

DUAL DEEP WORKER SUBMERSIBLE

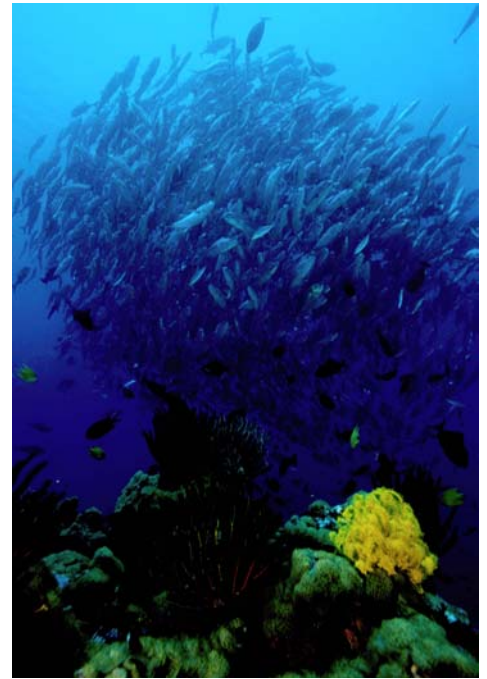


**OWNED AND OPERATED BY
DEEP OCEAN EXPEDITIONS LLC**

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DEEP OCEAN EXPEDITIONS

- In the past Deep Ocean Expeditions (DOE) has chartered a variety of manned deep submersibles from around the world to conduct its diving expeditions.
- In addition to partnering with the PP Shirshov Institute of the Russian Academy of Sciences in the operation of the 6,000-metre rated MIR submersibles, Deep Ocean Expeditions also own the 600 metre (2000 feet) rated Dual Deep Worker and co-own the two (2) 1,000 metre (3300 feet) rated Deep Rover 1002 submersibles.
- The company's diving expeditions range from unique seafloor natural history sites to historical wrecks. Sites dived on to date include the wrecks of the RMS Titanic, the first manned submersible dives to the wreck of the German battleship Bismarck and exploratory diving on an unknown wreck located in 5,182 metres (17,000 feet) in the Caribbean. Our clients have also dived to the hydrothermal vents in the Atlantic and Pacific Ocean and also to ancient wrecks in the Mediterranean.



- DOE clients have made dives to depths as shallow as 100 m (328 feet) and as deep as 5,180 metres (17,000 feet). This is approximately half the greatest depth in the world ocean.

- The founding principles of Deep Ocean Expeditions are simple: offer unique expedition experiences for the adventurer; educate lay people about the world's deep oceans, help support scientific research and support documentary film making. In addition, the company upholds the highest marine conservation standards during its operations. Nothing is disturbed, touched or removed other than for approved scientific or archaeological sampling.



- To support scientific investigation at its operating sites, DOE invites marine scientists to participate in its expeditions wherever possible. In this way, the company can help contribute to our knowledge of the world's oceans.
- The company is actively planning an array of exciting expeditions in 2004 and beyond. Underlying this expansion of the project base is consistent attention to the founding principles: education, science and adventure.

**DEEP OCEAN EXPEDITIONS : INNOVATORS
IN ADVENTURE DIVING WITH SUBMERSIBLES**



THE DUAL DEEPWORKER SUBMERSIBLE

- The Dual Deep Worker 2000 (DDW) submersible was built and designed by Phil Nuytten of Nuytco, Vancouver, Canada. It was commissioned for building in 2001 by Deep Ocean Expeditions and was launched in July 2003.
- The Dual Deep Worker submersible has a maximum operating depth of 600 metres (2,000 feet).
- The Dual Deep Worker is a modified version of the well-proven Deep Worker, a single hulled but similar submersible. The design has proven to be extremely safe with many practical applications.
- The Dual Deep Worker is certified +A1 manned submersible by Lloyds Register of Shipping.
- The pressure hull consists of two separate steel hulls. Each hull has a 38-inch diameter acrylic hinged hatch attached to the steel pressure hull. This hatch is used to enter/exit the submersible.
- Cabin pressure inside the submersible remains at one atmosphere: cabin air is recycled and cleaned of carbon dioxide and oxygen replenished using a metabolic make up system, which is identical to that used aboard spacecraft.
- The Dual Deep Worker has a favourable weight to power ratio giving it superb manoeuvrability.
- The Dual Deep Worker is the perfect submersible for exploring and capturing on film the 'Twilight Zone'. It is in this zone, below 800 feet, where no ambient light penetrates that many species are seen for the first time.
- Whether exploring the bottom or cruising the sloping walls into the abyss, the Dual Deep Worker is the submersible of choice.



DUAL DEEPWORKER SUBMERSIBLE FEATURES

- **Visibility / Viewing ports**

The pilot and observer enter the pressure hull of the Dual Deep Worker via two independently hinged 76cm (30-inch) diameter acrylic hemisphere hatches. In addition to entry/exit ports these hatches serve as viewing ports.



- **Pressure Hull**

There are two separate steel pressure hulls each consisting of a 38-inch diameter sphere attached to 24-inch diameter by 36-inch long cylinder which serves as a leg extension.

- **Comfort**

The pilot and observer sit comfortably in an upright-seated position in the pressure hulls, which are maintained at a one-atmosphere pressure.

- **Reliability**

The Deep Worker submersibles built to date have logged over hundreds of dives and their design has proven to be safe, reliable and effective.



- **Ease of Handling / Thrusters**

Four horizontally mounted one-horsepower thrusters plus two vertical thrusters mounted fore and aft assist the pilot in manoeuvring the submersible.

- **Safety**

There are four methods of rapidly bringing the DDW back to the surface by the Pilot as follows:

1. The main ballast tanks can be 'blown' (i.e., filled with air)
2. A full vertical thrust command should be capable of bringing the DDW to the surface, provided the pilot has the vehicle ballasted correctly.
3. The pilot or the observer can jettison the emergency drop-weight.
4. Both the battery pods can be jettisoned (last choice)

A safety briefing is given to all passengers prior to the start of any dive, which includes information on the use of all safety equipment, communication systems as well as instructions on how to return the submersible to the surface in the event the pilot is incapacitated.

- **Life Support**

There are four (4) oxygen cylinders (two (2) for each pressure hull) carried externally and four (4) oxygen bellows units located internally (two (2) for each pressure hull), which together control the supply of oxygen into each pressure hull. A total of 160 man-hours of oxygen are available to the occupants of the DDW eight hours of which is for normal operations and a 72-hour supply for emergencies (for each occupant). Carbon dioxide is removed from the cabin atmosphere using four (4) independent soda-lime scrubbers. Carbon dioxide and oxygen monitors are installed in each hull. Each scrubber provides 40 hours of carbon dioxide absorption.

Emergency breathing is provided by a B.I.B.S. (Built In Breathing System) unit, which consists of the second stage of a SCUBA regulator connected directly to a regulated air supply derived from the submersibles HP air storage cylinders. In addition, a lung powered scrubber system is provided, which enables the occupant to draw breathable air directly from the CO₂ scrubber unit without the need for electrical power.

- **Navigation / Sonar**

A modified Imagenex colour imaging sonar unit is installed. It is switchable from standard scan to high-resolution short-range scan for use on the bottom when searching for sites.

- **Communications**

A) A standard marine VHF radio is used for surface communications.

B) A digital underwater telephone called a Newtcom® is used for subsea communications. The Newtcom® is a single frequency 27 kHz underwater telephone, which is capable of transmitting at 70 Watts.

C) An internal PA system is used for communications between the two pressure hulls. For safety reasons, both the pilot and observer can communicate with the surface but the pilot will normally initiate all communications from the submersible and his/her microphone overrides the observers when necessary.

- **Power**

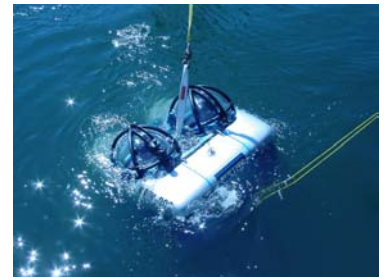
The power supply gives the DDW a total of 55-Ampere hours (Ah) at 240 Volts. In the event there is a loss of power, an emergency power supply is capable of running the life-support and communications systems for the duration of an extended stay on the bottom.

- **Manipulators**

Presently, the DDW is not fitted with a manipulator arm but all necessary electronic control functions have been installed, which will allow the rapid integration of a suitable arm when it is required in the future.

- **Launch and Retrievals**

The Dual Deep Worker will be used on board 'ships of opportunity'. The DDW can be easily launched by any crane system rated to lift the 2.7 tonne weight of the submersible. A single lift point is fitted between the two pressure hatches on the centreline of the submersible. An alternative 4-point sling arrangement can also be used if necessary.



- **Lighting**

Depending on the job at hand an array of lighting packages can be installed on the Dual Deep Worker. Lights available include 1200-watt, 600-watt, 400-watt and 200-watt HMI lights.

- **Filmmaking**

Currently a super HAD CCD 3000 metre depth rated digital camera is mounted externally on the DDW. A additional package of cameras and lighting equipment can also be fitted if requested. A series of penetrators are installed in the pressure hulls. These penetrators act as 'conduits' for controls and wiring from external equipment to be installed inside the DDW, and sufficient are available for adding additional cameras, lights and other equipment.

- **Pilots and Sub Crew**

The pilots, technicians and engineers on our DDW crew have spent thousands of hours working on a variety of submersibles and their combined experience is our client's best guarantee that operations will be run in a safe, professional and courteous manner.

- **Additional features**

Additional science sampling equipment or filming equipment can be mounted on the vehicle at the request of clients. Multiple dives can be made in a day. A second set of charged batteries ensures available power throughout a working day.

- **Future**

In 2004 the Dual Deep Worker will be available for worldwide projects. DOE is open to ideas of use for the DDW. The entire operation can easily be sea-freighted air freighted to required destinations. A team of three pilots and technicians efficiently runs the operation. Any array of projects can be considered including (but not limited to) tourist diving, filming, marine sampling and marine archaeology.

DUAL DEEPWORKER SUBMERSIBLE **TECHNICAL SPECIFICATIONS**

- **LAUNCH DATE** July 2003
- **BUILDER** Nuytco Research Co: Vancouver, Canada
- **SIZE**

| | |
|--------|----------------------------|
| Length | 2.20 metres / 86.55 inches |
| Width | 2.00 metres / 79.42 inches |
| Height | 2.00 metres / 79.30 inches |
- **WEIGHT** 2.7 tonnes / 6,000 lbs
- **OPERATING DEPTH** 600 metres / 2,000 feet
- **MAXIMUM SPEED** 2 – 3 knots
- **CREW** 1 Pilot / 1 Observer
- **PAYLOAD** Standard 315 kgs / 700 lbs
- **PRESSURE HULL**

Two independent hulls 96 cm (38 inch) diameter sphere attached to 61 cm diameter by 91cm diameter (24 inch diameter. by 36 inch diameter) long leg cylinders.
Manufactured of A516 grade 70 steel with 316 stainless steel hatch ring.
Pressure hulls installed on a ‘J-Can’ frame above two cylindrical aluminium battery pods.
- **VIEWING PORTS**

Two 76 cm (30inch) diameter acrylic hemispheres serving as entry/exit hatches.
- **POWER SOURCE**

Two 46 cm (18 inch) diameter battery pods.
Each pod contains 10 high ampere, deep cycle AGM batteries.
Nominal voltage 240 VDC, 12 KW total power.
12 and 24 volts (500 watts) supplied by converter.
- **BALLAST**

175 cubic feet of ballast air provided to fill bow/stern ‘soft’ buoyancy tanks.
Bow tank 62 kgs (145 lbs) lift, stern tank 100 kg (224 lbs).
Lift Thruster control available from either hull.
Auto depth control via on-board PLC.
- **MANEUVERING CONTROL**

Four Main 1 H.P. horizontal thrusters.
Two 1 H.P. ducted vertical thrusters located fore and aft.
- **LIFE SUPPORT**

160 man-hours from four oxygen cylinders carried externally.
Four mechanical oxygen controllers with electronic and analog monitoring.
Carbon dioxide removed via four independent scrubbers.

Emergency breathing via built in breathing system (BIBS).

- **NAVIGATION SYSTEMS**

Gyro Compass.

Modified Imagenex Sonar unit switchable from standard scan to high-resolution short range.

- **OBSERVATION**

2 x 200 Watt Newtlite® HMI lighting system.

Plus ability to add lighting and camera packages.

- **INSTALLED CAMERA SYSTEM**

1/3 inch super HAD CCD

768 x 494 NTSC picture elements

460 horizontal TV lines

12 x zoom lens

3000 metre depth rating.

- **COMMUNICATION**

Surface standard marine VHF radio.

Subsea communication via UQC 27 KHz digital Newtcom® acoustic underwater telephone.

Inter-hull communication via VOX controlled headsets and microphones.

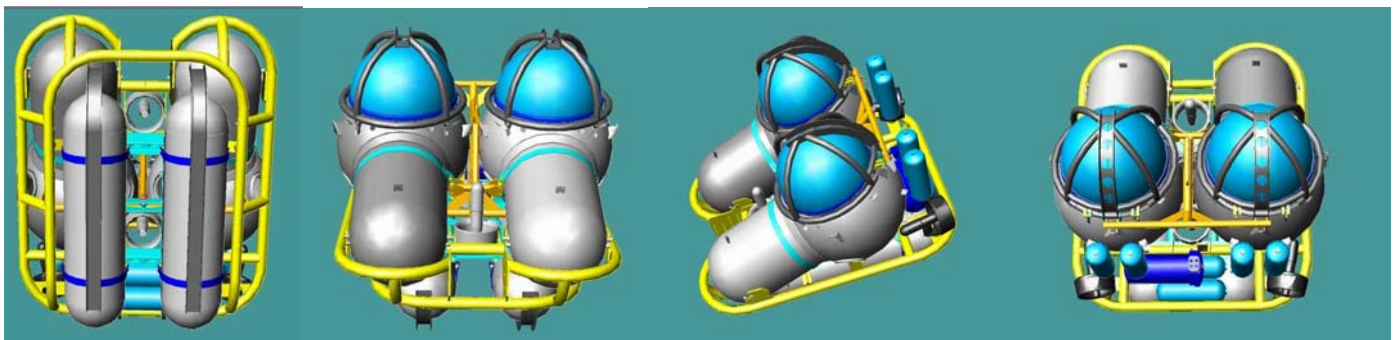


Figure 1: Design drawings of the Dual Deep Worker showing aft, forward, side and top views (L to R)