

Computers and Dive Tables

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South Carolina
Aquarium

South Carolina Aquarium Dive Operations

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It is the mission of the South Carolina Aquarium (SCA) Dive Team to provide excellence in animal care and husbandry, to actively support both the educational and conservation endeavors of the SCA, and to provide a memorable, positive guest experience to all those who visit our facility.

Training Schedule

- PowerPoint Presentation
- Quiz
- 2 Checkout Dives
 - > **Supervised by DSO's or Designee**

Effects of Compressed Gas on Divers

- Divers using compressed gas intake abnormal partial pressures of nitrogen or possibly oxygen in the case of enriched air (nitrox) use.
- Increased levels of nitrogen can lead to possible DCS issues and increased levels of oxygen can lead to oxygen toxicity

Planning a Dive

- Divers need to plan their dives to minimize risk due to breathing compressed gasses at depth
- Dive Tables are the original method for planning a dive
 - > Assume dive plan of a Square Profile
- Dive computers have evolved based off of dive tables and can give an instantaneous tracking of possible gas loads
 - > Tracks spontaneous depth profiles and changes the diver makes
 - > Therefore Divers often have longer No-Deco Dive Times using a Dive Computer VS Tables

J.S. Haldane

- “Father of Decompression Theory”
- Physiologist appointed to develop decompression tables for the Royal Navy divers.
- Tables were based off of tissue saturation theory and experimentation on goats.

U.S Navy Tables

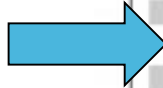
- Based on Haldanes tissue compartment work. 1907
- 1930's U.S navy researchers used human volunteers. It took until 1957 to publish the original Navy tables.
- 564 dives resulting in 26 case of decompression sickness
- 122 repetitive dives based on 61 profiles with 3 cases of bends.
- “M” values of supersaturation ratios for each compartment
- 5,10,20,40,80 and 120 minute tissues.
- Tables are based on actual dives using tissue compartment theory.

U.S. Navy Dive Table 3

Unlimited/No-Decompression Limits and Repetitive Group Designation Table for Unlimited/No-Decompression Air Dives—1999

Depth (feet/meters)	No-Decompression Limits (min)	Group Designation Letter																	
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O			
10	3.0	unlimited	60	120	210	300	797	*											
15	4.6	unlimited	35	70	110	160	225	350	452	*									
20	6.1	unlimited	25	50	75	100	135	180	240	325	390	917	*						
25	7.6	595	20	35	55	75	100	125	160	195	245	315	361	540	595				
30	9.1	405	15	30	45	60	75	95	120	145	170	205	250	310	344	405			
35	10.7	310	5	15	25	40	50	60	80	100	120	140	160	190	220	270	310		
40	12.2	200	5	15	25	30	40	50	70	80	100	110	130	150	170	200			
50	15.2	100		10	15	25	30	40	50	60	70	80	90	100					
60	18.2	60		10	15	20	25	30	40	50	55	60							
70	21.3	50		5	10	15	20	30	35	40	45	50							
80	24.4	40		5	10	15	20	25	30	35	40								
90	27.4	30		5	10	12	15	20	25	30									
100	30.5	25		5	7	10	15	20	22	25									
110	33.5	20			5	10	13	15	20										
120	36.6	15			5	10	12	15											
130	39.6	10			5	8	10												
140	42.7	10			5	7	10												
150	45.7	5			5														
160	48.8	5				5													
170	51.8	5				5													
180	54.8	5				5													
190	59.9	5				5													

*Highest repetitive group that can be achieved at this depth regardless of bottom time



NAUI TABLES

- NAUI tables are derived from the Navy tables with additional safety factors.
- Breathing rates, body exertion, which are affected by, stress, temperature, age, weight, and many other factors make the tables less consistent

WARNING: EVEN STRICT COMPLIANCE WITH THESE TABLES WILL NOT GUARANTEE AVOIDANCE OF DECOMPRESSION SICKNESS. CONSERVATIVE USAGE IS STRONGLY RECOMMENDED.

RNT RESIDUAL NITROGEN TIME
+ADT ACTUAL DIVE TIME
TNT TOTAL NITROGEN TIME
(USE THIS FIGURE TO DETERMINE END-OF-DIVE LETTER GROUP)

DIVE TABLES

TABLE 1 - END-OF-DIVE LETTER GROUP

START DEPTH M	START DEPTH FEET	00 MAXIMUM DIVE TIME (MDT)								00 DIVE TIME REQUIRING DECOMPRESSION NO. MINUTES REQUIRED AT 15' STOP (5M)							
		5	15	25	30	40	50	70	80	100	110	130	150				
12	40	5	15	25	30	40	50	70	80	100	110	130	150				
15	50		10	15	25	30	40	50	60	70	80						
18	60		10	15	20	25	30	40	50	55	60						
21	70		5	10	15	20	30	35	40	45	50	60	70				
24	80		5	10	15	20	25	30	35	40	45	50	60				
27	90		5	10	12	15	20	25	30	35	40	45	50				
30	100		5	7	10	15	20	25	30	35	40	45	50				
33	110			5	10	13	15	20	25	30	35	40	45				
36	120			5	10	12	15	20	25	30	35	40	45				
39	130			5	8	10	15	20	25	30	35	40	45				

M. FT.	12	15	18	21	24	27	30	33	36	39	NEW GROUP
40	7	6	5	4	4	3	3	3	3	3	A
50	17	13	11	9	8	7	7	6	6	6	B
60	113	67	44	36	27	18	15	9	6	6	C
70	25	21	17	15	13	11	10	10	9	8	D
80	105	59	38	30	22	14	12	5			E
90	93	51	31	25	17	9	8				F
100	49	38	30	26	23	20	18	16	15	13	G
110	81	42	25	19	12	5	4				H
120	61	47	36	31	28	24	22	20	18	16	I
130	69	33	19	14	7						J
	73	56	44	37	32	29	26	24	21	19	K
	57	24	11	8							L
	87	66	52	43	38	33	30	27	25	22	
	43	14									
	101	76	61	50	43	38	34	31	28	25	
	29	4									
	116	87	70	57	48	43	38	AVOID REPETITIVE DIVES OVER 100 FEET			
	138	99	79	64	54	47					
	161	111	88	72	61	53					

TABLE 3 - REPETITIVE DIVE TIMETABLE

00 LIGHT FACE NUMBERS ARE RESIDUAL NITROGEN TIMES (RNT)
00 BOLD FACE NUMBERS ARE ADJUSTED MAXIMUM DIVE TIMES (AMDT)

TABLE 2 - SURFACE INTERVAL TIME (SIT) TABLE

TIME RANGES IN HOURS : MINUTES
ACTUAL DIVE TIME SHOULD NOT EXCEED THIS NUMBER

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PADI RDP

- Based on Haldanian system of tissue compartments.
- Used 60min tissue for control Vs. 120min
- Doppler monitored 743 dives 325 dive schedules
- Bubbles detected in 53 of the 743 dives
- No Cases of Bends arose in any test

Choosing a Dive Computer

- User Friendliness
 - > 1, 2, 3 or 4 function buttons
- Nitrox or Technical Gas diving capability?
- Air Integrated
 - > Hose
 - > Wireless
 - > Not Capable
- Battery Replacement
 - > User or Technician?
 - > Rechargeable
- Computer Downloadable?
 - > Digitize Computer Dive Logs
 - > Paper & Pen Logbook

Choosing a Dive Computer(*cont.*)

- Information Display
 - > Graphic representation
 - > Font sizing
 - > Overall screen size
- Mounting options
 - > Console
 - > Wrist
 - > Interchangeable Options
- User customization
 - > Deco-limits or Algorithms
 - > Alarms
 - > Other conservative factors

General Computer Use

- Every diver should be self-sufficient with their own Dive Computer
 - > Sharing Computers between divers leads to erroneous Nitrogen loading calculations
 - > Computers should not be switched until complete off-gassing (24 hours Surface Interval) has occurred
 - > Divers diving on back to back days (< 24hrs Surface Interval) must use the same computer
- If diving different brands or models, the dive plan should be slave to the most conservative computer in the diving team

General Computer Use_(cont.)

- Divers should avoid pushing bottom times to the computer's limits.
 - > These limits are model limits, they do not allow for environmental conditions or personal limitations (i.e., strenuous work, diver's age, previous injury, history of DCS, etc.).
- Ascending profiles should always be used on a deep, multi-level dive.
- Repetitive dives should be planned with the **deepest dive first** and subsequent dives shallower than the one preceding
- Due to often longer bottom times allowed by Computers VS Tables, divers are more likely to encounter:
 - > Hypothermia
 - > Unintentional Deco Obligations
 - > Out-of-Air Situations

General Computer Use_(cont.)

- Terminate dive & Ascend to Safety Stop if Dive Computer:
 - > Displays No Deco-Time \leq 10mins left
 - *This prevents unintentionally going into a Decompression Stop Obligation*
 - *Most recreational divers do not carry enough air to complete a Deco-Stop, which leads to a high likelihood of DCS*
- Terminate dive & skip Safety Stop if Dive Computer:
 - > Fails or malfunctions
 - > Indicates Low Battery Warning

If any of the above occurs, Diver must be restricted from diving until discussion with Dive Operations.

Most of these occurrences in GOT are rare and due to computer malfunctions. Diver usually returns to diving under Dive Table guidelines.

SCA Guidelines: Dive Computers

- Decompression diving is not allowed under the auspices of the SCA diving program. Dive computers must not be used to facilitate this type of diving
- Divers should always start a Safety Stop between 10-25ft for 3-5 minutes even if the Dive Computer doesn't prompt
- Dive Computer Number should be recorded on Whiteboard & Paper Dive Logs
- Divers should also use their personal dive computer as supplement if diving outside SCA the next day (ie. within 24 hours of their last SCA dive)
 - > The more conservative computer will be followed during SCA diving
 - > *DPIC or DSO needs to be alerted before diving commences*

Sherwood Amphos

- The South Carolina Aquarium has chosen to use the Sherwood Amphos Dive Computer



Activating Dive Mode

- Amphos default into Watch Mode after 2 hours of inactivity
- Press & Hold “Mode” / Upper Left Button for approx. 2 seconds
 - > Release button when screen changes
 - > Dive Mode should be activated every time before diver enters tank



Activating Dive Mode(*cont.*)

- Make note of **Nor** – Normal Dive Mode
- Other modes should not be used:
 - > GAU – Gauge Mode does not calculate nitrogen loading; the computer only tracks depth & time
 - > tot / FREE – Freediving Mode; computer becomes a freediving depth & time tracker
- Keep holding down Mode Button until Amphos cycles back to **Nor**
 - > Release then single press Mode to confirm Normal Dive Mode



Fig. 29 - NORM SURF MAIN



Fig. 30 - GAUG SURF MAIN



Fig. 31 - FREE SURF MAIN

Battery Warning

- The Amphos will do a battery voltage check every time it is activated into Dive Mode
 - > Make note if one or both of the indicators appear
 - > **Turn into DPIC immediately for battery change**

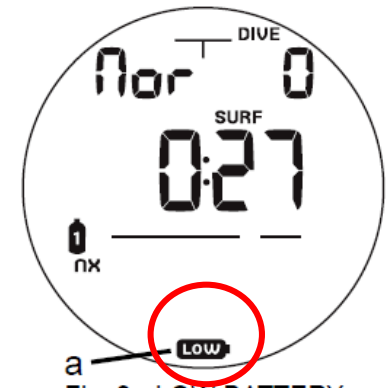


Fig. 3 - LOW BATTERY WARNING



Fig. 4 - LOW BATTERY ALARM

To Use, or Not to Use

- Computers used by other divers within 24 hours should not be used
- Make note of **0 Dives**
 - > Confirm **Nor** – Normal Dive Mode is set

Good to Use



Used Yesterday



Wrist Mount

- Divers are required to wrist mount the Amphos
- There are extension bands available
- If you do not need the extension band, leave it hanging on the hook in the gear room



Dive Mode Interface *(cont.)*

*Dive Mode - Main Screen
activates once 4-6ft depth is
reached*

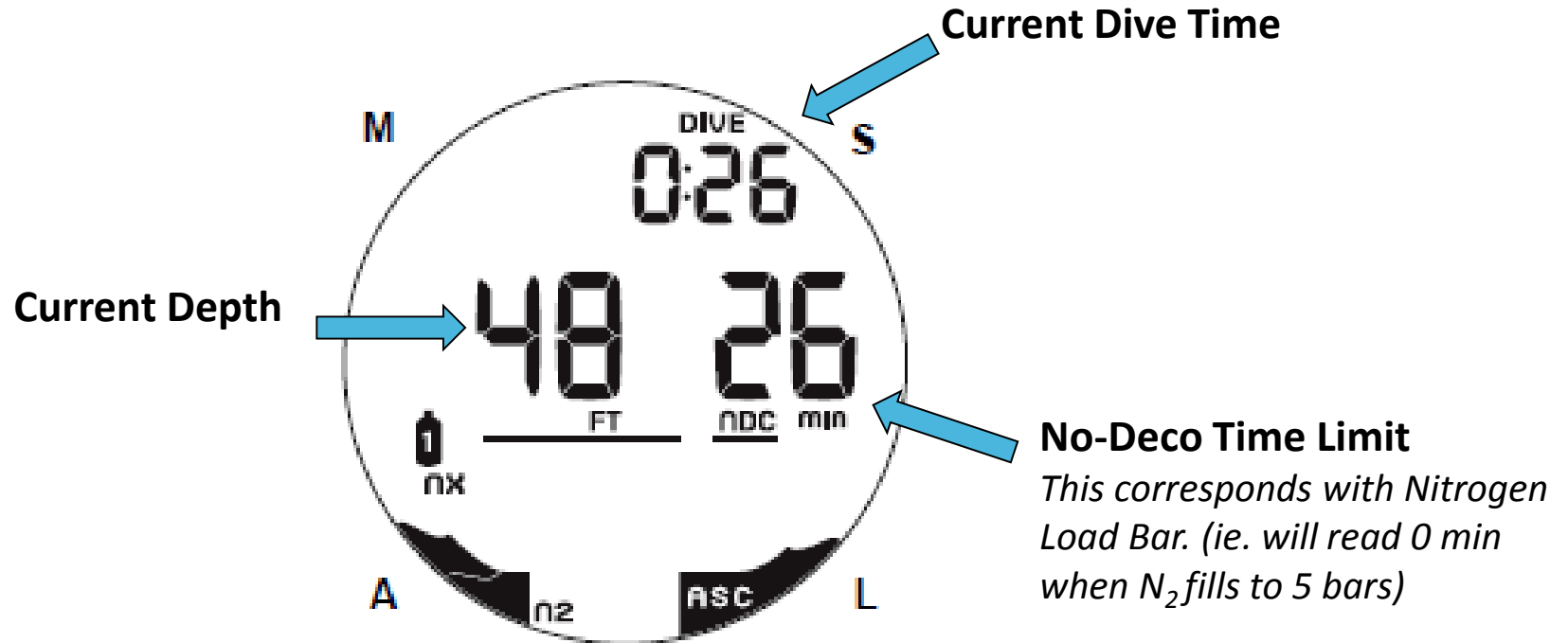


Fig. 69 - NO DECO MAIN

Dive Mode Interface(cont.)

Fig a.

Nitrogen Load (N₂), represented by a 5 bar graph on the lower left side of the display

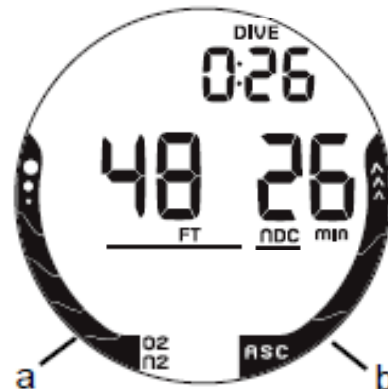


Fig. 23 - BAR GRAPHS

Fig b.

Ascent rate (ASC) is represented by a 3 bar graph on the lower right side of the computer

ASC values		
Deeper than 60 FT (18 M)		
Segments	Ascent Rate =	
Displayed	FPM	MPM
0	0 - 20	0 - 6
1	21-50	6.5-15
2	51-60	15.5-18
3	>60	>18
60 FT (18 M) & Shallower		
Segments	Ascent Rate =	
Displayed	FPM	MPM
0	0 - 10	0 - 3
1	11-25	3.5-7.5
2	26-30	8-9
3	>30	>9

Divers should not exceed 2 bars on the ASC graph when ascending

Dive Mode Interface(cont.)

Once Diving only 2 buttons should ever be pressed

- **A** – Adv / Lower Left
 - > Switched to alternate info screen
 - > Will revert back in 5 seconds or when pressed
- **L** – Light / Lower Right
 - > Activated 5 second Backlight
 - > Pressing again will turn off
- Upper Buttons **M** & **S** will activate extra functions when held down
 - > Leads to diver induced computer errors for GOT diving environment

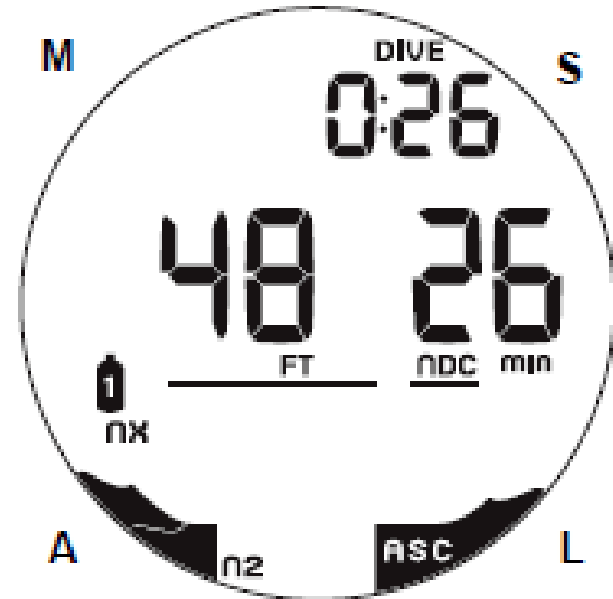
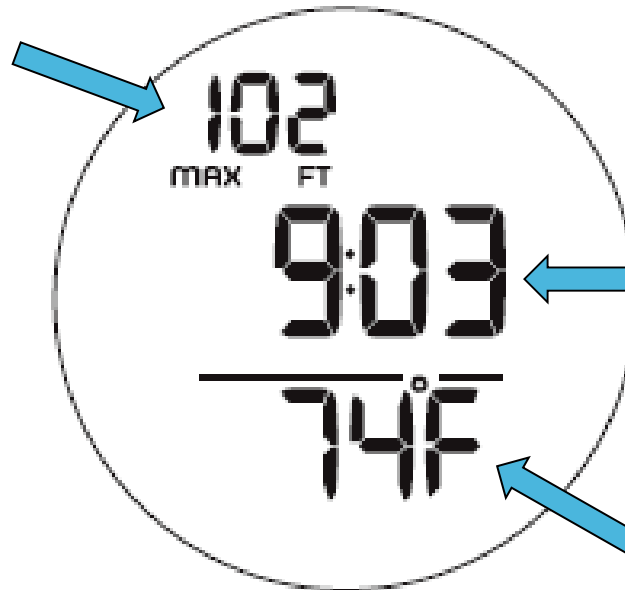


Fig. 69 - NO DECO MAIN

Dive Mode Interface(cont.)

*Alternate Screen activates once
A – Lower Left Button is pressed*

Max Depth



**Time of Day
(24:00 Format)**

Current Temperature

Fig. 70 - NO DECO ALT 1

Alarms

- Alarms are turned ON
 - > High pitched beep alternating every second
 - > Supplemented with a visual warning on screen
- Ascent Rate Alarms are the most “common” alarm in Aquarium diving
- Always pay attention to your alarms.

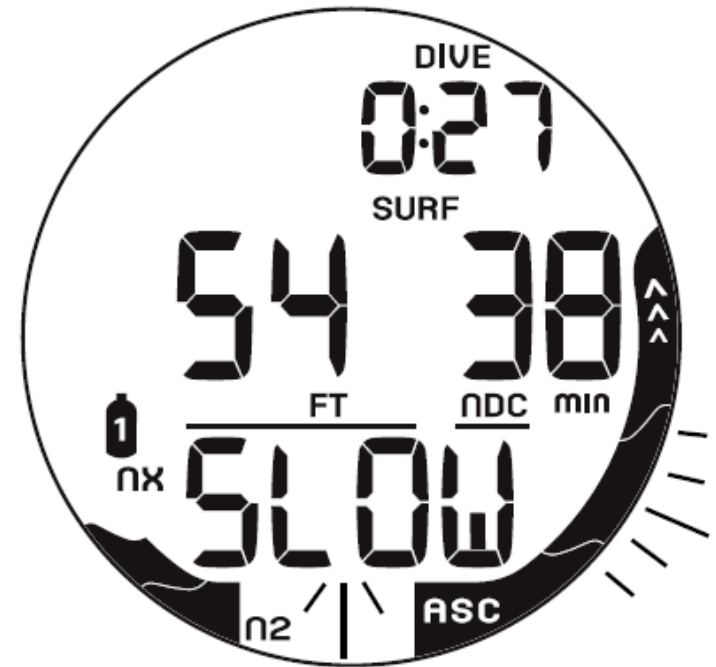


Fig. 68 - ASCENT ALARM

Safety Stops

- SCA required divers to start a safety stop at the ending of every dive
- Amphos prompts a **15ft/3:00 min** Safety Stop once diver reached 20ft, but only if
 - > Diver exceed 30ft depth
 - > For 1 minute or more
- *Divers still have to manually track and conduct a Safety Stop even if Amphos does not prompt you*



Fig. 74 - SS MAIN

Logging Dives

- Dives will be logged as Normal
 - > Dive Whiteboard – Record Computer Number
 - > Paper Log – Record Computer Number
 - > Online/Digital – Choose option: **Decompression Planning: Computer – Sherwood**
 - *Computer number needs to be recorded on digital log if there was a malfunction, diver injury, or DCS issue.*

Cleaning Dive Computer

At End of Day:

- Rinse the dive computers in freshwater only and return them to their assigned numbered hook
- Do not leave computers in the bottom of the disinfect/rinse buckets
- Team Leaders should confirm all gear has been returned to the gear room at the end of the day

Computer Manual

The full Sherwood Amphos Dive Computer Manual is available in the back of the Dive Computer Training Binder or digital copy via the Dive Safety Officer, upon request.

This training presentation covers all basics features needed to use the Amphos for Exhibit Diving in the South Carolina Aquarium

Dive 1

Choose Dive Computer clear of Nitrogen Time

Overview Dive Screen at depth

Activate & Overview Alternate Screen at depth

Monitor during your dive

Dive 2

Activate Dive Mode

Monitor during dive

Monitor during RASS Ascent

