

OWNER'S INSTRUCTION MANUAL

# The **EDGE**™

Electronic Dive Guide



## Introduction

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This is the owner's manual for the EDGE™ Electronic Dive Guide™. It consists of a description of what the EDGE is and how it functions, followed by instruction on how to use it. The next sections lead you through some common dive profiles, showing you how to read the EDGE's display screen. Then the care and maintenance of the EDGE is described, followed by a section

on the limitations you should be aware of. A section on background and theory is provided for those with a technical orientation or who simply wish a deeper understanding. A Question & Answer section is provided at the end; we urge you to call ORCA Industries if any additional questions come to mind.

The EDGE itself is a compact, submersible computer which gives you the information you need to plan your dives and to avoid the bends. It is also a precision depth gauge, dive-timer, and surface interval timer. It takes care of repetitive dives as well as single dives. When using the EDGE, you get credit for the shallow portions of a dive,

because the EDGE accounts for the fact that your body absorbs less nitrogen at shallower depths; typically divers using the EDGE get double the time allowed by U.S. Navy tables. You also get Orca Industries' patented tissue-tracking display of dissolved nitrogen, scrolling repetitive dive table, and maximum depth recorder.

The EDGE is not just a new product, it is a new way of diving. Rather than explaining further, allow this manual and a few exhilarating dives with the EDGE to tell you what we mean!

## Update for Div 4 & Div 5 Software:

EDGEs shipped after September 1, 1986 have improved software, called "DIV 4," which gives a rate of ascent indicator, plus two other small changes. DIV 5 is just like DIV 4, but it is only for upgrades of older EDGEs. Here is the additional information you need to use DIV 4/DIV 5:

The screen will flash "ASCEND SLOWER" if you exceed the prescribed ascent rates:

20 fsw/min. in the 0-60 fsw range  
40 fsw/min. in the 60-120 fsw range  
60 fsw/min. in the 120+ fsw range

You can ascend quickly when deep, but ascent rate slows as you near the surface. It will take 3 full minutes to ascend from 60' to the

surface! This is very important in avoiding bubble formation and minimizing your risk of bends.

To ascend, begin your ascent at what you feel is the proper rate, keeping your eye on the EDGE screen (looking toward surface, arm w/EDGE above your head, is best technique). If you see "ASCEND SLOWER," then slow ascent until message stops.

If you surface while the message is flashing, it will flash for 10 minutes (as an aid to rescuers in the event of an accident).

Since it is difficult to ascend slowly in the last several feet, it is a good idea to stop at about 10 fsw for a minute prior to your final ascent. This will prevent surfacing with an "ASCEND SLOWER," since time spent at a steady depth builds up an 8 fsw bracket of "free ascent."

(This bracket builds up at a rate of 1 fsw every 3 seconds and is designed to eliminate "false alarms" during the dive.)

By popular demand, the temperature reads in degrees Fahrenheit rather than Celsius. Over 99 degrees F is shown in reverse video, without the leading "1" for one hundred.

The limits of the slowest tissues were increased slightly from DIV 3 to always allow decompression at 10 fsw, solving what previous arduous divers termed the "1 foot Ceiling problem."

We hope these changes will make your diving with the EDGE even more enjoyable! Good Diving!



## Important Note About Installing Battery Door (Effective 7/19/85)

Since the manual originally went to press, we have developed a more complete explanation of how to seal the battery door:

Follow the instructions on page 5 of the manual, EXCEPT for what is illustrated in Fig. 4! Instead:

1. Place the door on the properly seated O-ring squarely and gently (don't slide it around or do anything to give the O-ring an excuse to jump out of its groove).
2. Then PINCH & HOLD the case front and the door together, between your forefinger and thumb. NOW is the easy time to find out if the O-ring is still in its groove. While pinching,

CHECK all three sides of the battery door: the gap between door & case should be very slight and EXACTLY THE SAME on all three sides. If not, re-do. The door must feel rock-solid-in-place, with an even gap all around, before proceeding.

3. While pinching firmly, tighten the screws with the other hand. The screws are relatively easy to turn until you start compressing the rubber of the O-ring, then you feel resistance. It takes less than one and a half (1.5) turns to compress the O-ring completely. If it seems to be taking more turns, the O-ring has probably jumped out of its groove.

Following these suggestions, the risk of flooding the EDGE is minimal.

GOOD DIVING!

A free-floating O-ring is best, but several EDGE owners have asked if they can somehow glue their O-ring in. Actually, gluing it would make for a very uncertain seal, but if you have a special need to immobilize it, you might try the following on an experimental basis:

Clean O-ring and groove. Place very, very small drop of RTV silicone on the four inside corners of groove. (For location, see Fig. 3; it's exactly where the upper arrow is pointing). Then place O-ring in groove and allow RTV silicone to cure.

ORCA has done no field trials on this method, so you are on your own. Some of the things to consider are how you will keep the O-ring clean & greased, and how residual silicone in the groove might affect the seal when you eventually remove the O-ring. Please call or write with any suggestions or questions.

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## Description of the Edge

The EDGE™ (Electronic Dive Guide™) is a MICROPROCESSOR BASED, DIVER CARRIED DECOMPRESSION/NO-DECOMPRESSION COMPUTER. The EDGE gives the diver a continuous readout of decompression status based on individual dive profiles. Unlike tables, the EDGE bases its information on a calculation procedure which updates decompression status continuously. This allows the EDGE to take into account the shallower portions of a dive profile instead of basing the decompression status solely on the maximum depth achieved during the dive. The

EDGE in essence creates a custom-calculated table for any dive profile.

The EDGE is simple to use and read. You just turn it on at the surface and dive with it. The decompression status information is conveyed in both digital and graphical form. Once you have learned how to read it, decompression status can be obtained at a glance.

The EDGE contains state-of-the-art microprocessor and electronic technology all housed in a rugged, waterproof, alloy case. The pressure transducer is temperature compensated and is accurate to  $\pm 1$  fsw throughout its range from 0-160 fsw. The EDGE is powered by a normal 9v alkaline battery which provides at least 48 hours continuous use. It also has the capability

of battery replacement without losing information from your previous dives.

The model programmed in the EDGE provides a safer dive than the U.S. Navy tables for dives with profiles where the Navy tables are marginal, while providing more dive time for multi-level dives. The model is based on the uptake and elimination of NITROGEN in twelve tissue groups with half-times ranging from 5 to 480 minutes. The combination of the ability to run the EDGE continuously and the longer tissue half times allow you to monitor decompression status over periods of days.

It should be remembered that the EDGE is a tool to help you dive with greater safety and freedom, but should not be used as a substitute

## Limited Warranty & Disclaimer

for thorough dive planning and safe diving techniques.

To be as safe as possible when using the EDGE:

1. Familiarize yourself thoroughly with its use before you begin diving with it. If you have any questions that cannot be answered by the manual or your dive shop, contact ORCA Industries directly.
2. Wear backup depth and time measuring devices.
3. Regularly confirm the calibration of the depth gauge.

The EDGE™ is warranted against defects in workmanship and materials for a period of one (1) year after purchase, subject to and in accordance with the terms and conditions set forth below. Buyer is responsible to obtain approval from Manufacturer before returning any unit, and any units returned must be well protected for shipping, insured, and shipped to the Manufacturer pre-paid. Buyer shall enclose a written statement detailing the nature of any problem and the circumstances under which it occurred.

This Limited Warranty shall not be effective unless the enclosed warranty card is completed and returned to Manufacturer within ten (10) days after the date of purchase, together with a photocopy of Buyer's receipt or similar

proof of purchase. This Limited Warranty shall apply only to the original Buyer of the unit, and shall not be effective with respect to units which have been used in rental, sharing, or similar multi-user arrangements.

Seller's and Manufacturer's responsibility and liability is limited to replacement or repair of any unit returned to Manufacturer within one (1) year after date of sale if such unit is determined by Manufacturer upon inspection to be defective in workmanship or materials. The battery clips and wires, however, are only warranted for 90 days from date of purchase. Replacement or repair shall include the cost of both



## Limited Warranty & Disclaimer

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4 materials and labor. Neither Seller nor Manufacturer shall be responsible to replace or repair any unit which has been damaged by improper or excessive use, alteration or tampering, accident or jolting, or any cause whatsoever other than defective workmanship or materials. It should be understood that the EDGE™ is a sensitive electronic device which is susceptible to damage if misused, abused, or subjected to accidental jolting or striking. It is intended only to provide an additional measure of safety to divers, and should not be relied upon by any user as his sole means of protection.

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### Disclaimer

It is expressly understood and agreed that by purchasing or using the EDGE, Buyer and any other person who may use it accepts it "as is", and with the understanding that Seller and Manufacturer disclaim any and all warranties and guarantees, whether express or implied, statutory or otherwise, except for the express limited warranty to repair or replace defective parts and materials set forth in the immediately preceding paragraph. Without limiting the generality of the foregoing, Seller and Manufacturer disclaim any other warranty or guaranty, whether express or implied, including, without limitation, any implied warranty of merchantability or implied warranty of fitness for any particular purpose. It is understood and agreed that neither seller nor manufacturer shall have any liability for any personal injury resulting from operation of the EDGE, or for any other damage, whether direct, consequential, or incidental, and Seller and Manufacturer disclaim such liability and Buyer and other users waive the right to assert such liability against Seller or Manufacturer.

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The EDGE is to be used only by certified divers who are fully trained and are aware of and have an understanding of the risks and potential hazards of diving. If you are not trained, please seek training prior to using the EDGE.

## Inserting the Battery and Sealing the Battery Door



Fig. 1

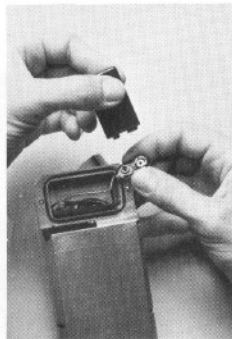


Fig. 2

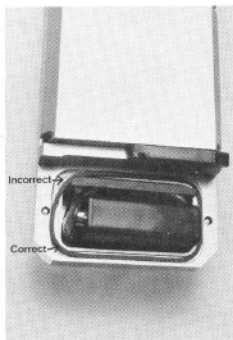


Fig. 3

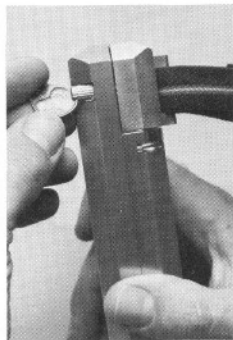


Fig. 4

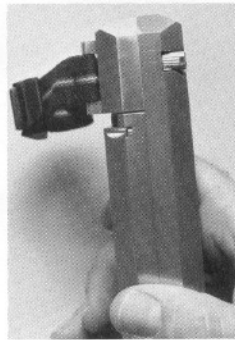


Fig. 5

**1.** Loosen the screws to the battery door with a coin and remove the Battery Door (Fig. 1). To prevent loss of the door place it in a secure place.

**2.** Connect a 9 volt alkaline battery to one of the battery clips. Snap the auxiliary clip into the holder (Fig. 2). Arrange the battery wires so that they are clear of the O-ring. The battery must seat firmly so that the cover will fit; take care that crossed wires do not get under the battery.

**3.** Slip the battery into place. Make sure the O-ring is in place (Fig. 3).

**4.** Replace the Battery Door and tighten the screws (Fig. 4) using a coin or similarly sized object. Tighten screws alternately, one or two turns at a time.

**5.** TIGHTEN until Door is FLUSH with the case (Fig. 5). If a gap remains, remove Door and check for interference.

## Turning the Edge On.



Fig. 6



Fig. 7



Fig. 8



Fig. 9



Fig. 10

6

**6.** Make sure the Battery is installed properly (page 5). Flip the Magnetic switch on the case back to the ON position (Fig. 6).

**7.** The EDGE will first display an Orca pattern. During this time it performs a self check of its functional integrity (Fig. 7).

**8.** With all memory locations and calculations checked, the EDGE displays a reminder to read the manual thoroughly (Fig. 8).

**9.** Next a blinking checkerboard pattern is displayed as the EDGE determines ambient surface pressure (Fig. 9). This allows an accurate depth reading even when used at altitude. (If the pattern does not blink, you are trying to initialize the EDGE either underwater or at an altitude greater than 12,000 feet.)

**10.** The EDGE then shifts to the main display (Fig. 10). At this time the top number will display the present temperature (in Centigrade), and the Depth section will display a "0" in reverse video, the Time section will display "0:00" in reverse video alternating with your surface interval in normal video, and the bottom line will start to display your No-Decompression Limits. The main display is explained in detail on page 9.

## Wearing the EDGE



Fig. 11

**11.** Make sure the EDGE is turned on. The switch cannot be operated while the unit is being worn. Thread the hook side of the velcro straps through the pins, starting on the same side of the case "ON" is printed (Fig. 11).

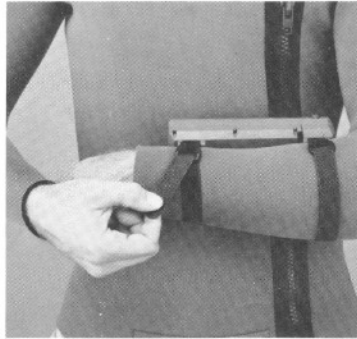


Fig. 12

**12.** Place the EDGE on the palm side of your forearm and connect the straps (Fig. 12). Holding the EDGE in place against your body, tighten the straps. An optional holster is available if you wish to wear your EDGE on your belt or as a console (Fig. 13).

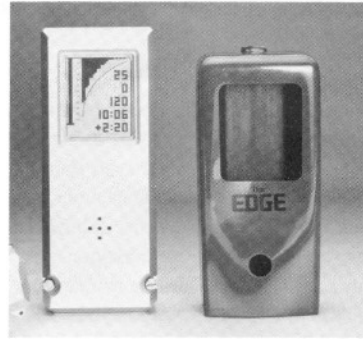


Fig. 13

## Terminology

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Here are some new terms (or new definitions for old terms) that go with the EDGE:

### **Dive time**

Total time spent underwater during a dive.

### **Repetitive dive**

Any dive made when the EDGE is still registering residual nitrogen on the tissue-tracker. Unlike the Navy tables, this may be longer than 12 hours after the previous dive, since the EDGE accounts for the slower tissues.

### **Residual dive**

A more descriptive and accurate term for repetitive dives with the EDGE.

### **Clear dive**

The first dive you make after turning the EDGE on.

### **Ceiling**

The shallowest depth to which you can ascend without getting the bends. Similar to a Decompression stop depth, except that it is OK to be DEEPER than your Ceiling. Also, Navy Decompression stops are multiples of 10 (10, 20, 30, etc.) whereas Ceilings can be any value (10, 23, 48, for example).

### **Ascent Rate**

The rate at which you may ascend towards the surface during a No-Decompression dive. Twenty feet per minute is the recommended ascent rate with the EDGE; 40 feet per minute is the MAXIMUM ascent rate.

## Reading the EDGE

**Note:** Open the fold-out of the EDGE display screen found on the inside front cover as you read the following section.

The EDGE's display is a 32 × 40 dot LCD matrix which is divided into a graphical and a digital section.

**The graphical section gives you the following information:**

- Graphical Representation of Present Depth by using a DEPTH BAR (A). The DEPTH BAR indicates your present depth down to a depth of 132 fsw (40 meters). The depth is read by using the DEPTH SCALE.
- MAXIMUM DEPTH RECORDER (B) indicates the maximum depth achieved during a dive.

- TISSUE-TRACKING DISPLAY™  
— Graphical Representation of the Nitrogen Levels in the 12 Tissue Groups shown by the TISSUE PRESSURE BARS (C) and their Distance from their Surface Nitrogen Limits represented by the TISSUE SURFACE LIMIT LINE (D). As long as the Bars remain above the Limit Line you are in a No-Decompression dive. If any of the Bars cross the Limit Line you must decompress long enough to pull the Bar(s) back above the Line.

The “Fast” tissues, those which take on and give off nitrogen quickly, are closest to the depth bar. The “Slow” tissues, those which equilibrate slowly, are farthest from the depth bar.

The Tissue Tracker™ permits you to:

1) Visualize how much Nitrogen your body has absorbed. Deep bars close to or over the Line mean much dissolved Nitrogen, whereas shallow bars mean little dissolved Nitrogen.

2) Control how much Nitrogen you absorb. Each bar is constantly traveling toward the level of the depth bar. By ascending until your depth bar is shallower than a given tissue bar, you can “pull” it away from the Limit Line.

- Graphical Representation of Ceiling (Safe Ascent Depth) (see page 18, Fig. 32). If the dive becomes a Decompression dive two “ears” will start to descend along either side of the DEPTH BAR showing your Ceiling (the shallowest depth you can safely ascend to).

## Reading the EDGE

The digital section, which has a SURFACE and DIVE mode, displays:

- Present/Maximum Depth (E). When the dive is underway this area displays your present depth. At the surface the maximum depth of the dive is displayed in reverse video (F) so you may log it.
- Dive Time/Surface Interval Timer (G). The Dive Timer is activated when you descend below 2 meters (6.5 fsw) and freezes the time in reverse video (H) when you ascend above 1 meter (3.3 fsw). If you descend again within 10 minutes the timer will continue to add time to the previous Dive Time. If over 10 minutes elapse before a new dive is started the EDGE will consider it a new dive and reset the Dive Time to zero. At the surface the Dive Time will alternate with the Surface Interval which will be

displayed in normal video. Note that Surface Interval reads in hours & minutes (normal video) whereas the Dive Time reads in minutes & seconds (reverse video at surface but normal video during dive).

- Ceiling (I). This section of the display gives the numerical display of your Ceiling. As long as the Ceiling remains 0 you can ascend to the surface. If a Decompression dive is being performed you cannot ascend to a depth shallower than the Ceiling. If you do ascend above the Ceiling a warning will be flashed telling you to DESCEND NOW (Fig. 38, page 19).
- No-Decompression Time/Decompression Time/Repetitive Dive Time Display (J). This section conveys the decompression status information to you, showing Remaining No-Decompression Time (RNDDT)

or Remaining Decompression Time (RDT) during a dive, and a Repetitive Dive Time Table while on the surface.

During a dive, the RNDDT or the RDT is displayed in minutes and seconds. A plus (" + ") sign indicates the no-decompression time you have left if you stay at the PRESENT DEPTH. It is a precise calculation of the amount of time until any one of your TISSUE BARS crosses over the Limit Line.

If you descend the time will become shorter and if you ascend the time will increase. If you stay longer than the No-Decompression time the number will be replaced by an up arrow ("↑"). This indicates that you have entered a Decompression dive and will need to ascend when you wish to start

decompressing. As you ascend towards (but not above) the Ceiling the up arrow will be replaced by a negative (“-”) sign followed by a time (in minutes and seconds). This is the DECOMPRESSION TIME REQUIRED at the PRESENT DEPTH in order for you to safely ascend to the surface. It is also the time required to pull all TISSUE BARS back above the Limit Line. After the Decompression time has elapsed the RNDT for the present depth will once again be displayed. The EDGE will not show a decompression time if the RNDT after decompression will be less than 5 minutes.

At the surface this section displays your Repetitive Dive Times

Ⓚ The display will show the depth of a repetitive dive and the No-Decompression time for that depth based on the remaining nitrogen in your tissue groups. This information will be conveyed in 10 fsw increments from 30' to 150' and then recycle. For example the display 50' 34 indicates that you could stay for 34 minutes at 50 fsw before Decompression is required. Unlike the Tables, ascent and descent times are NOT part of this time.

■ Temperature and Low Battery Indicator Ⓛ. This section displays the temperature in degrees Celsius within the range of -15 to 50

degrees Celsius. When the temperature drops below 0 the temperature will be displayed in reverse video. When the battery weakens the Low Battery warning “Lo” is alternated with the temperature display. This warns you that the unit will operate approximately 4 more hours and that you should replace the battery as soon as possible.



## No-Decompression Diving With the EDGE

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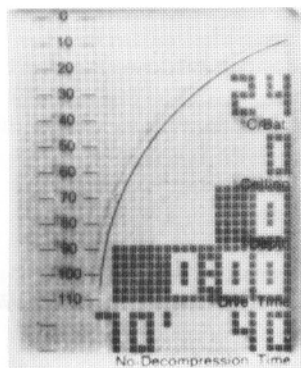


Fig. 16

Example: Suppose you set off from a dock to dive a wreck lying a few hundred yards offshore. A No-Decompression Dive is planned to 70 fsw. When you turn your EDGE on it will show the No-Decompression limit for 70 fsw to be 40 minutes (Fig. 16). You plan on a wreck dive to 70 fsw dive for 30 minutes and start your descent to 70 feet. During your descent the EDGE

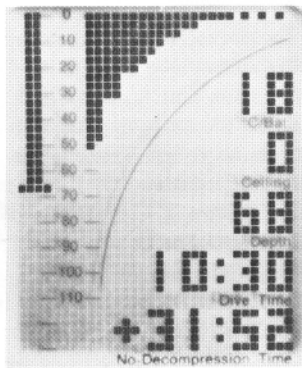


Fig. 17

displays your present depth — a glance at the Depth Bar gives you a quick “feel” of where you are, and a look at the digital readout gives you a precise reading.

Ten and one half minutes into the dive you are 68 fsw (Fig. 17). Your Tissue Bars are working their way down towards this depth, although none are very close to the Limit Line yet. Your remaining No-Decompression Time tells you that you have 31

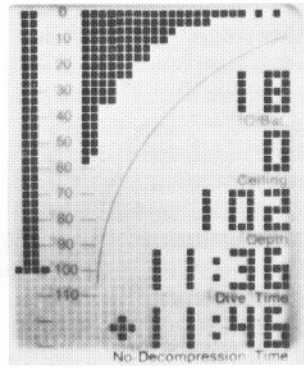


Fig. 18

minutes and 52 seconds until you would cross over into a Decompression dive. Your dive timer reads 10 minutes and 30 seconds, and your temperature has dropped to 18 degrees C.

Following the chain of what appears to be the wreck's anchor line, you descend to 102 feet in a little over a minute. Your EDGE now appears as in Figure 18, with +11:46

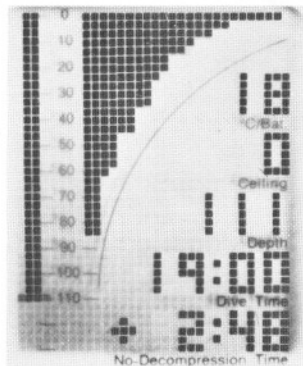


Fig. 19

RNDT. The EDGE automatically adjusts for the change in dive plan! You find the ship's anchor, and spend about seven minutes exploring it. Now the EDGE reads as shown in Figure 19, with only 2 minutes and 48 seconds remaining before decompression would be required. Notice that your fastest Tissue Bar is about to cross the Limit

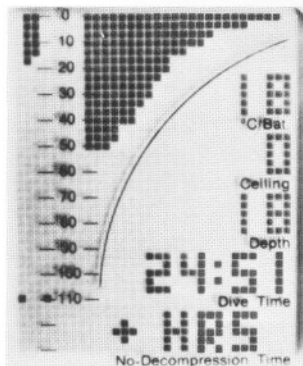


Fig. 20

Line, and several others are close behind. You begin your ascent from 111 fsw, stopping for a few minutes at approximately 18 feet in order to pull your Tissue Bars back from the Limit Line (Fig. 20). This off-gassing is a good idea if you have been close to your No-Decompression Limits.

Important note regarding ASCENT RATE: The recommended ascent rate with the EDGE is 20 feet per minute. This is much slower than the 60 feet per minute used with the US Navy Tables. It is easy to maintain 20 feet per minute with the EDGE — regulate your ascent rate so that the depth readout changes by 1 foot at a time. Twenty feet per minute must be used in all cases where your tissue bars have been close to the line or when you are doing multiple bounce dives. Forty feet per minute is the MAXIMUM ASCENT RATE with the EDGE, for use in other cases, and emergencies. If the depth readout changes by 2 feet at a time, you are ascending at 40 ft/min.

## No-Decompression Diving With the EDGE

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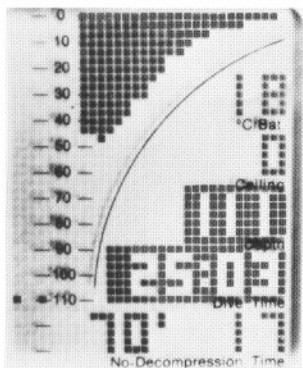


Fig. 21

Surfacing after your wreck dive, the EDGE reads as shown in Figure 21. Your maximum depth and total dive time are shown in reverse video. Underneath your dive time a Repetitive Dive Table begins to scroll. Here, you see that you would have 17 minutes at 70 feet. Your Tissue Bars are pulling back toward the sur-

face, the fast Bars have already retracted considerably during your slow ascent and safety stop.

This example shows the flexibility of the EDGE. It has allowed you to perform a dive that according to the tables would have to be calculated as a 120 fsw dive for 30 minutes, involving stage decompression. It handled the alteration in the dive plan effortlessly and always told you how long you had before decompression was required.

How can the EDGE do this when the tables cannot? The answer is that the EDGE tracks your Nitrogen uptake CONTINUOUSLY, and com-

pares the amount of gas you have absorbed to permitted limits of supersaturation. There exist millions of possible multi-level dive profiles; tables must make the approximation that you spent your whole dive at one depth, the maximum depth, to avoid having to carry literally millions of tables. The EDGE, which calculates directly, is not limited in this regard.

## Repetitive Information and Surface Mode.

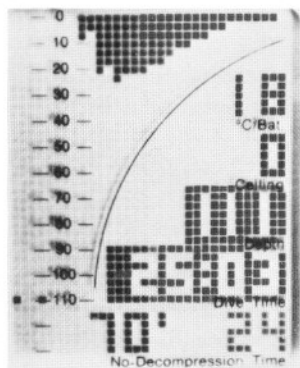


Fig. 22

Once you surface the EDGE will switch into Surface Mode. (The switch-over point is at 3.3 feet of seawater). In this mode the EDGE times your surface interval, continually updates your repetitive dive status, and displays the maximum Depth and Time of your previous dive so you may record it.

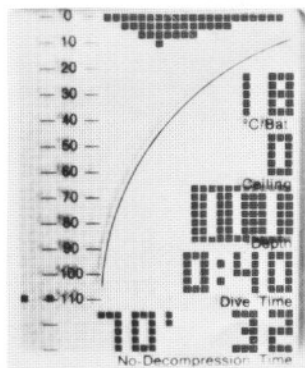


Fig. 23

Example: You surfaced from the wreck dive twelve minutes ago (Fig. 22). Your nitrogen levels are decreasing while on the surface, so your repetitive times are steadily increasing. The No-D limit for 70 fsw is now 24 minutes. Notice the changing shape of the Tissue Bar Profile. (With practice, you will be able to recognize what kind of diving someone has done in the past day or two just by the shape of his/her Tissue Bar Profile).

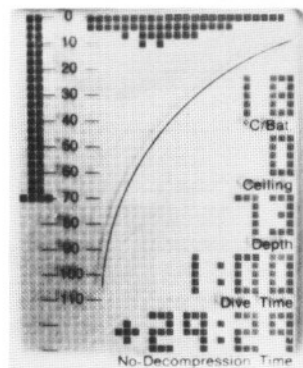


Fig. 24

Figure 23 shows the EDGE display after 40 minutes of surface interval. The Repetitive Table scrolls to 70' and you see that you have 32 minutes there. You gear up and plan a dive to explore the area surrounding the wreck. Your descent to 73 feet takes 1 minute, and you note that your RNDT is 29 minutes, 29 seconds (Fig. 24). After 27 minutes you are at 69 feet and your

## Repetitive Information and Surface Mode.

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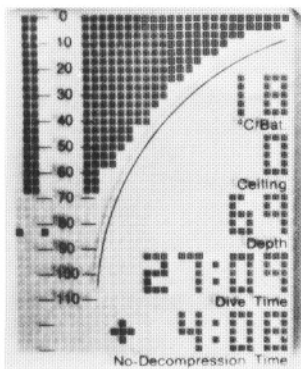


Fig. 25

RNDT is 4:08 (Fig. 25). (27:09 plus 4:08 is longer than the original 29:29 RNDT you had when you first arrived at 73 feet. Why? . . . CREDIT for the shallower portions of the dive.) Since your RNDT is down to only +4:08 and you have many Tissue Bars close to the Limit

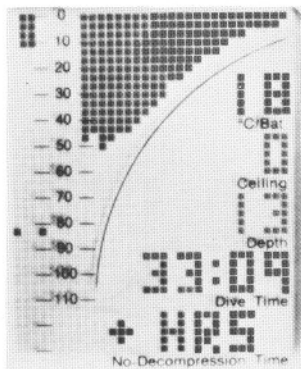


Fig. 26

Line, you start your ascent, using a 20 fsw per minute rate. Leveling off at 13 fsw, your RNDT there is +HRS, meaning that you could stay hours at this depth (Fig. 26). You then spend ten minutes photographing shrimp and anemones around the pilings of the dock from which you are diving, putting in your safety stop at the same time.

## Decompression Diving With the EDGE

After Surfacing, your EDGE displays the information in Figure 27. Compare the Tissue Bar Profile after this second dive to that after the first dive (Fig. 22); you now have quite a bit more residual nitrogen in your slow tissues. This nitrogen in the slow tissues builds up slowly throughout a day (or days) of diving. It is only slowly released, as is illustrated by Figure 28, showing the display 2 hours and 10 minutes after the dive. The EDGE tracks the nitrogen even in these very slow tissues. If you are diving several times per day, for several days, you should keep your EDGE running continuously to avoid over-saturating your slow tissues.

Decompression with the EDGE can be performed in one of three ways (or any combination of the three) by using the Ceiling display and the Remaining Decompression Time display:

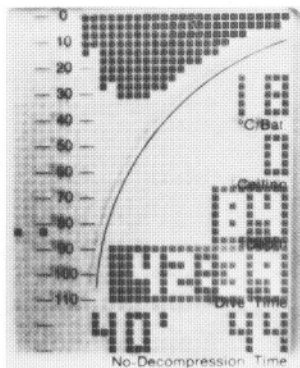


Fig. 27

- One Level Decompression.** You can ascend to a depth (deeper than the Ceiling) above where the bottom line display changes from an up arrow ("↑") to RDT and spend the entire Decompression Time and decompress at a single level (if you have enough air).
- Normal Stepped Decompression.** If your Ceiling is 27 fsw you can ascend to 30 fsw and wait until

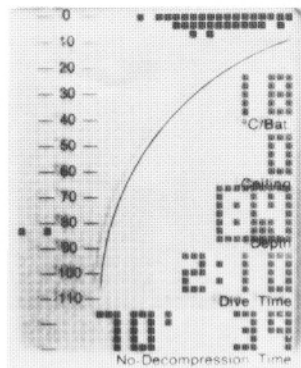


Fig. 28

- the Ceiling reaches 20 fsw. At this time you can ascend to 20 fsw and wait for the Ceiling to reach 10 fsw. You may then ascend to 10 fsw and finish your decompression there.
- Continuous Decompression.** Continuous Decompression is where you move up to the Ceiling and keep matching your Depth

## Decompression Diving With the EDGE

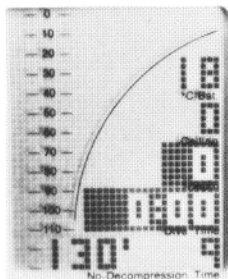


Fig. 29

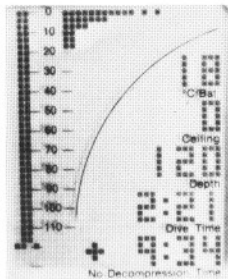


Fig. 30

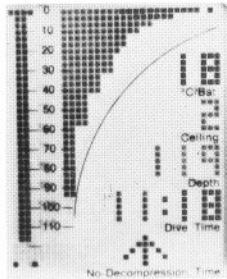


Fig. 31

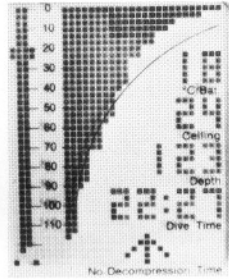


Fig. 32

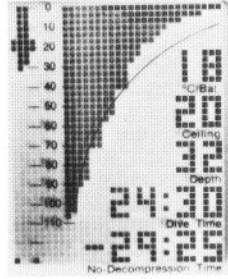


Fig. 33

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with the Ceiling. This method gives the shortest decompression time but may require a decompression line to maintain accurate depth. It is recommended that continuous decompression be performed only to a depth of 8-10 fsw since it is hard to maintain shallower depths, even with a line.

In fact, decompression can be performed at any depth between your Ceiling and the depth at

which your up-arrow becomes a RDT; as long as you are in this zone, you are decompressing.

You can give yourself a safety factor by staying a given depth, say 10 feet, below your Ceiling. Additionally, when your Ceiling reaches zero, remain at 10 feet long enough to allow your tissue bars to pull back a few dots, or pixels, from the Limit Line.

If at any time during a decompression dive the Ceiling is violated a warning saying "DANGER

DESCEND NOW" will be flashed on the screen (Fig. 38). If this should occur you must descend to a depth below the Ceiling IMMEDIATELY!

Example: A Decompression Dive is planned to 130 fsw for 25 minutes. The EDGE tells you that the No-Ceiling Limit for 130' is 9 minutes (Fig. 29). You descend to 120 feet; upon arrival your dive time is 2 minutes 21 seconds and your RNDT is +9:34 (Fig. 30). Eleven minutes later one of your Tissue

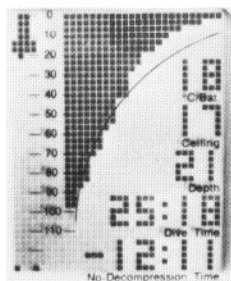


Fig. 34

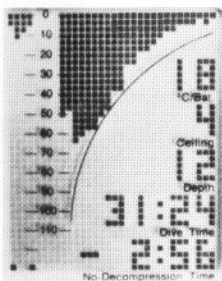


Fig. 35

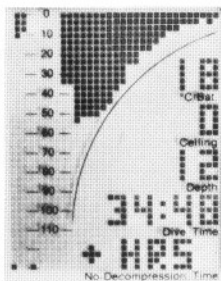


Fig. 36

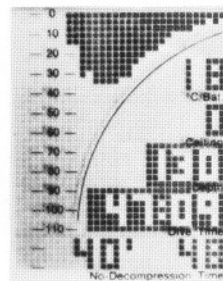


Fig. 37



Fig. 38

Bars crosses the Limit Line and your Remaining No-Decompression Time is replaced by an up-arrow ("↑") which tells you that you need to ascend when you wish to start decompressing (Fig. 31).

Whenever you have an up-arrow, you are still absorbing more nitrogen and incurring more decompression obligation.

Twenty two and a half minutes into the dive you are at 123 feet and your Ceiling is 24 feet (Fig. 32). You begin your ascent at 20'

per minute. At 32 feet you level off. Your Remaining No-Decompression Time, RDT, of -29:25 (RDTs are preceded by a minus sign to set them apart from RNDTs which have a plus sign). Although you can decompress at 32 feet, you can decompress more quickly by ascending closer to the Ceiling, so you go to 21 feet, where your RDT is only -12:11 (Fig. 34).

You decide to perform continuous decompression, and follow your Ceiling up, continuously matching the Ceiling and Depth numbers or by keeping the bottom of the Depth Bar between the Ceiling ears (Figures 34 & 35). Once the Ceiling reaches zero again you may surface, however, it is good practice to wait at 10 to 15 feet if possible until your Tissue Bars have pulled up from the Limit Line a few pixels (Figs. 36 & 37).



## Replacing the Battery Without Loss of Information

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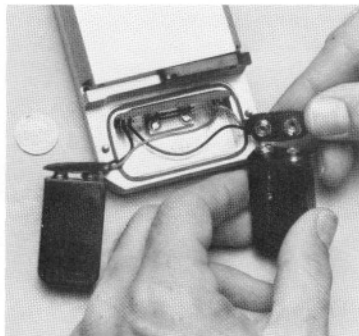


Fig. 14

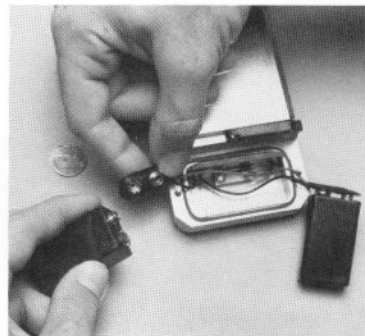


Fig. 15

1. Rinse your EDGE in fresh water and dry it off.
2. Remove the battery with the clip attached. **DO NOT DISCONNECT THE BATTERY** (Fig. 14). Please note that when the battery door is off, the actuator can **FLIP OFF VERY EASILY**.

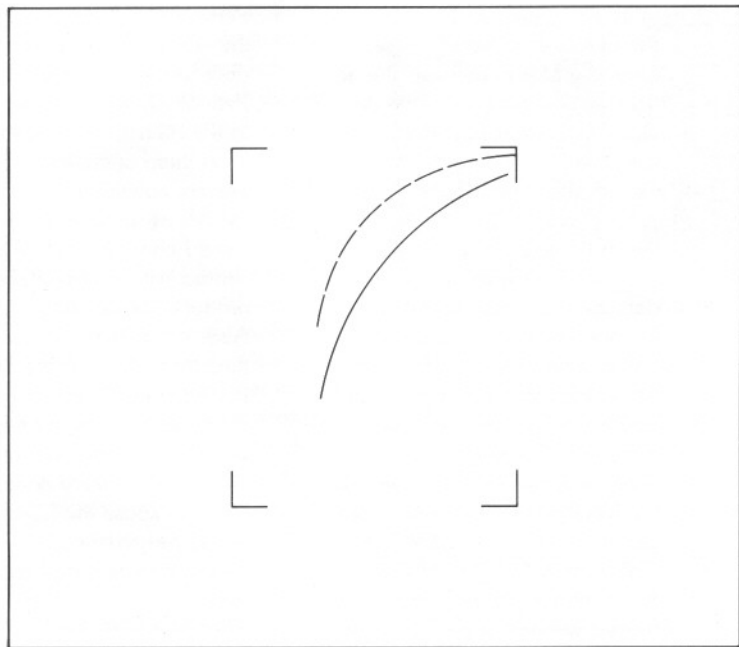
Take care not to let this happen, as if it did, all your repetitive dive information would be lost.

3. Take the auxiliary battery clip and attach a fresh battery to it. (Fig. 15).
4. Remove the old battery as soon as the new one has been connected and place the unused battery clip onto the holder.

Please note that if the free clip contacts the metal housing, there can be a momentary short and consequent loss of power and information.

5. Slip the new battery into the battery compartment, check the "O"-ring, and replace the Battery Door (see page 5, "Inserting Battery").

## Flying After Diving



You may fly in a commercial airliner (8000' cabin pressure) after all your tissue bars rise above the line shown in the figure at left.

If you turn your EDGE off after your last dive it is recommended that you wait at least 12 hours after a No-Decompression Dive and 24 hours following a Decompression Dive before flying.

## Maintenance & Care

Although the EDGE is a rugged piece of equipment, proper care and maintenance can help prevent any possible problems. By following these suggestions the EDGE should last for years without requiring re-adjustment or repair:

- A. Never leave the EDGE out in the direct sun or in a potentially hot place such as a car trunk. Excessive heating can cause damage to the internal components.
- B. After use rinse the EDGE with fresh water, dry it, and replace it in its carrying case. This prevents the EDGE from being banged around and also prevents the accidental switching off of the device if you are planning a repetitive dive.
- C. Do not drop the EDGE. It contains glass.
- D. Never poke anything into the transducer ports as this could damage the special membrane. Do not dive with an EDGE that has silicone oil leaking from the transducer port; this would indicate a need for factory service.
- E. If the EDGE is not going to be used for a period of time remove the battery from the battery compartment. **DO NOT REMOVE THE BACK OF THE UNIT!!!** Any unit that has had its back removed will not be covered by its warranty.
- F. Periodically grease and inspect the "O"-Ring on the battery case door to maintain a good seal.
- G. Periodically apply silicone grease to the Battery Door screws to keep them operating freely and prevent corrosion.
- H. Do not allow water to enter the battery compartment. Water in contact with alkaline batteries can produce caustic compounds. Also, it is possible for water to pass through the protective barrier into the electronics compartment, such as might happen if you dived deeply with an open or unsealed battery door.
- I. Do not expose the EDGE to solvents, petrochemicals, or strong cleaners; these can damage the seals.

## Limitations

- A. For use at altitudes greater than 500 m or 1600 feet please contact your dealer or Orca Industries. The Limit Line is shallower at higher altitudes, and this must be accounted for.
- B. The maximum depth the EDGE can distinguish is 160 fsw. If the EDGE is taken below this level "OR" (Fig. 39) will be displayed in the depth display and the EDGE will flash a warning that the Depth Range was exceeded (Fig. 40) for the remainder of the dive. In order to provide a small safety factor, in case the depth range is exceeded, the EDGE will calculate nitrogen uptake as if you were at 200 fsw whenever it is Out of Range.
- C. The EDGE can be operated in any temperature of water (0 to 40 degrees C) but should not be left out in temperatures below or

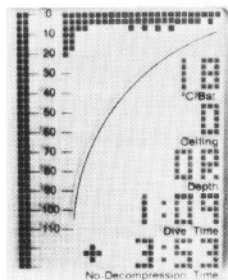


Fig. 39

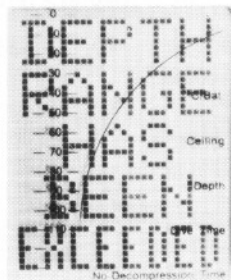


Fig. 40

- above this range. The Liquid Crystal Display may seem sluggish at the lower operating temperatures.
- D. The Dive Timer times up to 199:59 and then recycles to 0:00.
- E. Any No-Decompression or Decompression Time greater than 99:59 will be displayed as "HRS" ("HOURS").
- F. The Ceiling will only display values up to 99 fsw.
- G. The Magnetic Flip Switch will affect a compass if it is held within 1.5' (50 cm) of the EDGE.
- H. A scrambled screen indicates a momentary loss of power (accidental switching off) and invalidates information.
- I. Several minutes before the battery dies, the temperature reading will be incorrect.

## Questions and Answers

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Please mail us your questions if they are not answered here.

- Q.** Does the EDGE require a special container to carry it aboard an airplane?
- A.** No, it is a solid-state electronic device and can be carried in its regular carrying case.
- Q.** The EDGE's display sometimes flickers. What does this mean?
- A.** Flickering at high temperatures is a general property of multiplexed Liquid Crystal Displays; the EDGE has this type.
- Q.** Because of my body build and age I'm prone to the bends. Should I throw in an extra Safety Factor when using the EDGE?
- A.** Yes, in fact throwing in an extra safety factor is a good idea for all sport divers, and is very easy to do with the EDGE: 1) Don't get closer than five or ten minutes to your No-Decompression Limits, 2) Keep your Tissue Bars well away from the Limit Line, 3) Avoid decompression dives, and 4) Stay ten to twenty feet below your Ceiling if you must do decompression dives. You will still get all the advantages of the EDGE's multi-level capabilities.
- Q.** What if I accidentally turn the EDGE off during my day of diving?
- A.** You will have lost your repetitive dive information and will not be able to dive again that day. Take care not to accidentally switch it off, and keep a good spare battery in your carrying case.
- Q.** Why are only alkaline 9 volt batteries specified?
- A.** Regular carbon-zinc 9 volt batteries have a shorter life and often cease functioning when they get cold, as is often the

case underwater. Ni-Cads also have a short life, and they give only a few minutes warning on the Low Battery Indicator. (A rechargeable option is available from ORCA Industries consisting of a special high-energy battery and charger.) Alkaline batteries will give over 48 hours continuous running, operate well even when cold, and give at least four hours of low battery warning.

- Q.** I get a lot more than 48 hours out of a battery; what's the upper limit?
- A.** Using "Energizer" brand 9 volts, the record is over 80 hours continuous running.

**Q.** I don't have access to a pressure chamber. How can I check the calibration of my EDGE?

**A.** Measure a 30 foot depth of clothesline or other cord that is inelastic. Tie your EDGE onto one end and lower it down 30 feet, wait a few seconds, then pull it back up. The Maximum Depth will be displayed in reverse video. You can also ask your local dive shop to check it, as most have a small pressure chamber. (The EDGE is more accurate than the gauges commonly in use as pressure gauges and depth gauges; try to find a precision reference.)

**Q.** Why do the No-D limits I get when I first turn on my EDGE vary slightly?

**A.** Due to minute variations in air pressure readings after you have turned the EDGE on. The No-D limits for the shallow depths can vary by several minutes, those for the greater depths by one minute or less.

**Q.** The depth bar doesn't line up with the gradations on the depth scale. Why is this?

**A.** Each pixel actually equals one meter, which is 3.3 feet, so it would line up only if the depth scale were in meters.

## Questions and Answers

Please mail us your questions if they are not answered here.

**Q.** Sometimes I get tissue bars only one pixel wide, mostly in the slow tissues. Why is this?

**A.** Each Tissue Bar is two pixels wide, like the Depth Bar, but is written one pixel at a time. The left one lights first, then the right one lights. The next pixel is the left one, one row down, and so forth. This essentially doubles the resolution of the Depth and Tissue Bars. Regarding your question, you saw several slow tissues with only one pixel lighted.

**Q.** Can I get the bends while using the EDGE?

**A.** Yes. Using the EDGE is not a guarantee of avoiding the bends. However experience

from thousands of dives over the past year indicates that the EDGE is a better bet than the US Navy Tables; as of this time (8/84) no cases of bends have been reported. At the present time the EDGE is the best solution to the decompression problem, providing long bottom times along with excellent safety.

**Q.** I got a 1 foot Ceiling with "-HRS" of decompression on my second decompression dive. What does this mean and how should I deal with it?

**A.** This situation occurs when the slow tissues are near the Limit Line at the start of a residual (repetitive) dive, and then are

pulled over during the dive, thus requiring decompression. The Ceiling will be shallow, such as 1 or 2 feet. If you could actually hold this depth, you could decompress rather quickly, but at 8 to 10 feet, you are actually still ON-GASSING or OFF-GASSING VERY SLOWLY in your slow tissues, so decompression there would be lengthy. The solution is to avoid going into decompression on residual dives.

In an emergency, you would probably not be bent if you surfaced despite a 1 foot Ceiling. No further diving should be done afterwards.

## Holster Installation

The optional EDGE holster can be worn on the high-pressure hose, the belt, or anywhere you find convenient.

The most popular location is on the high-pressure hose, which makes for a complete, compact console.

Needed to install on HP hose:

Hot water (boiling, if possible), a lubricant (silicone or dishwashing liquid), and a T-wrench (optional).

1. Remove your submersible pressure gauge (SPG) from regulator. If you are using soap as lubricant, use tape to block soap from entering

HP hose. Lubricate the nut and hose at the end farthest from the SPG.

2. Immerse the holster in HOT water so that the channel into which the HP hose is to be inserted gets very soft. If possible, only heat the channel; this makes the holster easier to hold in the next step.
3. Remove the holster from water and immediately insert the nut-end of HP hose into the channel, twisting gently (make sure to insert into the end nearest the view window cutout!). Twist and push until at least 1 inch has been inserted, then

insert the T-wrench from the other end, screw into place, and pull the hose all the way through. Slide the holster all the way down the hose until it comes to rest against the SPG. Push holster up onto the nut that links SPG and hose; this helps immobilize it.

4. Without a T-wrench, you must complete the installation by continuing to push and twist the HP hose until the nut clears the other end of the channel.

The key ingredient is HEAT. The hotter the water, the softer the channel and the easier the installation.



## Background & Theory

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The algorithm used in the EDGE has evolved from two distinct backgrounds:

1. **Multi-Level Diving Techniques practiced using the U.S. Navy No-Decompression Tables.**
2. **Shorter No-Decompression Limits developed by Dr. Merrill Spencer.**

### **1. Multi-Level Diving Techniques:**

The U.S. Navy No-Decompression/Decompression Tables and procedures were designed for single depth dives. Divers are required to use the maximum depth attained during the dive profile to calculate the No-Decompression Limit or the Decompression schedule as if the entire dive had occurred at that maximum depth. Many divers feel that they are penalized and limited by this procedure since they do not spend all their time at the deepest depth. Consequently, divers have sought new procedures for reading and using the U.S. Navy dive tables that allowed longer bottom times. The technique that gained the most acceptance in the diving community are Multi-Level dive table interpretations.

Some diving authorities indicate that these or similar procedures have been tested and used in commercial oil-field diving although little published data is available. This lack of data has not prevented the use of these techniques by thousands of sport divers.

With the acceptance of these techniques there have been questions with respect to the safety involved. Mathematical analysis of "acceptable" Multi-Level profiles shows that in some of the permitted profiles tissue nitrogen levels exceeded the U.S. Navy surface nitrogen limits (Mo values). These excessive nitrogen values are due to the fact that the group designations in the U.S. Navy No-Decompression Tables were calculated using one tissue group (the 120 min. group). The unacceptable levels were generated in other tissue groups,

most noticeably in the 40 min. group. However an analysis of dive profiles performed by three dive guides at a Bahama resort showed that all their tissue nitrogen levels stayed below the U.S. Navy M values. Also, many hyperbaric physicians feel that the concept is valid and safe if specific precautions are followed.

The conclusion in these theoretical studies indicates that in some, but not all, Multi-Level dive profiles the tissue pressures remain below their Mo values. In order to be sure that none of the other tissue groups exceed their Mo values all the tissues must be taken into account when constructing tables or calculating decompression information.

The algorithm in the EDGE takes this conclusion into account. It calculates the divers' tissue and decompression status based on 12 different tissue groups ranging from 5 min. to 480 min.

## **2. Shorter No-Decompression Limits:**

With the development of Ultrasonic Doppler detectors it was possible to detect the formation of venous gas emboli (VGE), or silent bubbles, in the body after decompression. Using this monitoring technique Spencer published New No-Decompression limits that would produce a low occurrence of VGE. These limits tend to be more conservative than the U.S. Navy limits. It is these limits that were used to calculate the Mo values for the 12 tissue groups (5 min. - 480 min.) used in the EDGE.

The algorithm used in the EDGE is a combination of these two backgrounds. The main ideas for Multi-Level Diving Techniques are merged with the new Mo values to form an algorithm which will theoretically

yield no, or a minimal amount of, VGE. This is achieved by calculating the uptake and elimination of nitrogen in the 12 tissue groups every three seconds during the dive and comparing the pressures to the new Mo values. This technique guarantees that the nitrogen pressure in any tissue group will never exceed its Mo value (as long as the diver follows the information given by the EDGE).

In order to release the EDGE to the public ORCA Industries conducted a study to examine the effects of Multi-Level Dives (allowed by the EDGE) on human subjects. The results showed that the profiles tested were safe to all the divers exposed. A summary of the study can

## Background & Theory

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be obtained by writing ORCA Industries. The results are also published in the proceedings of IQ14, "Ultrasonic Doppler Study of Multi-level Diving Profiles," by Karl Huggins.

**Additional information on these subjects can be obtained in the following published papers:**

- Graver, Dennis, "A Decompression Table Procedure for Multi-Level Diving," in Fead, L. (ed.), PROCEEDINGS OF THE EIGHTH INTERNATIONAL CONFERENCE ON UNDERWATER EDUCATION, National Association of Underwater Instructors, Colton, CA 1976.
- Huggins, Karl E., Somers, L., MATHEMATICAL EVALUATION OF MULTI-LEVEL DIVING, Michigan Sea Grant Publication #MICHU-SG-81-207, Ann Arbor, MI, 1981.
- Huggins, Karl E., NEW NO-DECOMPRESSION TABLES BASED ON NO-DECOMPRESSION LIMITS DETERMINED BY DOPPLER ULTRASONIC BUBBLE DETECTION, Michigan Sea Grant Publication #MICHU-SG-81-205, Ann Arbor, MI, 1981.
- Spencer, M.P., "Decompression Limits for Compressed Air Determined by Ultrasonically Detected Blood Bubbles," JOURNAL OF APPLIED PHYSIOLOGY, Vol. 40, #2, pp. 229-235, 1976.

### Addresses:

- NAUI, P.O. Box 14650, Montclair, CA, 91763, (714) 621-5801
- MICHIGAN SEA GRANT OFFICE, 4107 I.S.T. Building, 2200 Bonsteal Blvd., Ann Arbor, MI, 48109, (313) 763-1437
- JOURNAL OF APPLIED PHYSIOLOGY, 9650 Rockville Pike, Bethesda, MD 20014

## Comparison of No-Decompression Limits

DEPTH (fsw)	EDGE	LIMITS (min)			DEPTH (msw)	EDGE	LIMITS (min)
		U.S. Navy	Spencer	Bassett			Royal Navy
30	234	none	225	220	9	225	none
40	136	200	135	120	10	189	232
50	77	100	75	70	12	137	137
60	53	60	50	50	14	91	96
70	40	50	40	40	16	67	72
80	31	40	30	30	18	54	57
90	24	30	25	25	20	44	46
100	19	25	20	20	22	37	38
110	13	20	15	15	24	32	32
120	11	15	10	12	26	27	27
130	9	10	5	10	28	23	23
140	7	10			30	20	20
150	7	5			32	15	18
160	6	5			34	13	16
170	5	5			36	11	14
					38	10	12
					40	9	11
					50	6	7

## Technical Specifications

EDGE available reading in either Metric or English Units

### Decompression Model:

- Algorithm . . . . . Modified Haldanean
- Number of Tissue Groups . . . . . 12
- Tissue Half-Time Range . . . . . 5 minutes to 480 minutes
- Tissue M Values . . . . . Derived from No-

Decompression Limits that were determined by Doppler studies, more conservative than U.S. Navy M values

- Decompression Functions . . . . . Tissue nitrogen levels Remaining No- Decompression Times Remaining Decompression Time Repetitive No- Decompression Time

### Depth Gauge:

- Transducer . . . . . 0 to 100 psi absolute transducer, temperature compensated
- Accuracy . . . . .  $\pm 0.3$  msw ( $\pm 1$  fsw)
- Depth Display Range . . . . . 0 to 49 msw (0 to 160 fsw)
- Depth Display Resolution . . . . . 0.3 msw (1 fsw)

- Depth Bar Range . . . . . 0 to 40 msw (0 to 132 fsw)
- Depth Bar Resolution . . . . . 0.5 msw (1.6 fsw)
- Depth Functions . . . . . Present Depth Maximum Depth Recorder Maximum Depth Display @ surface

### Dive Timer:

- Accuracy . . . . .  $\pm 13$  seconds per day
- Range . . . . . 0 to 99 minutes 59 seconds
- Activation Depth . . . . . 2 msw (6.6 fsw)
- Deactivation Depth . . . . . 1 msw (3.3 fsw)
- Dive Timer Functions . . . . . Present Dive Time Freezes Dive Time @ Surface Dive Time reset to 0 if a new dive is started (only if surface Interval > 10 min.)

### Surface Interval Timer:

- Accuracy . . . . .  $\pm 13$  seconds per day
- Range . . . . . 0 to 99 hours 59 minutes

### Temperature Display:

- Accuracy . . . . .  $\pm 2^{\circ}\text{C}$  ( $\pm 3.6^{\circ}\text{F}$ )
- Range . . . . .  $-15^{\circ}\text{C}$  to  $50^{\circ}\text{C}$  ( $16.8^{\circ}\text{F}$  to  $123^{\circ}\text{F}$ )

**Power:**

- Battery ..... One 9v alkaline battery
- Duration ..... 48 hours @ 25°C
- Low Battery indicator ... Gives 4 hour warning
- Replacement ..... Battery can be replaced without losing information
- On/Off Switch ..... Magnetic Flip Switch
- Battery Door ..... Removed/Replaced using any coin

**Environmental Limitations:**

- Depth Range ..... 0 to 49 msw (0 to 160 fsw)
- Altitude Ranges:
  - Decompression Algorithm ..... 0m to 350m above sea level (0' to 1150' above sea level)
  - Tissue Calculations ... 0m to 6100m above sea level (0' to 20,000' above sea level)
- Temperature Ranges:
  - Operating ..... -4°C to 50°C (24.8°F to 122°F)
  - Storage ..... -40°C to 75°C (-40°F to 167°F)

**Case:**

- Construction ..... Cast Aluminum Alloy
- Battery Compartment Seal ..... 033 Square Ring
- Dimensions ..... 182mm x 73mm x 33mm (7.2" x 2.9" 1.3")
- View Window ..... Mineral Glass
- View Window Dimensions ..... 57.15mm x 47.65mm x 6.53mm (2.250" x 1.875" x 0.250")
- Weight ..... 680 gm (1.5 lbs)

**Display:**

- Configuration ..... 32 x 40 Square Dot LCD Matrix
- Illumination ..... Ambient Light

**Warranty:**

- Limited One-Year Warranty

**Service:**

- All servicing and repairs will be done by ORCA Industries' Consumer Service Department

(msw = meters of sea water; fsw = feet of sea water; °C = degrees Celsius; °F = degrees Fahrenheit)

Specifications subject to change without notice.

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## **Finally, Underwater Reliability**



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Toughkenamon, PA 19374  
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