

<b>WADECO INDUSTRIES</b>		<b>DESCRIPTION</b>		Update: 5/1/2004 Edition: 3/30/2013	
<b>PS 700</b>		Version: 3		Page 0 sur 12	
<b>Mailing list</b>					
NOM	Company	Numbers of copies	For Information	For Action	
Onofri	PSI	1		*	
	BV	1	***		
	Affaires Maritimes CEO	1	***		
	Affaires Maritimes CCS	1	***		
	Client		***		
<b>List of modifications</b>					
Version	Date	Modifications			
V0	3/dec/99 :	Draft			
V1	19/dec/00	Updated according construction et requirement CCS et CEO			
V2	7/nov/01	Addition of operation condition			
V3	01/Mai/2004	Version NC 703			
					
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<p><b>1. GENERAL DESCRIPTION</b></p> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;">  </div> <div style="width: 50%;"> <p>PS 700 is an independent submersible designed for leisure. It offers six passengers and the pilot the ultimate view and comfort during their undersea expedition.</p> <p>The operating depth is -50 meters, supported with a safety factor of three.</p> <p>The electric autonomy is 8 hours at half power and 72 hours in emergency</p> <p>The total air ballast capacity enables more than 10 dives per day without refilling the bottles. The oxygen capacity, the CO2 absorbent and dehumidification are sufficient for 72 hours life support.</p> <p>Bottle refilling and battery charging are possible when PS 700 is alongside the quay.</p> <p>Good stability on surface, floatability and a very high freeboard enable the passengers to be transferred directly on the dive site, with a maximum sea state of three or 4.</p> <p>The design and the construction of PS 700 are carried out under the control of the French Bureau Véritas.</p> <p>The acrylic windows are manufactured in accordance with the ASME PVHO rules.</p> </div> </div> <p><b>2. OVERALL DIMENSIONS</b></p> <table border="0" style="width: 100%;"> <tr><td>Length</td><td>6390 mm</td></tr> <tr><td>Width</td><td>3400 mm</td></tr> <tr><td>Height</td><td>4000 mm</td></tr> <tr><td colspan="2"> </td></tr> <tr><td>Draught</td><td>2500 mm</td></tr> <tr><td>Freeboard of the hatch</td><td>800 mm</td></tr> <tr><td>Freeboard of the conning tower</td><td>1500 mm</td></tr> <tr><td colspan="2"> </td></tr> <tr><td>Weight in Air</td><td>10800 Kg</td></tr> <tr><td>Surface displacement</td><td>11300 liters</td></tr> <tr><td>Displacement in water</td><td>13000 liters</td></tr> <tr><td colspan="2"> </td></tr> <tr><td>Drop weight</td><td>900 kg</td></tr> <tr><td>Crew and equipment weight mini</td><td>300 kg</td></tr> <tr><td>Crew and equipment weight maxi</td><td>600 kg</td></tr> <tr><td colspan="2"> </td></tr> <tr><td>half full speed autonomy</td><td>8 hours</td></tr> <tr><td>Emergency life support</td><td>72 hours</td></tr> <tr><td colspan="2"> </td></tr> <tr><td>Max forward speed</td><td>2 knots</td></tr> <tr><td>Max towing speed</td><td>5 knots</td></tr> <tr><td colspan="2"> </td></tr> <tr><td>Max sea state for towing</td><td>3</td></tr> </table>			Length	6390 mm	Width	3400 mm	Height	4000 mm			Draught	2500 mm	Freeboard of the hatch	800 mm	Freeboard of the conning tower	1500 mm			Weight in Air	10800 Kg	Surface displacement	11300 liters	Displacement in water	13000 liters			Drop weight	900 kg	Crew and equipment weight mini	300 kg	Crew and equipment weight maxi	600 kg			half full speed autonomy	8 hours	Emergency life support	72 hours			Max forward speed	2 knots	Max towing speed	5 knots			Max sea state for towing	3
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**3. STABILITY**



The "Vertical" design of the PS700 gives a very good underwater stability enabling the passengers to move inside the cabin.

The position of the soft ballast and their volume gives a good surface stability and allows the passengers to move everywhere on the deck. The French government authorized the boarding of passengers directly from a boat to the deck of the PS700.

**4. PERSONNEL COMPARTMENT**



The pressure vessel is constructed by the assembly of:

- An elliptical A42CP steel hull (2100 mm in diameter and 13 mm in thickness). In this hull are the passengers chairs, the electrical control panel, the 24 VDC distribution board and the air conditioning and dehumidification systems.
- A cylinder window made of acrylic plastic (2100 mm in diameter, 80 mm in thickness, 1150 mm in height) placed on an L flange welded to the elliptical steel hull.
- An upper spherical steel hull, 2000 mm in radius, welded to an L flange is placed on the window.

This assembly is held under compression by eight internal tie rods to obtain tightness of the bearing windows/flange when PS 700 is on surface.

A conning tower (800 mm in diameter, 1000 mm height, 15° bend aft) enables an easy access to the cabin.

The hatch is made of a hemispherical hull (500 mm in radius) welded on a flange, 800 mm in diameter. The hatch can be opened from both outside and inside.

A spring washer system opens the hatch partly and automatically in case of internal over-pressure.

An inner and outer valve fixed on the top of the hatch

enables the internal pressurization.

The metallic part inside the hull is covered by fire retardant paint and thermal isolation to avoid condensation.

**5. EXOSKELETON**



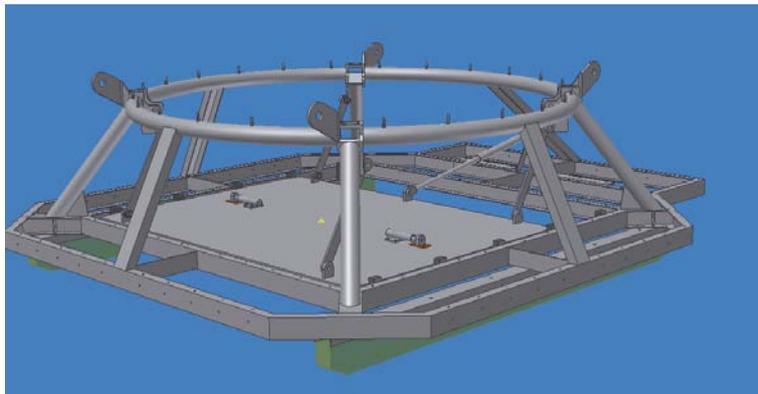
The tubular structure is made of a 88.9mm OD thickness 4 mm Stainless steel pipe.

A lower ring forms the fixed point of the hull and the upper ring is used as a guide for the upper cap of the hull.

A lower frame sustains all the batteries cells.

On the upper frame, the soft ballasts, the deck and fairing are hung. The handling points are welded on this frame.

**6. HARD BALLAST**



A one-ton movable hard ballast allows the trim adjustment in case of payload.

A part of this hard ballast is releasable and allows to surface even in case of HP blowing air loss or damage on the soft ballasts.

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## 7. DECK



The upper deck is made of fiberglass covered with anti-slip paint and fixed to the pipe frame.

There are several trapdoors on the upper deck in which we can reach the security equipment, external valves, oxygen tanks, filling valves, handling points...

A coning tower enables the cabin hatch protection from sprays.

A mirror system enables the pilot to control the surface from his seat in the cabin, through the spherical window.

Manropes and hand-ropes enable the passengers transfer in good security conditions.

An auxiliary towing point is on the front of the deck and fixed to the pipe frame.

## 8. AIR SYSTEM

### 8.1. DESIGN

There are two independent networks outside the cabin.

The blowing of each pair of ballasts is carried out by a 3/4" valve. The purging of each pair of ballasts is carried out by a 1 1/2" valve

Two Pressure reducers adjusted to P+5 and P+10 make the automatic change from the main bottles to the reserve bottles.

Manometers (2 on Hp pressure, 1 on Low pressure) are visible through the cylinder window.

### 8.2. AIR bottles

Three bottles of 50 liters, 200 bars, as the main system, provides enough air for blowing more than 20 times the ballasts on surface.

A fourth bottle as part of the reserve system provides enough air to blow the tanks on a depth is -50 meters.

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<h2>9. WEIGHT ADJUSTEMENT</h2>		
<h3>9.1. Air ballast system (soft ballast)</h3>		
<p>There are four independent ballast tanks, made of AG4MC Marine Aluminum. When on surface, only half of the ballasts are underwater so the volume above the water line is an important stability and floatability reserve.</p>		
	<h3>9.2. Outside water ballast (water tank)</h3>	
	<p>There is a 220 liters pressure tank to adjust precisely the weight of the PS 700. The level of water in this tank is set by compressed air through a blow valve or opening purge and vent valves.</p>	
	<p>Blow (3/4"), purge (1 1/2") and event (3/4") valves are outside the personnel compartment and operated from inside the cabin.</p>	
<p>A level controller allows a precise adjustment of the weighting</p>		
<h3>9.3. Inside Water Ballast</h3>		
<p>An internal tank inside the hull allows 150 Kg of adjustment. (For example in the case of a dive with four passengers instead of six.)</p>		
<p>The filling up and the emptying are done by a reversal 50 l/min electric bilge pump. Two 1" valves then isolate this tank from outside.</p>		
<h2>10. LIFE SUPPORT SYSTEM</h2>		
<h3>10.1. OXYGEN</h3>		
<p>Four external tanks (20 liters, 200 bars), and one outside 5 liters bottle are connected to an inside network. There is a pressure reducer and flow meter on this network.</p>		
<p>Only one 5 liters bottle outside the cabin is in operation. It is changed easily every day.</p>		
<p>The four other bottles give an emergency life support of 72 hours for the six passengers and the pilot.</p>		
<p>The oxygen flow is set by a manual injection valve and controlled by a flow meter.</p>		
<p>An oxy-meter checks the O2 partial pressure continuously</p>		
<p>A second oxy-meter checks the O2 partial pressure in back up.</p>		
<p>Seven individual self-breathing apparatus Masks allow 45 minutes life autonomy in case of cabin pollution.</p>		
<h3>10.2. Air scrubber</h3>		
<p>Airflow goes through a silent electric fan and a canister of soda lime for removal of carbon dioxide.</p>		
<p>A second system is in standby.</p>		
<p>The volume of soda lime stocked in the PS700 is sufficient for 3 days survival.</p>		
<p>The CO2 rate is checked continuously by an analyzer</p>		
<p>The CO2 rate can be monitored manually too in back up.</p>		
<h3>10.3. Dehumidifier and Air COOLING system</h3>		
<p>A 4500 Btu air conditioning system allows a precise control of the temperature and humidity</p>		
<p>The condensates are manually removed at the end of the day from the inner water tank.</p>		
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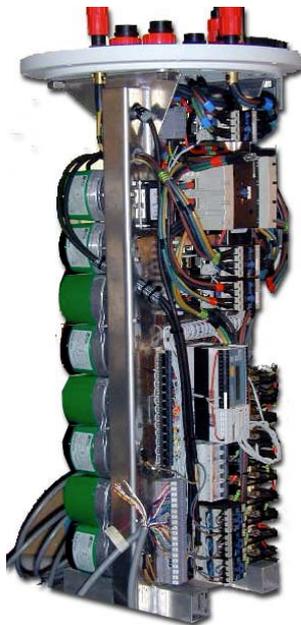
## 11. MAIN BATTERIES



Marine standard lead acid batteries are used in soft fiberglass tanks that are filled with oil and pressure compensated. Hydrogen is captured on the top of each cover of tank. Safety valves open by themselves when hydrogen pressure is above 100mbar.

A fairing protects the batteries tanks.

There are 46 elements of 12V 160 AH C5 in 10 fiberglass tanks



## 12. 276/552 VDC NETWORK

The 552 Voltage network is confined in an external electrical tank.

The charging of the batteries is done through this electrical tank, without slipping the submersible.

This external pressure tank contains the electronics needed for the control and protection of the AC Asynchronous motors of the thrusters.

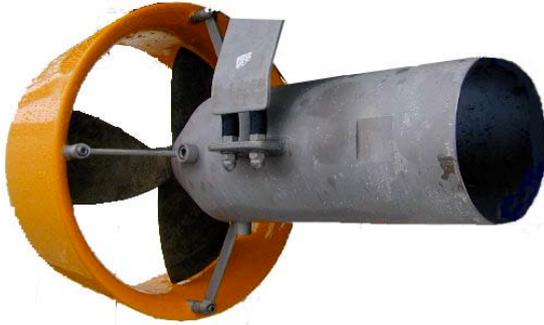
## 13. 24 /12VDC DISTRIBUTION

Converters 276/24V and 276/12V supply the 24 and 12 V networks

Emergency batteries (2 elements Gel acid 12V 86 AH C20) located in the cabin provide 72 hours autonomy (Air scrubber, Communication, internal light)

**14. PROPULSION**

The thrusters are made of an AC motor working in a dry tank. The water tightness is created by a rotating gland seal on the shaft.



The power on shaft is 5500 W

There is one horizontal thruster on each side, which control the movements and directions at different speed levels.

One vertical thrusters on the bow adjust submersion and pitch of the sub.

**15. LIGHTING**

Six external and pressure resistant lights 500 W, 220 VAC allow night dives and intensification of natural colors.

**16. MONITORING AND COMMAND**

One joysticks control the thrusters.

The blowing, venting and filling valves of the soft ballasts and water tank are operated by mean of a mechanical system through the hull.

A hydraulic system can drop and move hard ballast fixed under the hull.

Two valves equalize the cabin pressure just before opening the hatch.

Two stop valves adjust the oxygen system.



The pilot communicates by mean of VHF radio when on surface and by ultra sonic telephone when underwater (20 W 25 KHz).

The pilot monitors:

552 VDC and 24/12 VDC voltages  
Current input to each thrusters

Earth default alarms on each circuit  
Presence of water in electric tank.

Heading (Magnetic compass)  
Depth under the hull and submersion  
Internal pressure  
O2 partial pressure  
CO2 level  
temperature and humidity  
Roll and pitch situation  
Time

Pressure of HP air and LP air  
Pressure of each oxygen circuit.

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<p><b>17. INTERNAL FITTING OUT</b></p> <p>The floor is made of AG4MC .</p> <p>The legs of the seats are in aluminum and the seats are covered with Fire retardant cloth.</p> <p>The ladder is made of aluminum covered with Antis lip TBS indoor. The lowest step turns into the pilot seat with armrest.</p> <p><b>18. SAFETY EQUIPMENTS</b></p> <p>All the components inside the cabin are fire resistant type. In addition, two fire extinguishers (water with nitrogen gas) are available.</p> <p>If the atmosphere of the cabin becomes polluted, individual masks are available for 45 Minutes autonomy. Before every emersion, the pilot can release a buoy with a flasher and radar beacon. This is to show his position to the surface controller and to ensure that the emersion site is clear.</p> <p>When submerged, an acoustic beacon is automatically in use, so an acoustic positioning of the PS 700 is always possible by a device called ping pointer.</p> <p>The soft ballasts can be filled with an external bottle. (Divers' equipment)</p> <p>Water, food and hygienic bags are available for 72 hours.</p> <p>Lifting points are clearly indicated when hauling up the PS 700 with a tender boat.</p> <p><b>19. OPERATING PROCEDURE (ABSTRACT)</b></p> <p><b>19.1. Availability</b></p> <p>The submarine is in preventive maintenance 2 days every month for operations related to the control of the batteries and 10 days per year for the renewal of certification (Véritas Bureau). (Stand by Maintenance 30 days maximum)</p> <p>The commercial exploitation is ensured during all the safe remainder of the year for the cyclonic periods of alarms and the periods of winds higher than Force 6 raising a sea higher than Force 3 ( Stand By Weather 30 days)</p> <p>Two teams working in watch ensure a continuous operation: each team works one day out of two from 7h00 to 17h30 so an equivalent of 36h 45 per week</p> <p>The periods of holidays of the personnel will be mainly selected for the periods of stop for maintenance (1 month out of 2) and due weather</p> <p>Two weeks of stop for leave are left on the initiative of the personnel</p> <p><b>19.2. Staff Responsibilities</b></p> <p>The Base manager and the person in charge of maintenance ensure the continuity of the responsibility for the operation. The base manager takes charge of marketing and of the management of the base.</p> <p>The person in charge of the maintenance assists the pilots in the servicing of the material and assures the preventive maintenance of the submarine and of the surface boats</p> <p>Two identical teams organized in watch ensure the continuous operation of the submarine 7 days a week.</p> <p>Each teams are made up of a Pilot, responsible for the team and two pilots who ensure in turn the control of surface and the collect and the transport of the passengers, of a hostess who is charged to welcome the customers on the on shore base and to inform them of the safety instructions.</p> <p><b>19.3. Location</b></p> <p>The depth must not exceed 50 meters</p> <p>Underwater Current less than 1 knot</p> <p>Sea-state less than 3 (waves height under 0.6m)</p>		
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		<p>The dive spot is to be selected in a range less than 3 Nautical Miles far from the passenger collecting spot and the onshore base of the submarine.</p> <p>The PS 700 is towed at 5 knots on the diving site.</p>
<p style="text-align: center;"><b>19.4. Daily Program</b></p> <p>The submarine is constantly accompanied by a boat support equipped with a VHF radio and an acoustic telephone. This semi-rigid Standard Boat of 8.4m with Diesel Inboard 230Cv, covered for a protection, offers 6 seats to the passengers and allows a towing speed of the submarine of 5 knots.</p> <p>A second identical boat ensures at a speed of 20 knots the collect of the passengers during the dives..</p>		
		<p>The functions taken by the 3 pilots during the day are summarized by the table following</p>
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From	to	Pilot 1	Pilot 2	Pilot 3	
07:00	07:15	Checking and submarine Preparation	Checking and Preparation Boat 1	Checking and Preparation Boat 2	
07:15	08:00	Towing Boat 1	Towing Boat 1	Collect Passengers P1 Bateau 2	
08:00	09:00	Control surface Bateau 2	Collect Passenger P2 Bateau 1	Pilot submarine Passenger P1	
09:00	10:00	Return Passenger P1, Collect Passenger P3	Pilot submarine Passenger P2	Control Surface	
10:00	11:00	Pilot submarine Passenger P3	Control Surface	Return Passenger P2, Collect Passenger P4	
11:00	12:00	Control Surface	Return Passenger P3, Collect Passenger P5	Pilot submarine Passenger P4	
12:00	13:00	Return Passenger P4, Collect Passenger P6	Pilot submarine Passenger P5	Control Surface	
13:00	14:00	Pilot submarine Passenger P6	Control Surface	Return Passenger P5, Collect Passenger P7	
14:00	15:00	Control surface	Return Passenger P6, Collect Passenger P8	Pilot submarine Passenger P7	
15:00	16:00	Return Passenger P7, Return on dive spot Vide	Pilot submarine Passenger P8	Control Surface	
16:00	16:45	Towing	Towing	Return Passenger P8	
16:45	17:30	Submarine check and maintenance of	Boat 1 Check and maintenance	Boat 2 Check and maintenance	

The diving proceed in the following way:

At H-5, the submarine makes surface, the boat of Control surface puts alongside of submarine, the passengers come out of the submarine and go up in the boat of control surfaces which becomes shuttle boat to bring them back to the quay and to take a new passengers group.

At H, the shuttle boat arrives with a new team, it puts alongside of submarine, the passengers embark on the submarine, and the pilot of the preceding dive becomes the controller of surface while the pilot of the shuttle becomes Pilot of the submarine

At H+5, the submarine begins its new diving on a bottom from 20 to 50meters.

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<p style="text-align: center;"><b>19.5. Operation during Dive</b></p> <p>The passengers boards on the diving place Pilot closes the hatch</p> <div style="display: flex; justify-content: space-between;"> <div data-bbox="193 327 952 831" style="width: 45%;">  </div> <div data-bbox="970 320 1372 837" style="width: 50%;"> <p>Life support system is in use Filling the air ballast Filling the water tank until the conning tower starts to submerge Using the thrusters to begin the dive Contact with the surface controller every 10 minutes by the ultra sonic telephone Underwater expedition Release the surface beacon and request surfacing permission Blow the water tank Blow the air ballast when approaching the surface Equalize the cabin pressure Open the hatch and let passengers get off</p> </div> </div> <p>Boarding of next passengers</p> <p>A complete operating instructions manual will be supplied with the PS 700.</p> <p><b>20. MAINTENANCE</b></p> <div style="display: flex; justify-content: space-between;"> <div data-bbox="193 1059 952 1626" style="width: 45%;">  </div> <div data-bbox="970 1021 1372 1653" style="width: 50%;"> <p>Periodic check of the batteries and rotating gland seal is the main maintenance procedure.</p> <p>Batteries charging can be made with PS 700 alongside the quay.</p> <p>Nevertheless, PS 700 is to be hauled on shore every month to check the general tightness, the level of the oil in the fiberglass tank and the quality of the batteries solution.</p> <p>Windows cleaning will be done depending of the seawater quality and biologic growth.</p> <p>A yearly check of the system is carried out under control of a certified organization.</p> <p>Every 5 years, a complete</p> </div> </div> <p>disassembly of the PS700 is carried out for a full inspection and tests.</p> <p>The lifetime of the window is 20 years</p> <p>Maintenance Program specification is available for more information.</p>		
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