

# **Design Guidelines for Personal Submersibles**

**Revision 2011.1**

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# **1 GENERAL DESIGN**

## **1.1 Adoption of ABS and ASME Standards.**

### **1.1.1 Applicability.**

Except where defined elsewhere within this document, all designs in whole or in part shall conform to the latest standards defined by the American Bureau of Shipping (ABS) and/or the American Society of Mechanical Engineers (ASME).

### **1.1.2 Conflicts.**

In the event of a conflict between guidelines and standards between various entities or agencies, the recommendation, standard, guideline, or requirement that provides the greatest level of safety shall be used.

## **1.2 Definitions.**

### **1.2.1 Design Depth.**

Maximum depth for which a system or vehicle is designed.

### **1.2.2 Rated Depth.**

Maximum depth successfully reached by the submersible during a manned test dive. The rated depth may not exceed the design depth of the vehicle.

### **1.2.3 Operating Depth.**

Depth at which the vessel normally operates. The operating depth may not exceed the rated depth of the vehicle.

## **1.3 General Systems.**

### **1.3.1 Basic Requirements.**

1. The basic requirement for personal submersible design is that in the event of any single casualty the vessel can be returned to the surface without external assistance. Backups of systems and equipment are essential in order to meet this general design requirement. Vital systems, such as those necessary for the vessel to surface, to deploy lifesaving equipment, to disembark personnel, or for life support must be shown to have an acceptable level of reliability, a manual override control, or redundancy.

### **1.3.2 Buoyancy and Stability.**

1. Positive buoyancy should be implemented in all operating modes so that if power or some

other critical system is lost the vessel will return to the surface naturally (automatically). Vertical thrusters can be used for maintaining the desired depth when operating with positive buoyancy.

2. Adequate buoyancy and stability must be designed to permit the vessel to surface in a timely manner, while maintaining an upright attitude, even after receiving damage to any ballast/buoyancy tanks. Underwater escape and rescue from a submerged submersible is not likely to be successful and in any event it will be difficult and hazardous. Therefore, all means for returning the submersible to the surface in both the normal and emergency modes should be detailed.
3. Adequate free-board and stability must be available on the surface to permit safe exit from the vehicle, and access to lifesaving equipment, under the worst expected surface conditions in the designated operating area.

### **1.3.3 Life Support.**

1. Life support should be designed to provide a minimum of 72 hours survival for the maximum number of persons carried by the submersible, in the event of an unforeseen circumstance that prohibits the submersible from surfacing. The life support system should include:
  - a) Carbon Dioxide removal.
  - b) Oxygen supply.
  - c) Emergency breathing.

### **1.3.4 Sensors and Monitoring.**

1. Sensors and monitoring equipment are required for:
  - a) Fire protection systems
  - b) Life support systems
  - c) Ballast systems
  - d) Bilge system

## **2 PRESSURE HULL**

### ***2.1 Large Opening Reinforcement.***

#### **2.1.1 100% Rule.**

1. The 100% rule shall be allowed for calculating the amount of reinforcement required for all openings and reinforcements.

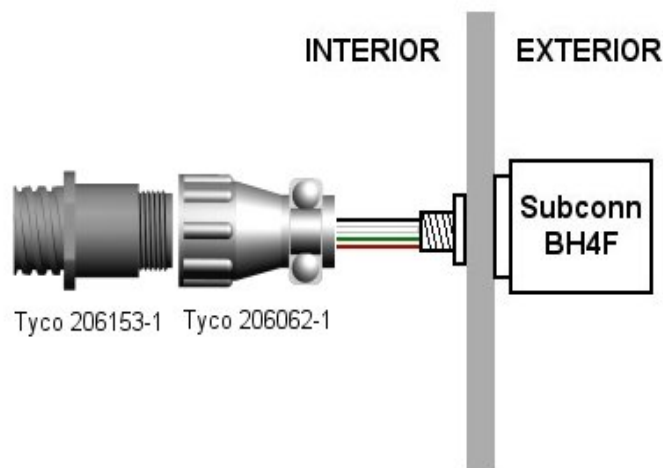
## 3 EQUIPMENT

### 3.1 Electrical Thru-Hull.

#### 3.1.1 Subconn BH4F.

1. Each vessel shall install at least one electrical thru-hull connector comprised of the following components:
  - a) One Subconn BH4F bulkhead connector
  - b) One Tyco Electronics 206062-1 cable clamp.
  - c) One Tyco Electronics 206153-1 receptacle.
2. The electrical connections between the BH4F and 206153-1 shall be wired “straight-thru” in the following sequence:
  - a) Pin 1 – Black wire
  - b) Pin 2 – White wire
  - c) Pin 3 – Red wire
  - d) Pin 4 – Green wire

*Illustration 1: BH4F Bulkhead Connection*



#### 3.1.2 OTS UCQ Hardware.

1. Vessels utilizing Ocean Technology Systems (OTS) underwater communications hardware shall make electrical connections between the transducer and Subconn BH4F connector as follows:
  - a) Pin 1 – Black wire – Transducer shield.

- b) Pin 4 – Green wire – Transducer center.
- c) See Appendix-1 for more information.