



**Homeland
Security**

Science and Technology

Summary

U.S. Department of Homeland Security



System Assessment and Validation for Emergency Responders

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders making procurement decisions.

Located within the Science and Technology Directorate (S&T) of DHS, the SAVER Program conducts objective assessments and validations on commercial equipment and systems, and provides those results along with other relevant equipment information to the emergency responder community in an operationally useful form. SAVER provides information on equipment that falls within the categories listed in the DHS Authorized Equipment List (AEL).

The SAVER Program is supported by a network of technical agents who perform assessment and validation activities. Further, SAVER focuses primarily on two main questions for the emergency responder community: "What equipment is available?" and "How does it perform?"

For more information on this and other technologies, contact the SAVER Program Support Office.

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Dive Computers

(AEL reference number 03WA-01-DCMP)

Dive computers are devices that increase diver safety and reduce the risk of decompression sickness by providing important information about current dive conditions. This information may include current depth, maximum depth, dive time remaining at depth, rate of ascent, water temperature, and decompression status.

To provide responders with information on currently available dive computers, the Space and Naval Warfare Systems Center Atlantic conducted a comparative assessment of these devices for the System Assessment and Validation for Emergency Responders (SAVER) Program in August 2011. Detailed findings are provided in the *Dive Computers Assessment Report*, which is available by request at <https://www.rkb.us/saver>.

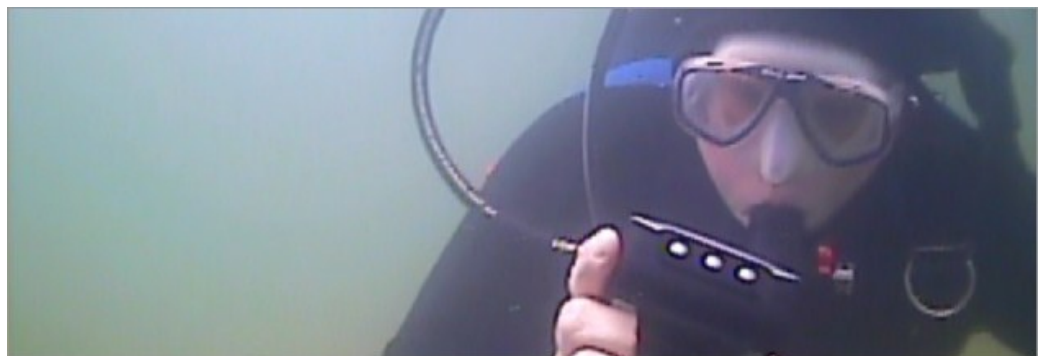
Assessment Methodology

Prior to the assessment, eight responders with experience using dive computers as members of police or fire department dive teams participated in a focus group. The group identified evaluation criteria and recommended product selection criteria and possible scenarios for assessment.

After identifying evaluation criteria, the focus group assigned each criterion to one of five SAVER categories, and then assigned a weight for its level of importance. Once the criteria were weighted, the five SAVER categories were assigned a percentage value to represent the level of each category's importance relative to the other categories.

Based on focus group recommendations, market research, and availability, the following dive computers were selected for assessment:

- SCUBAPRO Galileo SOL, Johnson Outdoors Inc.;
- X1, Liquivision Products Inc.;
- Oceanic VEO 3.0, American Underwater Products;
- Archimede 2, Cressi USA;
- EMC-20H, Cochran Undersea Technology;
- GP4000, IST Diving System; and
- NHeO3, VR Technology Ltd.



Six certified public safety divers served as evaluators for this assessment. All evaluators had experience using dive computers as members of law enforcement, fire rescue, or search and rescue dive teams.

During the assessment, evaluators rated the dive computers based on evaluation criteria established by the focus group. The assessment was separated into two phases: the specification assessment and the operational assessment. Evaluators assessed the systems based on vendor-provided information during the specification assessment. Hands-on experience using the dive computers during a pre-dive scenario and while making a shallow water dive served as the basis for the operational assessment. A dive supervisor conducted a safety briefing prior to the start of the operational dives. When making these dives, the evaluators followed a predefined course laid out along the lake bottom. Safety divers were present and located at different points along the course to assist the evaluators during the dives if needed.

| SAVER Category Definitions | |
|----------------------------|--|
| Affordability | groups criteria related to life-cycle costs of a piece of equipment or system. |
| Capability | groups criteria related to the power, capacity, or features available for a piece of equipment or system to perform or assist the responder in performing one or more relevant tasks. |
| Deployability | groups criteria related to the movement, installation, or implementation of a piece of equipment or system by responders at the site of its intended use. |
| Maintainability | groups criteria related to the maintenance and restoration of a piece of equipment or system to operational condition by responders. |
| Usability | groups criteria related to the quality of the responders' experience with the operational employment of a piece of equipment or system. This includes the relative ease of use, efficiency, and overall satisfaction of the responders with the equipment or system. |

Assessment Results

According to evaluators, all of the assessed dive computers worked as expected to assist public safety divers in providing needed and important diver safety information. Table 1 displays the composite assessment scores as well as the category scores for each dive computer. Higher scores indicate a more favorable rating by evaluators. The advantages and disadvantages of each dive computer, as identified by evaluators, are listed in table 2. To view how each dive computer scored against the evaluation criteria assigned to the SAVER categories, see table 3. For specifications, see table 4.

Responder agencies that may be considering the purchase of a dive computer should review the detailed findings in the *Dive Computers Assessment Report* and carefully consider each dive computer's overall capabilities and limitations in relation to their jurisdiction's operational needs. All reports in this series, as well as reports on other technologies, are available in the SAVER section of the Responder Knowledge Base (RKB) website, <https://www.rkb.us/saver>.

Table 1. Dive Computer Assessment Results

| Product | Composite Score | Affordability (5% Weighting) | Capability (25% Weighting) | Deployability (23% Weighting) | Maintainability (22% Weighting) | Usability (25% Weighting) |
|----------------------|-----------------|------------------------------|----------------------------|-------------------------------|---------------------------------|---------------------------|
| SCUBAPRO Galileo SOL | 4.2 | 4.2 | 4.5 | 4.1 | 4.1 | 4.3 |
| X1 | 4.1 | 3.0 | 4.3 | 4.3 | 3.6 | 4.4 |
| Oceanic VEO 3.0 | 4.0 | 4.7 | 3.8 | 3.9 | 4.2 | 4.1 |
| Archimede 2 | 4.0 | 4.2 | 3.5 | 4.2 | 4.3 | 3.9 |
| EMC-20H | 3.9 | 1.7 | 3.9 | 4.2 | 4.3 | 3.8 |
| GP4000 | 3.8 | 4.2 | 3.7 | 3.8 | 4.0 | 3.8 |
| NHeO3 | 3.7 | 4.7 | 3.4 | 3.8 | 4.2 | 3.4 |

Table 2. Dive Computer Advantages and Disadvantages

| Product | Advantages | Disadvantages |
|---|--|---|
|  <p>SCUBAPRO Galileo SOL Composite Score: 4.2</p> | <ul style="list-style-type: none"> • A display that is easy to understand, navigate, and read • Air integrated to monitor tank pressure to calculate remaining dive time • Log storage capacity of 99 dives or 100 dive hours • The lockout feature includes a supervisor override capability • The buttons are easily operated with gloves • A quick look reference guide is included | <ul style="list-style-type: none"> • The device is large and heavy • Infrared software download connection must be in close proximity to personal computer (PC) |
|  <p>X1 Composite Score: 4.1</p> | <ul style="list-style-type: none"> • A button-free tap technology that is easily operated with and without gloves • A bright and well organized display that is easy to read, with user-selectable font size and brightness • Multiple options for dive modeling software • Compact size with solid, durable construction • All functions and menus available while operating underwater | <ul style="list-style-type: none"> • Only available in wrist-mounted options • Major services and repairs are performed in Canada with possible delays due to international shipping • Battery is not user replaceable • Only has a 1-year warranty |
|  <p>Oceanic VEO 3.0 Composite Score: 4.0</p> | <ul style="list-style-type: none"> • The display is easy to read with bright backlighting • A highly visible flashing red light alarm indicator • Easy to connect cable interface between dive computer and the PC • A battery that is easy to access and replace | <ul style="list-style-type: none"> • A tool is required to access the battery compartment • Small parts can be lost during battery replacement • Wrist mount is not interchangeable with the console mount (due to the side button) • Backlighting may be difficult to operate |
|  <p>Archimede 2 Composite Score: 4.0</p> | <ul style="list-style-type: none"> • User can easily swap between three different mounting options • Multiple user-definable conservatism settings • Comprehensive dive log information is presented in the PC display | <ul style="list-style-type: none"> • Faint backlight that can be difficult to turn on • Downloading data from the dive computer to the PC was time consuming • It defaults to metric measurements after battery replacement |
|  <p>EMC-20H Composite Score: 3.9</p> | <ul style="list-style-type: none"> • Large, well organized, easy-to-read display • Durable due to no moving parts or buttons • Audible alarms are differentiated and distinct • An informative Microsoft® PowerPoint® user training presentation | <ul style="list-style-type: none"> • Difficult to set up; must be operated with wet fingers and a coin • Difficult to connect the PC and dive computer • Users cannot navigate the menus or modify the dive plan while underwater • The audible alarms are hard to hear while wearing a dive hood |
|  <p>GP4000 Composite Score: 3.8</p> | <ul style="list-style-type: none"> • Well organized and easy-to-read display • Real-time graphical display of dive profiles with the graph showing the dive depths during a dive • Two mounting options are available from the manufacturer and aftermarket mounts are also available • The altitude diving adjustment feature is presented in a graduated display | <ul style="list-style-type: none"> • The continuously flashing dive information could be interpreted as an alarm • Difficult to connect the PC and dive computer • The time to download information from the dive computer to the laptop could be slow • No training support available |
|  <p>NHeO3 Composite Score: 3.7</p> | <ul style="list-style-type: none"> • All functions and menus are accessible underwater • Powered by AAA battery that is easy to replace • Easy dive computer-to-PC interface setup • Three-year warranty • Multi-gas functions for up to 10 gas mixes | <ul style="list-style-type: none"> • Display is difficult to read due to limited brightness • Major services and repairs are performed in the U.K. with possible delays due to international shipping • Only a wrist-mounted option is available |

Table 3. Dive Computer Criteria Ratings¹

| | KEY | | | | | | |
|-----------------------------|----------------------|----|-----------------|-------------|---------|----------------|-------|
| | Least Favorable | | | | | Most Favorable | |
| | SCUBAPRO Galileo SOL | X1 | Oceanic VEO 3.0 | Archimede 2 | EMC-20H | GP4000 | NHeO3 |
| Affordability | | | | | | | |
| Warranty | | | | | | | |
| Capability | | | | | | | |
| Visual indicators | | | | | | | |
| Record keeping | | | | | | | |
| Air integration | | | | | | | |
| Gauge mode | | | | | | | |
| Integrated compass | | | | | | | |
| Lockout | | | | | | | |
| Owner identification record | | | | | | | |
| Deployability | | | | | | | |
| Durability | | | | | | | |
| Mounting options | | | | | | | |
| Dive planning | | | | | | | |
| Altitude diving adjustment | | | | | | | |
| Maintainability | | | | | | | |
| Battery type | | | | | | | |
| Battery access | | | | | | | |
| Time to replace battery | | | | | | | |
| Technical support | | | | | | | |
| Battery life | | | | | | | |
| Usability | | | | | | | |
| Ease of operation | | | | | | | |
| Audible alarms | | | | | | | |
| Visual alarms | | | | | | | |
| Display | | | | | | | |
| Size | | | | | | | |
| Auto-activation | | | | | | | |
| User definable conservatism | | | | | | | |
| Training | | | | | | | |

Note:

¹ Averaged criteria ratings for each assessed product are graphically represented by colored and shaded circles. Highest ratings are represented by full green circles.

Table 4. Dive Computer Specifications¹

| Specifications | SCUBAPRO Galileo SOL | X1 | Oceanic VEO 3.0 | Archimede 2 | EMC-20H | GP4000 | NHeO3 |
|-----------------------------|---|--|--|--|---|---|---|
| Wrist-mounted MSRP | \$1,980 | \$1,399 | \$459 | \$399 | \$1,360 | \$580 | \$800 |
| Alternate mounting options | Retractor mount | None | Two-gauge console mount ² , three-gauge console mount ² | Two-gauge console mount ² , three-gauge console mount ² | Retractor mount, hose mount, two-gauge console mount ² , three-gauge console mount ² | Two-gauge console mount ² | None |
| Auto-activation method | Water | Water | Pressure at depth of 5 feet | Pressure at depth of 5 feet | Water | Pressure at depth of 4 feet | Pressure at depth of 10 feet |
| Storage capacity | ~99 dives or 100 dive hours | User-selectable diver sampling rate: 30 to 154 dive hours | User-selectable diver sampling rate: 2 to 110 dive hours | 60 dives or 30 dive hours | User-selectable diver sampling rate: up to 1,450 dive hours | ~60 dives | ~100 dives |
| Air integrated | Yes | No | No | No | No | No | No |
| Gauge mode | Yes | Yes | Yes | Yes | Yes | Yes | No |
| Integrated compass | Yes | Yes | Yes | No | No | Yes | Yes |
| Lockout | Yes | No | Yes | Yes | No | Yes | No |
| Owner identification record | No | Yes | No | No | Yes | No | Yes |
| Durability | Shatter resistant, tested for oil/chemical resistance | Shockproof, shatterproof, tested for oil/chemical resistance | Shockproof, shatterproof, scratch resistant | Replaceable screen cover, scratch resistant | Shatterproof, tested for oil/chemical resistance | Not shockproof, not shatterproof, not shock resistant | Scratch resistant, shatter resistant |
| Battery type | Disposable 3 volt (V) lithium-manganese (CR12600SE/CR2NP) | Proprietary rechargeable lithium polymer | Disposable 3V lithium (CR2450) | Disposable 3V lithium-manganese (CR2032) | Disposable 3V lithium-manganese (CR12600SE/CR2NP) | Disposable 3V lithium (CR2032) | Disposable 1.5V alkaline or 3.6V lithium AA |
| Battery life | 2 to 3 years or 200 to 300 dives | 20 to 40 dive hours between recharges | 300 dive hours | 2 years at 50 dives per year | 1,000 dive hours | 60 dives | 20 to 40 dive hours |
| Training | Web-based | Web-based | Classroom, computer, web-based | None provided | Computer-based | None provided | None provided |
| Technical support | Online knowledge base, phone, e-mail | Phone, e-mail | Online knowledge base, phone, e-mail | Phone, e-mail | Phone, e-mail | Phone, e-mail | Phone, e-mail |
| Repairs | Repairs done at service center in El Cajon, CA | Repairs done at manufacturer location in Canada | Repairs done at authorized dealer or vendor service facilities | Repairs done by vendor | Repairs done at vendor's headquarters in Richardson, TX | Repairs done at vendor's location in Pomona, CA | Minor repairs done in WI, major repairs done at vendor's location in the U.K. |
| Warranty length | 2 years | 1 year | 2 years | 2 years | 2 years | Limited lifetime | 3 years |
| Warranty start date | Date of purchase | Date of purchase | Date of purchase | Date of purchase | Date shipped from manufacturer | Date of purchase (with registration within 15 days) | Date of purchase |

Notes:

¹ Information in table is based on data gathered and verified between January 2011 and February 2012.

² Console mounts hold dive computers or gauges and connect directly to the diver's equipment.