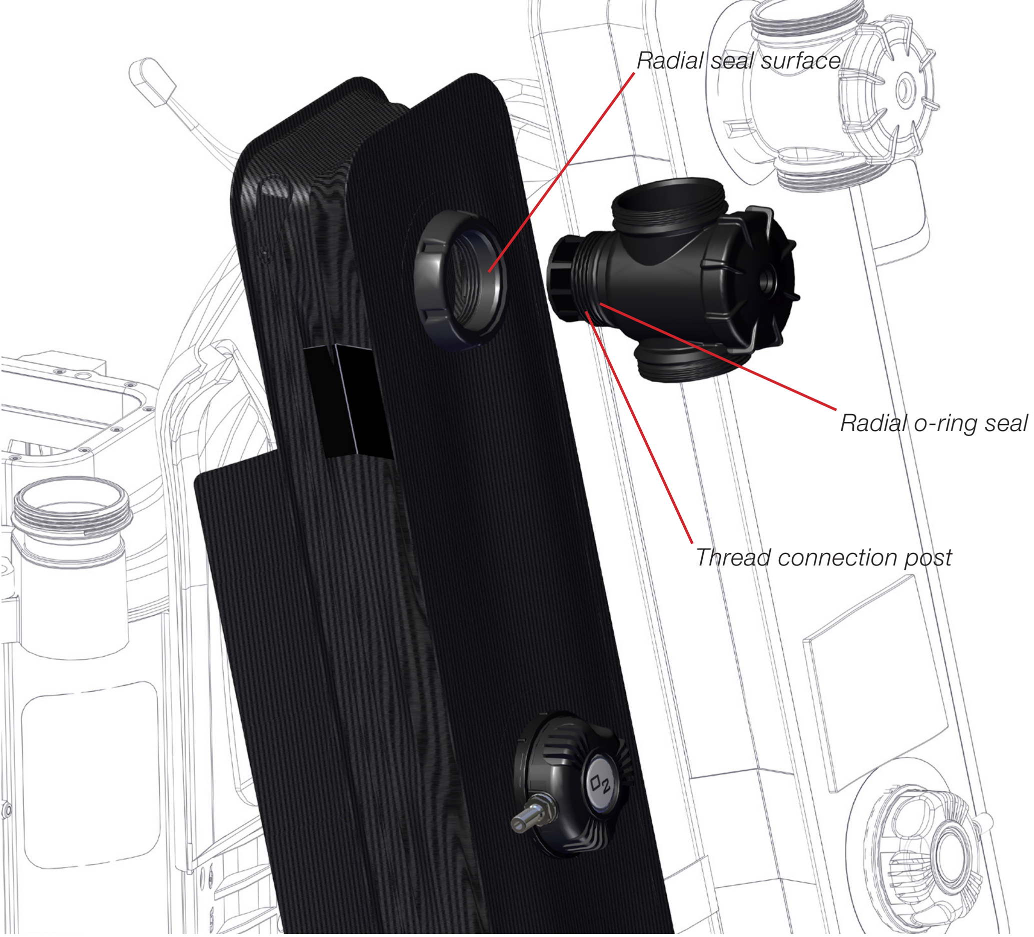


Figure 3-40. *Insert the right hand water diversion manifold into the port on the right counterlung. Clockwise tighten the water diversion manifold into the right and left counterlung shoulder port. Note the correct orientation, further described in chapter 1, section 4.*

Manual addition

The additional ports on the counterlungs can be used for Oxygen and Diluent manual gas addition valves for technical diving capabilities. These valves can be replaced with blank covers if manual gas addition capabilities are not required (e.g., for recreational diving). The port for the manual Oxygen addition valve (right counterlung) is intentionally placed higher than the diluent addition valve (left counterlung). This forces the diver to think prior to manually adding oxygen to the unit.

Manual addition O_2
The manual oxygen valve on the right counterlung allows you to add oxygen into the loop when attached. It will feed in more oxygen the longer the button is pressed.

> **!** **WARNING:**
> **Manual additions requires adequate training and can cause serious injury or death if not used correctly.**

Manual addition Dil
The manual diluent valve on the left counterlung allows you to add diluent into the loop when attached. It will feed in more diluent the longer the button is pressed.

Figure 3-41. *Remove the blank port plugs on each counterlung and replace them with the manual addition valves.*

Routing the inflator hoses

Connect the the O_2 inflator hose “marked O_2” to your onboard O_2 gas supply (or any other offboard source). Route the hose over your right shoulder and connect to the O_2 inflator valve though the quick connection.

Connect the the diluent inflator hose to your onboard diluent gas supply (or any other offboard source). Route the hose over your left sholder and connet to the diluent inflator valve though the quick connection.

The valves described above can be supplied with any other gas supply. E.g. your onboard oxygen is empty but you have a bailout stage with oxygen or another gas that you would like to manually add to the loop.

!

WARNING:
Gas plugged in to the system needs to be selected carefully to avoid hazardous loop PO_2.

Figure 3-42. *LP hose routing.*

3. Configuring the SE7EN for decompression diving

The SE7EN can be set up differently for different types of dives through the PC configuration software tool. This tool can be downloaded from the Poseidon website, **www.poseidon.com** Alternatively the settings can be altered from the M28 computer through the system app and further “Edit SE7EN reg”. This requires that the M28 is connected to the SE7EN system though a cable connected to the E-Module.

Decompression permitted

The Blue, Yellow, White and Black batteries are configured by the factory to allow decompression diving. Once a battery module configured for decompression diving is inserted into a SE7EN rebreather, a parameter in the rebreather is set to allow (optionally) decompression diving. Only Poseidon can set this ‘Decompression permitted’ parameter. Without the proper battery for decompression diving, none of the parameters described below can be altered.

Decompression enabled

Once a battery module that allows decompression is inserted into a SE7EN rebreather, the user can then select whether the rig is *enabled* for decompression before any particular dive. If this parameter is not set, then the battery behaves as though it is a non-decompression rig. This feature allows the diver to decide whether the rebreather should function as a decompression-enabled rebreather, or as a standard no-decompression rebreather, on any particular dive. This parameter is altered through the configuration tool.

40m Deco Version

With the yellow Deco 40m battery module, the user may use the PC configuration or optionally a M28 computer software tool to enable or disable decompression diving.

48m/60m/100m Deco Trimix Version

As with the yellow Deco 40m battery module, the blue Deco 48m, the white Deco 60m and black 100m Trimix battery modules allow the user to enable or disable decompression using the configuration software tool or the M28. In addition, these battery modules allow the user to alter the diluent gas mixture.
Using either the 48 or 60m Trimix batteries the SE7EN will only accept “normoxic” diluent mixtures (a minimum of 16% oxygen). Helium content is limited to 0-84% and N2 to 0-80%.

Moreover, the blue Deco 48m Trimix battery module allows dives to a maximum of 48 meters and White Deco 60m Trimix to 60 meters. Using the 100m Deep battery the Poseidon SE7EN will accept any diluent mixture with an oxygen fraction equal to or higher than 1%.

Decompression and TTS settings can be altered at any time until dive start meanwhile gas mixtures only can be altered until test 50 has been reached. When decompression is enabled, the “ceiling” indicator will be lit on the LCD screen.

Maximum TTS

All technical battery modules include a unique feature: the ability for a diver to set a maximum TTS value. This feature makes it easier to plan decompression dives, because this value determines when the system warns the diver that the limit has been reached. The generated alarm response will be similar to the alarm shown when the diver exceeds the maximum working depth of the rig. This value also affects the way the controlling resource algorithm (CRA) works, as described below. This parameter is altered through the configuration tool or optionally through the M28.

4. Pre-Dive Procedures with a Poseidon SE7EN enabled for Decompression Diving

It is possible to determine whether a rig is configured for decompression diving by examining the ceiling indicator during the pre-dive routine. The ceiling indicator will be blank for a standard rig and be lit flash for a SE7EN enabled for decompression diving.

48m/60m/100m Trimix

On a unit with the blue 48m, 60m or 100m Trimix battery installed, the diver will be prompted to confirm the helium fraction (pre-dive test 51) and O2 fraction (test 52) of the diluent mixture. This test occurs immediately after the mouthpiece 'CC' test (test 50), and will occur only if the SE7EN is configured for decompression diving, or if the configured diluent is not air (the test is not performed if the rig is not configured for decompression diving and the diluent is already configured as air).
The M28 will display 'is DIL Helium fraction nn%' during test 51 where 'nn' is the assumed Helium fraction. The diver is prompted to confirm YES or NO using the M28 buttons. During test 52 the procedure is repeated but now the diver is supposed to confirm the Oxygen content in the diluent. See figures 3-43 and 3-44.

If the helium or oxygen fraction is incorrect, the diver can either:

1. Use the PC Bluetooth link or the M28 to alter the CC gas to any of the predefined gases through the 'CC Gas select' option in the Dive menu. The gas content can be altered while in test 51 but not after. to change it to the correct value. The new value will appear in the LCD.
2. Let the test timeout (two minutes) at which point the rig will shut down.

Figure 3-43: *Helium confirmation screen at test 51, showing the question of helium fraction content in the diluent gas tank.*

Figure 3-44: *Oxygen confirmation screen at test 52, showing the question of oxygen fraction content in the diluent gas tank.*

5. Switching batteries

If a rig has been configured with a gas mixture other than air on a SE7EN using a 48m, 60m or a 100m battery, and then a 40m Deco battery or Recreational 40m battery is then inserted into the rig, the user will be given a special prompt during the pre-dive to confirm that diluent will be automatically changed to air.

Procedure

After inserting a Recreational 40m or yellow Deco 40m battery into a SE7EN that was previously configured for non-air diluent (e.g., trimix), the pre-dive routine will display tests 51 and 52 as described above for the user to confirm and acknowledge that the diluent will be air (0% Helium, and 21% oxygen). If these tests are completed successfully, the unit will automatically switch the diluent composition to air. If the Recreational 40m battery or Deco 40m battery was inserted by mistake, the diver should NOT confirm these tests. Instead, the test should be allowed to time out (two minutes) after which the rig will power-down, and then the correct (Deco 48m/60m) battery can be inserted. In this case, the original non-air diluent will be retained.

6. Decompression Diving with the SE7EN

A SE7EN enabled for decompression diving will behave differently compared to a SE7EN that is not configured for decompression diving. Important changes in the functionality when a diver approaches and enters decompression are:

- The ceiling indicator will not flash. It will just be on and not flashing. When the ceiling indicator is on, the alert triangle will not be on.
- The rig will not issue an alarm (HUD & Buddy lights, Audio Alarm) when decompression is entered." There is no audio alarm when decompression is entered on a non-decompression configuration.
- When the mouthpiece is found to be in an indeterminate state (neither in Open-Circuit nor Closed-Circuit position) a different audio alarm signal will alert the diver to correct the mouthpiece position. The reason for this is that when the mouthpiece is in an indeterminate position, decompression is calculated as though the diver is breathing in open-circuit mode. The alarm helps prevent the diver from being penalized from a decompression point of view.

Controlling Resource Algorithm (CRA)

A SE7EN enabled for decompression diving has a different controlling resource algorithm (CRA). In a standard SE7EN, the remaining dive time is the minimum of remaining no-decompression dive time (RNDT), Oxygen supply, Battery supply or OTU's. What this means in practice for most divers on most dives is that the remaining dive time is the RNDT.
For a decompression-enabled SE7EN, an RNDT of zero is permissible and will not generate an alarm. Thus, after the RNDT reaches zero (i.e., when a decompression ceiling exists), the CRA instead only takes into account the Oxygen Supply, Battery Supply, and OTU value when calculating the remaining dive time.
While a decompression ceiling exists, the CRA is not displayed on the LCD screen, because this part of the screen is used for the total decompression time (see chapter 3, dive procedures in the SE7EN manual). However, the CRA is still calculated (excluding the RNDT value) and used to generate alarms, if needed. Also, whenever a decompression ceiling exists, if the TTS exceeds 80% of the CRA time (for any of the CRA values other than RNDT), an alarm will alert the diver that the dive must be terminated.

Open-Circuit Bailout

On a SE7EN that is not enabled for decompression diving, the system monitors the amount of gas remaining in the diluent cylinder, and warns the diver when the calculated amount of diluent is insufficient to reach the surface. When using a SE7EN enabled for decompression diving, the system assumes that the diver is carrying additional gas supplies for open-circuit bailout, and therefore no warnings are given to the diver when the standad diluent supply is insufficient to allow a safe open-circuit bailout to the surface.

!

WARNING:
Planned decompression diving requires additional training and support equipment. NO NOT attempt to use a SE7EN rebreather for decompression diving without proper training and equipment! In particular, when diving with a SE7EN enabled for decompression diving, it is the DIVER'S RESPONSIBILITY to ensure access to an adequate supply of breathing gas to effect a safe and controlled bailout to the surface, including full decompression requirements!

Setpoint

A SE7EN enabled for decompression diving uses a different PO_2 setpoint algorithm. The intent of the algorithm is to keep the setpoint higher for longer when a decompression ceiling has been encountered during a dive. This comes at the cost of making buoyancy control more difficult in shallow water. The algorithm will always use the highest setpoint (typically 1.3 bar), subject to the following limitations:

1. The FO_2 is limited to 75%. Thus at the surface the setpoint would be 0.75 bar. At 3m the setpoint would be 0.98 bar, and at 6m and greater the setpoint would be 1.3 bar (for a rig with a 1.3 high setpoint value).
2. The hyperoxic linearity test still applies. Thus a rig that fails the hyperoxic linearity test will not be allowed to use a setpoint > 1 bar. (See chapter 3, hyperoxic linearity test in the SE7EN manual).