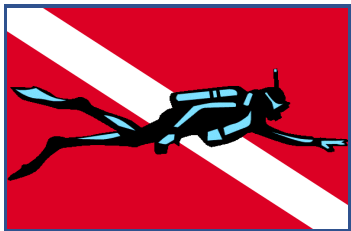


# Considerations In Selecting a Dive Computer



# Time to Buy a Computer



- So— you've decided it's time to buy a new Dive Computer Because:
  - You are New to the Sport.
  - You are coming back to the sport and it's time to transition from the PADI/SSI/SDI Dive Tables to a computer.
  - Whatever your experience level, your old computer has died and it's time to replace it.
- The Dilemma: What to Choose?

Suunto?

Oceanic?

DSAT/Z+?

Air Integrated?

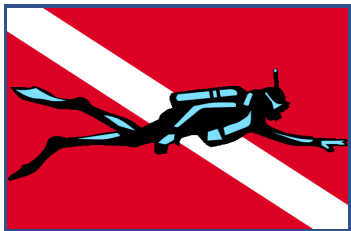
Battery / Rechargeable?

Wrist/Console?

ScubaPro?

Mares?

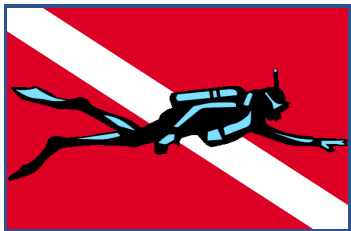
Aqualung?



# Computer Purchase/Use Considerations



- Decide on Price Range: (\$200-\$1600)
- Type: Console vs Wrist?
- Capabilities / Considerations:
  - Readability: Dial Size /Color / Multi-color / Illumination?
  - Data Show Options: **Current Depth, NDC (No DECO Time), EDT (Elapsed Dive Time),** Max Depth, ATR, Air, O2SAT, PO2, Temp, Etc.)
  - Ease of Use!!!! (Menu – Button Access?)
  - Dive Data Downloadable: Computer? / Computer and Phone?
  - Air Integrated?
  - Air-Nitrox-Tech Gases?
  - Usability with Existing Equipment (Console Size / Shape, Transmitters, Algorithm Etc.)
  - User Options: (Alarms, Deco Settings, Inc Safety, Etc.)
  - Algorithm: DSAT, Buhlmann ZHL-16C (Z+), ZH-L16 ADT MB PMG, Suunto RGBM, RGBM, Wienke-Haldane RGBM, Recreational RGBM, Etc.
  - Warranty – Local Dealer?

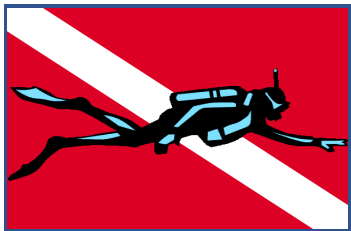


# Computer Purchase/Use Considerations

---



- **Decide on Price Range: (\$200-\$2100)**



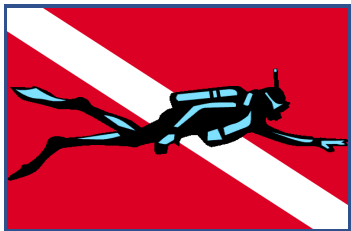
# Dive Computer Cost



- What is out on the market?

## Divers Direct

|              |                            |
|--------------|----------------------------|
| \$2-400-     | 11 Models                  |
| \$4-700-     | 14 Models                  |
| \$7-1000-    | 5 Models                   |
| \$1000-1600- | 18 Models (Air Integrated) |
| \$1600-2100- | 2 Models (Air Integrated)  |

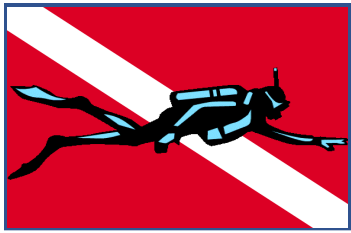


# Computer Purchase/Use Considerations

---



- Decide on Price Range: (\$200-\$2100)
- Type: Console vs Wrist?
- Capabilities / Considerations:
  - Readability: Dial Size / LCD /Color / Multi-color / Illumination?
  - Data Show Options: **Current Depth, NDC (No DECO Time), EDT (Elapsed Dive Time), Air vs Nitrox**, Nitrox Setting, Max Depth, ATR/GTR (Air Time Remaining), O2SAT, PO2, Temp, Etc.)



# Screen Visibility/Readability **TVSC**



**Oceanic Pro Plus 3**  
\$524-750



**Aqualung i770R**  
\$899 w/o Trnsmtr



**SUUNTO Zoop Nova**  
\$329



SF- Safety Factor  
(0, 1, 2)

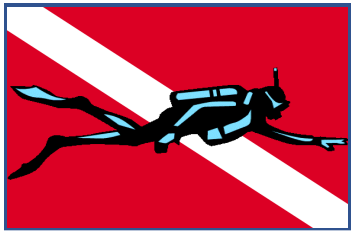
**Cressi Leonardo**  
\$200-250



**MARES Smart Air**  
\$464-519 w/o Trnsmtr



**Mares Quad**  
\$599



# Screen Visibility/Readability **TVSC**



**ScubaPro G2**  
\$1,249 w/ Trnsmtr



**Mares Genius**  
\$1,139 w/o Trnsmtr



**Mares Mission Puck 2**  
\$375



**Aqualung i200C**  
\$389

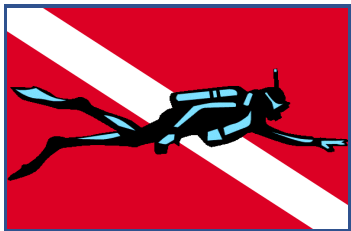


**Oceanic GEO 4.0**  
\$409



**Cressi Donatello**  
\$299



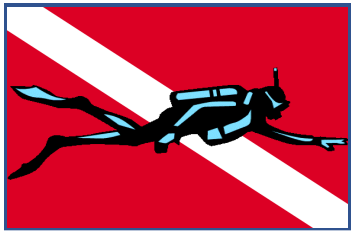


# Computer Purchase/Use Considerations

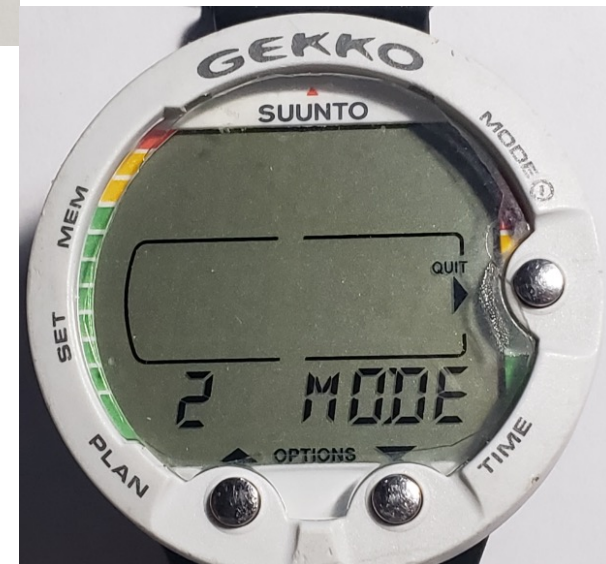
---

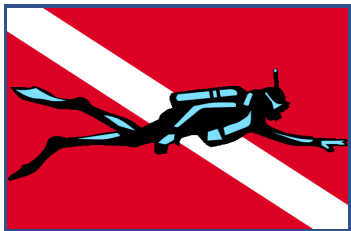


- Decide on Price Range: (\$200-\$1600)
- Type: Console vs Wrist?
- Capabilities / Considerations:
  - Readability: Dial Size /Color / Multi-color / Illumination?
  - Data Show Options: **Current Depth, NDC (No DECO Time), EDT (Elapsed Dive Time), Air vs Nitrox**, Nitrox Setting, Max Depth, ATR/GTR (Air/Gas Time Remaining), Air, O2SAT, PO2, Temp, Etc.)
  - Ease of Use!!!! (Menu – Button Access?)
  - Dive Data Downloadable: Computer? / Computer and Phone?
  - Air Integrated?



# Sample Menu's





# Transmitters



Hover to zoom

Move your mouse over image or click to enlarge

**Aqua-lung**



**Oceanic**



**TUSA**

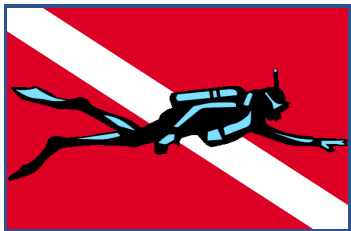


**SUUNTO**

**Transmitters:  
\$300-\$450**



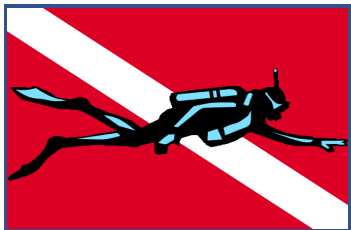
**MARES**



# Computer Purchase/Use Considerations



- Decide on Price Range: (\$200-\$1600)
- Type: Console vs Wrist?
- Capabilities / Considerations:
  - Readability: Dial Size /Color / Multi-color / Illumination?
  - Data Show Options: **Current Depth, NDC (No DECO Time), EDT (Elapsed Dive Time), Air vs Nitrox**, Nitrox Setting, Max Depth, ATR/GTR (Air/Gas Time Remaining), Air, O2SAT, PO2, Temp, Etc.)
  - Ease of Use!!!! (Menu – Button Access?)
  - Dive Data Downloadable: Computer? / Computer and Phone?
  - Air Integrated?
  - Air-Nitrox-Tech Gases?
  - Usability with Existing Equipment (Console Size / Shape, Transmitters, Algorithm Etc.)
  - User Options: (Alarms, Deco Settings, Inc Safety, Etc.)



# Common User Settings

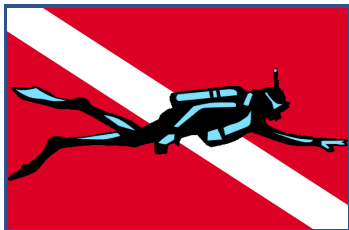


## Planning / Audible Warnings

- Depth
- Dive Time
- Turn Pressure (Air Integ)
- N2 Bar (Absorbed Nitrogen)
- **DTR** (Dive Time Remaining) / **NDC/NDL** (No Decompression Limit)
  
- Ascent Rate (Normally built in)

## Other User Settings

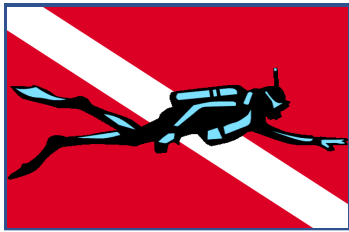
- Units
- Date/Time
- Sample Rate
- Deep Stop
- Safety Stop
- Conservatism Factor
  
- Gas Settings (Nitrox/Hel, Etc)
- Tank Settings (Up to 4+)



# Computer Purchase/Use Considerations



- Decide on Price Range: (\$200-\$1600)
- Type: Console vs Wrist?
- Capabilities / Considerations:
  - Readability: Dial Size /Color / Multi-color / Illumination?
  - Data Show Options: **Current Depth, NDC (No DECO Time), EDT (Elapsed Dive Time), Air vs Nitrox**, Max Depth, ATR/GTR (Air/Gas Time Remaining), Air, O2SAT, PO2, Temp, Etc.)
  - Ease of Use!!!! (Menu – Button Access?)
  - Dive Data Downloadable: Computer? / Computer and Phone?
  - Air Integrated?
  - Air-Nitrox-Tech Gases?
  - Usability with Existing Equipment (Console Size / Shape, Transmitters, Algorithm Etc.)
  - User Options: (Alarms, Deco Settings, Inc Safety, Etc.)
  - Algorithm: DSAT, Buhlmann ZHL-16C (Z+), ZHL-16 ADT MB PMG, Suunto RGBM, RGBM, Wienke-Haldane RGBM, Recreational RGBM, Etc



# Algorithms 101



## Tissues

### Haldane (1908):

- Body consists of a group of tissues which absorb and release gases at different rates.
- Defined limits of overpressure on different tissues
- Dev “HALF-TIME” concept – Req time for a given tissue to become “Half-Saturated”
- Suggested 5 Tissues with 5, 10, 20, 40, 75 Min Half-Times..

### Buhlmann (1960’s – Rel 1983)

- Built on Haldane Tissues Compartment concept
- Used Half-Time concept – but considered Half-Times up to 635 Min
- Common Model uses 16 Compartments (ZHL-16) but has been modified with various tissue structures (ZHL-8, ZHL-8 ADT, ZHL-16C, Etc.) by vendors.

### Diving Safety and Technology (DSAT) Model

- Used by PADI to develop PADI RDP. Relied on US Navy study (fit Men w/ Decompression Diving) with 6 Tissues Compartment up 120 Min
- PADI adapted model to adjust to Rec Diving and to accommodate Women and older divers.
- Reduced highest Half-Time for Surface Interval to 60 Min to account for Non-Decompression Diving.
- **Pretty Liberal Algorithm**

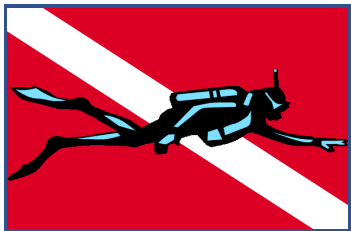
## Bubbles

### Variable Permeability Model (VPM)

- (Univ of Hawaii) Based on Bubble Formation/Growth in inanimate and in vivo system exposed to pressure
- Assume Micro bubble nuclei always exist in Water Containing Tissue
- Goal – to control the growth of LARGER bubbles in Tissue by large EXTERNAL Pressure during DECO.
- Assumes 1) Differing sizes of Bubbles in body
  - 2) Large Req less Pressure Red to Grow
  - 3) Fewer Large Bubbles than Small

### Reduced Gradient Bubble Model (RGBM)

- Wienke. Based on Both Buhlmann and VPM, but rejects some of the Gel Bubble assumptions:
- Blood Flow provides a limit on gas penetration.
- Exponential Distribution of size of bubble seeds
- Many more small seeds than large.
- Bubbles are permeable across boundaries under all pressures.
- Uses Haldane Half-Time ranges from 1 to 720 Min.
- Generally conservative family of algorithms.



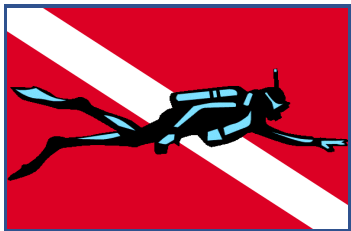
# Algorithm Safety



---

**All Current Algorithms Provide For A Safe  
Diving Environment When You Dive Within  
Their Parameters!**





# Computer Algorithms (Which Computers?)



## RGBM (Reduced Gradient Bubble Model)

- Based on a variation of Buhlmann designed by Dr. Weinke.
- Generally, a fairly conservative model
- Variations between Vendors
- SUUNTO, Cressi, Uwatec, Mares, TUSA

## Pelagic Z+

- Based on Buhlmann ZHL-16C.
- More Conservative than DSAT.
- Aqualung, Oceanic

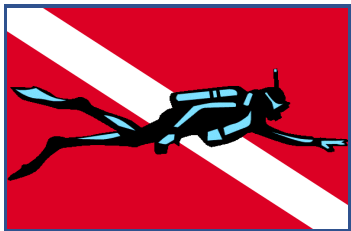
**NOTE- Oceanic is "Switchable"- Many of the Oceanic computers allow you to switch between DSAT and Pelagic Z+**

## Buhlmann has a variety of variations used by Vendors:

- ZHL-16C, ZHL-8 / ZHL-8 AD, ETC
- ScubaPro, Shearwater, Garmin

## DSAT (Diving Science & Technology - PADI RDP)

- Based on Haldane-Spenser Model.
- Generally, a More Liberal / Adjustable Model, (Reduces Surface Time Half-Time to 60 vs 120)
- Often used for Tech Diving
- Oceanic, Aeris, Sherwood, Genius, Some TUSA.



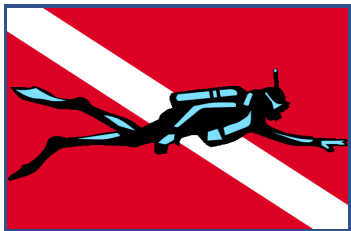
# Ranking of Computers

(Based on Degree of Conservatism)



**VERY ROUGH order Ranking of Dive computer vendors by degree of Conservatism:**

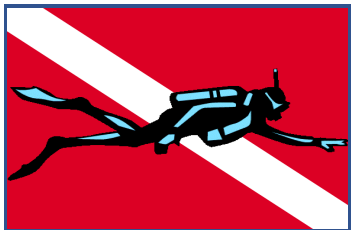
- SUUNTO (RGBM)
- Cressi (RGBM)
- Mares (RGBM/ Sel ZHL-16C)
- Uwatec (RGBM/Sel ZHL-8 ADT)
- TUSA (RGBM / Sel DSAT)
- Atomic (Rec RGBM)
- Oceanic (w/ Pelagic Z+)
- Aqualung (Pelagic Z+)
- Garmin (ZHL-16C)
- ScubaPro (ZHL-8 ADT MB)
- Oceanic (w/ DSAT)
- Aeris (DSAT)
- Sherwood (DSAT)
- Genis (DSAT)
- Shearwater (Buhlman/VPM-B)  
(VERY User Adjustable)



# Computer Purchase/Use Considerations



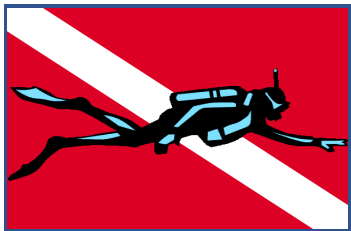
- Decide on Price Range: (\$200-\$1600)
- Type: Console vs Wrist?
- Capabilities / Considerations:
  - Readability: Dial Size /Color / Multi-color / Illumination?
  - Data Show Options: **Current Depth, NDC (No DECO Time), EDT (Elapsed Dive Time), Nitrox Setting, Max Depth, ATR, Air, O2SAT, PO2, Temp, Etc.)**
  - Ease of Use!!!! (Menu – Button Access?)
  - Dive Data Downloadable: Computer? / Computer and Phone?
  - Air Integrated?
  - Air-Nitrox-Tech Gases?
  - Usability with Existing Equipment (Console Size / Shape, Transmitters, Algorithm Etc.)
  - User Options: (Alarms, Deco Settings, Inc Safety, Etc.)
  - Algorithm: DSAT, Buhlmann ZHL-16C (Z+), ZH-L16 ADT MB PMG, Suunto RGBM, RGBM, Wienke-Haldane RGBM, Recreational RGBM, Etc.
  - Warranty – Local Dealer?



# Computer Maintenance



- **Dive Shop Annual Service:**
  - Replace Battery (Some Not User-Replaceable)
  - Inspect/Replace O-Rings
  - Inspect Housing for Damage
  - Forward to Manufacturer for Repair beyond above
  - Firmware Upgrade (Maybe/Maybe Not??)
- **Manufacturer Options (Depends on Status of Warranty)**
  - Replace
  - Repair (Oceanic -- \$140-180 outside Warranty)
  - Update Firmware



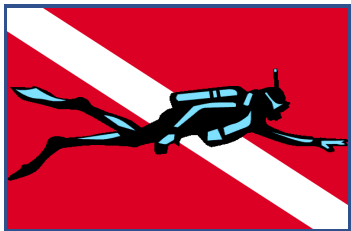
# Backup Computer



- **Backup Computer??**
  - **Maybe keep older computer as backup?**
  - **Purchase lower cost computer as backup?**
  - **Not use Backup.**



**Oceanic B.U.D**  
**\$199**



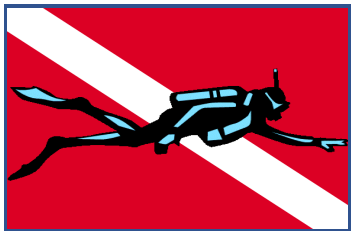
# Recommendation

---



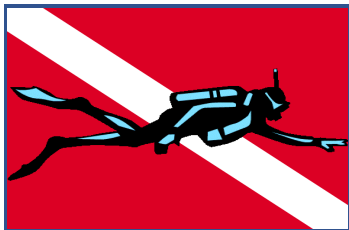
## RECOMMENDATION:

- Research the models you're interested in before going to a shop to buy or ordering online.
- Where possible, Physically handle the models you're interested in before buying: (Consider against your key factors: size, readability, menu structure, Etc)
- Once You Buy One, **READ THE MANUAL!!**



# Discussion



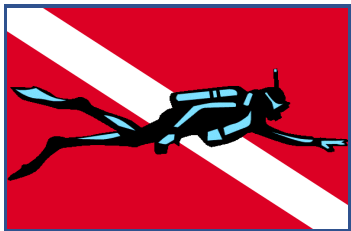


# Scuba Algorithms 101



- **1908 – Haldane.**
  - Develops the concept that the body was composed of a group of tissues which absorb and release gases at different rates.
  - Also, he defined limits on the amount of over pressurization different tissues could tolerate and a “half-time” (Required time for a given tissue to become “Half Saturated”)
  - He Suggested 5 Tissue Compartment with half times of 5, 10, 20, 40, 75 Minutes.
  - Much of what he discovered was used in developing the US Navy Tables.
- **1960’s – Buhlmann.**
  - Built on Haldane concept of theoretical tissue compartments.
  - Used the Half-Time concept but considered tissues with up to 635 minute half times.
  - Base model used 16 compartment, (ZHL-16) though model has been modified by vendors using different numbers of compartments and model identifiers (ZHL-8, ZHL-ADT, Etc)
- **Variable Permeability Model (VPM) – Univ of Hawaii.**
  - Based on Bubble formation / growth in inanimate/in vivo systems exposed to pressure.
  - Assumes Micro bubble nuclei always exist in water containing tissue – goal to control the growth of larger bubbles in tissue by large external pressure during Deco.
  - Assumes:
    - Differing sizes of bubbles in the body
    - Large Bubbles req less reduction in pressure to begin to grow than smaller bubbles.
    - Fewer large bubbles than smaller ones





# Scuba Algorithms 101



- **Wienke – Reduced Gradient Bubble Model (RGBM).**
  - Based in part on both Buhlmann and VPM. However, rejects some of the gel bubble parameters:
    - Blood Flow provides limit on tissue gas penetration.
    - Exponential distribution of size of bubble seeds – many more small vs large.
    - Bubbles are permeable across boundaries under all pressures.
    - Expands Haldane tissues compartments range in Half Time from 1 to 720 minutes.
- **Diving Science and Technology (DSAT) Model.**
  - Based on studied used to develop the PADI Recreational Dive Planner (RDP). Relied heavily on US Navy study which ultimately resulted in a Six Tissue compartments / Half-Times up to 120 Minutes Model. Based on Men in 20's to 30's, Reasonably Fit and Decompression Diving
  - With increase in Recreational Diving, Model adapted to adjust to recreational diving:
    - Adapt the Model to accommodate Women and Older Divers,
    - Account for Rec Divers NOT conducting Decompression Diving (Reduced Half Time for the Surface Interval from 120 to 60 Min.)
  - **Key** - Use of 60 minute half-time as the basis for Repetitive Diving