



Operating Guidelines for Personal Submersibles

Revision 2011.2

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1 GENERAL

1.1 Application.

1.1.1 Privately Owned Vessels.

1. These guidelines are applicable to privately owned manned submersibles that maintain at, or near, one atmosphere of pressure for human occupancy, and are designed for personal or recreational use. See 46 USC 2101 (25).

1.1.2 Passengers for Hire.

1. These guidelines are not applicable to any submersible of any type used for carrying passengers for hire. See 46 USC 2101 (21a).

1.1.3 Local Regulations.

1. Any government laws, regulations, or guidelines in the locality where the submersible is owned and/or operated shall always supersede and take precedence over this document.

1.2 Definitions.

1.2.1 Design Depth.

1. The maximum depth for which a system or vehicle is designed.

1.2.2 Operating Depth.

1. The maximum depth at which the vessel is designed to operate.

1.2.3 Rated Depth.

1. The maximum depth reached by the submersible during a manned test dive. The rated depth may not exceed the operating depth of the vehicle.

1.2.4 Passenger for Hire.

1. A passenger from whom consideration is received as a condition of carriage on the vessel, whether directly or indirectly flowing to the owner, charterer, operator, agent, or any other person having an interest in the vessel. See 46 USC 2101 (21a).

1.2.5 Recreational Vessel.

1. A manned submersible manufactured or operated primarily for pleasure; or leased, rented or chartered to another for the latter's pleasure. See 46 USC 2101 (25).

1.2.6 Submersible.

1. Throughout this document, **submersible** shall mean Recreational Vessel as defined in the Section 1.2.5 of this document.

1.2.7 Vessel.

1. Throughout this document, **vessel** shall mean Recreational Vessel as defined in the Section 1.2.5 of this document.

2 VESSELS

2.1 Equipment.

2.1.1 Legal Compliance.

1. Vessels operating within the jurisdiction of the United States Coast Guard (USCG) shall carry equipment as required by USCG rules for the classification to which that vessel belongs.
2. Vessels operating outside jurisdiction of the United States Coast Guard (USCG) are recommended to carry equipment as required by USCG rules for the classification to which that vessel belongs.
3. All vessels shall carry equipment required by laws and rules within the jurisdiction the dive is occurring.

2.1.2 Depth Gauge.

1. Vessels shall have at least one working depth gauge capable of accurately displaying the water depth of the vessel with a minimum of 10% accuracy.

2.1.3 O2 Gas Sensor.

1. A reliable and accurate O2 sensor is required for all vessels injecting supplemental oxygen into a human occupied cabin for life support.
2. The O2 sensor shall be calibrated in accordance with the manufacturers instructions prior to the vessel submerging.

2.1.4 CO2 Gas Sensor.

1. A reliable and accurate CO2 Gas Sensor is highly recommended for detection of CO2 within the vessel cabin.
2. Alternatively, a reliable and accurate timer with audible alarm may be set and used to indicate the necessity to surface and replenish air in the cabin based upon cabin volume and occupant respiration calculations performed by the pilot.

2.1.5 Releasable Buoy.

1. Every vessel is required to have a floating buoy attached to the hull that can be released from inside the cabin in the event of an emergency.
2. The releasable buoy shall be attached to a length of rope equal to the maximum diving depth of the vessel, PLUS 250 feet.
3. The releasable buoy must have sufficient buoyancy at depth to both reach the surface and counter the weight of the total length of rope or line to which the buoy is attached.

2.1.6 Marine Band Radio (VHF).

1. Marine Band (VHF) radios shall be the primary radio device used for communications when a submersible is surfaced on any coastal and intracoastal water (also the Great Lakes in North America).
2. At least one radio capable of transmitting and receiving on Marine Band (VHF) frequencies and having output power of at least 5 watts shall be available for use within the submersible cabin.

2.1.7 Family Radio Service (FRS).

1. Family Radio Service (FRS) radios shall be the primary radio device used for communications when a submersible is surfaced on inland lakes and rivers.
2. At least one radio capable of transmitting and receiving on FRS frequencies at a range of up to two miles shall be available for use within the submersible cabin.

2.1.8 Underwater Communication.

1. Every submersible shall have an underwater radio device providing clear communication between the submerged vessel and surface crew within the depth and area parameters of the planned dive.

2.2 Functional.

2.2.1 Hatch Operation.

1. All hatches providing human egress to or from the vessel shall be capable of being opened and closed from both inside and outside the vessel.

2.3 Documentation.

2.3.1 Operating Manual.

1. Every submersible shall have an operating manual which adequately describes:
 - a) The functions and capabilities of the vessel.
 - b) Equipment on-board the vessel.
 - c) Operating details including diving and surfacing.
2. During operations a copy of the operating manual shall be kept with the surface support crew.

2.3.2 Emergency Plan.

1. Every submersible shall have a written emergency plan which adequately describes:
 - a) The factors and conditions which shall constitute an emergency.

- b) How the submersible will communicate an emergency condition to surface support crew.
 - c) Details of life support equipment and their capacities.
2. During operations a copy of the emergency plan shall be kept with the surface support crew.

2.3.3 Pre-Dive Checklist.

1. Every manned submersible shall have a comprehensive written checklist which shall be used to ensure the vessel's systems and equipment are in the proper configuration for diving.

3 COMMUNICATIONS

3.1 Phonetic Alphabet.

3.1.1 NATO Nations.

1. The NATO phonetic alphabet shall be used in all communications between persons participating in submersible diving operations within NATO member nations. See APPENDIX-1.

3.1.2 Non-NATO Nations.

1. Phonetics used in diving operations within non-NATO nations shall be determined by the organizers and participants of the dive operation.

3.2 Radio Equipment.

3.2.1 Channel/Frequency Selection.

1. As part of the pre-dive planning, the specific channel or frequency used for any radio communications shall be determined and agreed upon by all parties.

3.2.2 Legal Compliance.

1. Use of radio equipment shall be in accordance with laws and regulations within the jurisdiction of the dive site.

4 DIVING

4.1 Planning.

4.1.1 Summary of event.

1. Create a descriptive summary of the planned dive operation that will provide vessel owners and attendees with a high level overview of the event.

4.1.2 Maximum dive depth.

1. Define a maximum dive depth based upon the experience of the pilots involved and water conditions that might affect surface support. Water depth should be no more than 20 feet when inexperienced pilots are participating in dive operations.
2. In the event the vessel cannot return to the surface on its own and sinks to the bottom, the depth of water at the dive site shall not exceed the operating depth of the **least** capable submersible.

4.1.3 Bottom Contour.

1. When approving the dive site, take into account the slope of the bottom in proximity to deep water to ensure that if a vessel veers off course in an emergency situation, it will not be stranded on the bottom in water deeper than its operating depth, or depth to which its rescue assistance is effective.

4.1.4 Weather, Tides, Current and Obstructions.

1. An evaluation of prevailing weather and sea conditions, and the availability of natural shelter, must be considered. Certain conditions such as strong tidal currents or hazards presented by other vessels or underwater obstructions may be cause for certain operating restrictions, additional design features, or possibly prohibiting operations altogether.

4.1.5 Number of dives planned.

1. Define the number of dives based upon factors such as projected weather and dive area conditions, launch/recovery, and the “turn-around” time required to change crew within a vessel. Remember that you may have to wait in line at a public launch or boat yard for your turn to put your vessel in the water.

4.1.6 Pilot experience.

1. Determine if the planned dive shall be open to all submersible pilots, or limited to pilots possessing a specific level of experience.
2. Communicate any limitations or requirements under this section to all submersible owners well in advance of the dive event.

4.1.7 On-site inspections.

1. Determine if on-site vessel inspections will be required and to ensure they comply with PSUBS standards and guidelines. Communicate this requirement to all submersible owners well in advance of the dive event.
2. If additional inspection criteria beyond PSUBS standards and guidelines are required, identify those requirements and communicate them to all submersible owners well in advance of the dive event.
3. Identify personnel who will act as inspectors and ensure they are familiar with and understand all inspection criteria vessels must meet to participate in dive operations.

4.1.8 Launch and recovery.

1. Research and identify the location and method (boat launch, boat lift, crane) submersibles are to gain water access. Ensure these facilities will accommodate all anticipated attending submersibles and communicate any costs involved to all submersible owners.
2. Research and confirm the water depth is adequate at the planned launch and recovery location for all attending submersibles, keeping in mind changes in tide and other similar considerations.

4.1.9 Leadership & Command.

1. The leadership and chain of command for each dive operation should be documented so that all participants understand and recognize who is in charge to make decisions for any issue or event that occurs during the course of the operation, including emergencies.
2. A minimal set of leadership positions should include:
 - a) Operations Director.

This position is responsible for oversight of all segments of the operation, and is the final arbiter and decision maker for all matters.
 - b) Dive Director.

This position is responsible for directing in-water operations within the dive area. The dive director may delegate various responsibilities to other participants as necessary.
 - c) Safety Director.

This position is responsible for issues and incidents related to safety both on shore and water. The Safety Officer may delegate various responsibilities to other participants as necessary.
3. All operation officers shall carry radio equipment when required for effective communications and coordination of the event. The type of equipment and frequencies to be used shall be determined by the operations director.

4.1.10 Surface Support.

1. A personal submersible will not be as self sufficient as a surface vessel, therefore special consideration will be given to the overall system of operations, support and maintenance in view of the environment in which the submersible will operate. A surface support craft and/or safety divers are required to be in the vicinity at all times.
2. Identify the number and type of surface vessels that will be required to support dive operations. This includes direct submersible support and surface vessels for observers.
3. Identify the number of support staff that will be required and define who will be assigned to each position.
4. The responsibilities of each support staff should be documented and available for inspection. Each support staff member should be fully aware of their duties for the duration of the operation, including their role in the event of an emergency.

4.1.11 Safety divers.

1. Identify if safety divers will be required for the event and determine how many should be present on-site.
2. Reserve the divers availability well in advance of the event. Divers from the local event area are often available to help.

4.1.12 Supplies & Equipment.

1. Identify any supplies or equipment that will be necessary to support both dive operations and the event in general. Take time to consider each element of the event, where supplies will come from, and who will be responsible for bringing them. Possible categories include:
 - a) Food and water.
 - b) Rope, tape, knife, hand tools.
 - c) SCUBA tanks and other related dive gear.

4.1.13 Surface Observers.

1. Determine an accurate count of participants to plan for observing logistics such as access to/from the dive area. Ensure planned facilities will accommodate all participants and communicate any costs involved.
2. Keep in mind that submersibles attract much attention from the public and a number of unanticipated observers may be present. Have a plan in place on how these unanticipated observers will be handled relative to event operations.

4.1.14 Safety Plan.

1. The safety plan should be a comprehensive document identifying issues and resolutions for all aspects of the dive operation both on shore and on water. Minimally, the safety plan should include the following items:

- a) Police, Fire, and Rescue phone numbers.
 - b) US Coast Guard phone number if diving in USCG jurisdiction.
 - c) Cell phone numbers of the dive operation officers listed in Section 4.1.9 of this document.
 - d) Water-based towing services and phone number or radio frequency.
 - e) Nearest dive shop and phone number.
 - f) Nearest hardware store for tools and parts.
 - g) Nearest rental shop for large tools and equipment.
5. All phone numbers should be distributed to a network of cell-phone owners in case one or more phones have signal trouble at the dive area.
 6. When planning an event in a remote area where cell-phone signal is not reliable, use of a long-range two-way radio (VHF, FRS, CB) must be setup between the dive area and a person having access to a land line who is available to contact help.

4.1.15 Emergency Plan.

1. The emergency plan should be comprehensive document that describes the process or procedure to be use in the event of an emergency situation on shore or on water. The parts of the plan that deal with a submersible emergency must be communicated to all submersible owners well in advance of the event. Minimally, the emergency plan should include:
 - a) Define the chain of command in an emergency, which may be different on-water than on-shore.
 1. Who will decide when it is time to call for help?
 2. Who will make the call for help?
 3. How will the call for help be made (radio, cell-phone)?
 - b) Define the parameters in which an emergency situation will be realized?
 1. Emergency buoy released.
 2. Verbal statement.
 3. Hand signal.
 4. Loss of communication.
 5. Other.
 - c) What roles will support crew play in the event of an emergency?
 Define an immediate action plan by officers and participants in the event of an emergency and communicate this plan to all participants.

4.1.16 Dive Area Survey.

1. Determine the physical size and area where diving is to occur and communicate these limitations to all submersible pilots. Use visual references when appropriate or use surface vessels and buoys to mark the area.
2. Determine if any exclusion zones should be identified within the dive area and communicate these zones to all submersible pilots.
3. Identify any known surface or sub-surface obstacles/obstructions and communicate these danger areas to all submersible pilots.
4. Do not operate in an area where currents or surface conditions are likely to affect a submersible or surface vessel from keeping a safe distance from any obstacle or obstruction.

4.1.17 Transit to/from Dive Area.

1. Identify and investigate the water route submersibles will take to or from the dive area, keeping in mind potential hazards such as:
 - a) Water depth along route.
 - b) Obstacles and obstructions.
 - c) Conflicting surface traffic.
2. Determine how surface observers will be transported to the dive area (if necessary) and coordinate appropriate services. Communicate any associated costs to all participants well in advance of the event.
3. Investigate, understand, and comply with any law or regulation for surface boating to the dive area.
4. If submersibles are to be towed to the dive area by surface boats, investigate if any special rules, lighting, or signal flags are required by the towing vessel.

4.2 Vessel Preparation.

4.2.1 Required equipment.

1. In addition to the equipment specified within this document, determine if any additional equipment is required for the specific dive operation being planned.

4.2.2 Visual Inspection.

1. A visual examination of the hull, both internally and externally, should be conducted insofar as is practical prior to launching the submersible. See Section 5.2.3 Inspection Points.

4.2.3 Maintenance Records.

1. Maintenance records should be reviewed by the owner and/or operator to ascertain the nature and extent of any maintenance, enhancements, or functional changes that have been performed on the submersible.

4.2.4 Component Preparation.

1. All monitoring instruments and gauges, particularly those in the life support systems, should be calibrated and proven functional. The failure of any vital system is reason to terminate dive operations until the system is repaired and tested.

4.2.5 Securing Items.

1. All vessel components that may possibly interfere with operations or recovery in an emergency shall be secured in a manner that prevents unattended shifting or movement, including but not limited to:
 - a) Ballast
 - b) Batteries
 - c) Air/Gas Cylinders
 - d) Loose rags and towels.
 - e) Hand tools.

4.2.6 Functional Test.

1. An operational dive, which need not be to the rated depth, should be conducted to ensure all systems are tested and functioning normally.

5 MAINTENANCE

5.1 General.

5.1.1 Guidelines and Standards.

1. ABS and/or ASME PVHO approved welding, fabrication, and testing procedures are required on all pressure hull repairs.

5.1.2 Required Repairs.

1. Full restoration is required for any wear, damage, decay, or fatigue found on any component of the submersible which might compromise the integrity of the pressure hull.

5.2 Vessel Inspection.

5.2.1 Trailered Vessels.

5.2.2 Docked Vessels.

5.2.3 Inspection Points.

1. Owners should adopt a very conservative approach regarding repairs to the hull, life support systems, and buoyancy/ballast systems.
2. Externally mounted ballast tanks must be checked for potential leaks, and decay that may cause failure during dive operations.
3. High pressure tanks and O2 bottles must be checked for damage.
4. Hydraulic and electrical systems must be checked for leaks, fitting damage, potential electrical faults, and general decay.
5. Care must be taken to determine if the pressure hull has sustained any damage which will require repair. External stiffeners and hull penetrations shall be checked carefully for evidence of fatigue cracking.

5.3 Viewport Replacement.

5.3.1 Replacement Material.

1. Viewports shall be replaced using ASME PVHO approved materials and methods.

5.3.2 Replacement Schedule.

1. Viewports have a limited number of dive cycles before fatigue failure becomes a concern and shall be replaced after 10,000 pressure cycles, or 10 years, whichever comes first.

5.3.3 Pressure Cycle.

1. Each dive imparts some deformation to the hull and viewports, therefore each dive (regardless of depth) shall be recorded as one pressure cycle.

5.3.4 Record Keeping.

1. The submersible owner is responsible for tracking each viewport's pressure cycles and time in service.

6 APPENDIX-1

6.1 NATO Phonetic Alphabet.

Character	Telephony	Pronunciation
Alphabet		
A	Alfa	AL-FAH
B	Bravo	BRAH-VOH
C	Charlie	CHAR-LEE
D	Delta	DELL-TAH
E	Echo	ECK-OH
F	Foxtrot	FOKS-TROT
G	Golf	GOLF
H	Hotel	HOH-TEL
I	India	IN-DEE-AH
J	Juliet	JEW-LEE-ETT
K	Kilo	KEE-LOH
L	Lima	LEE-MAH
M	Mike	MIKE
N	November	NO-VEM-BER
O	Oscar	OSS-CAH
P	Papa	PAH-PAH
Q	Quebec	KEH-BECK
R	Romeo	ROW-ME-OH
S	Sierra	SEE-AIR-RAH
T	Tango	TANG-GO
U	Uniform	YOU-NEE-FORM
V	Victor	VIK-TAH
W	Whiskey	WISS-KEY
X	Xray	ECKS-RAY
Y	Yankee	YANG-KEY
Z	Zulu	ZOO-LOO

6.2 NATO Phonetic Numbers & Special Characters.

Character	Telephony	Pronunciation
Numbers		
1	One	WUN
2	Two	TOO
3	Three	TREE
4	Four	FOW-ER
5	Five	FIFE
6	Six	SIX
7	Seven	SEV-EN
8	Eight	AIT
9	Nine	NIN-ER
0	Zero	ZEE-RO
Special Characters		
.	Point	POINT
-	Dash	DASH
#	Pound	POUND
!	Bang	BANG