



ABS Underwater Rule Requirements, Surface Supplied Diving Systems

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Overview of Surface Supplied Diving

- Commercial surface supplied diving systems operate at shallower depths than SAT diving systems
- Time at depth is limited by dive tables, and decompression (if required) takes place at the end of every dive
- Divers breathe either air, Nitrox (oxygen enriched air) or Heliox
- Operating depth is limited by need to avoid oxygen toxicity and nitrogen narcosis
- Divers travel to and from work site in either a wet bell, a dive stage or a ladder
- Breathing gas is supplied by umbilical from the surface to either a wet bell or directly to the diver
- Emergency breathing gas may be available at bell/stage

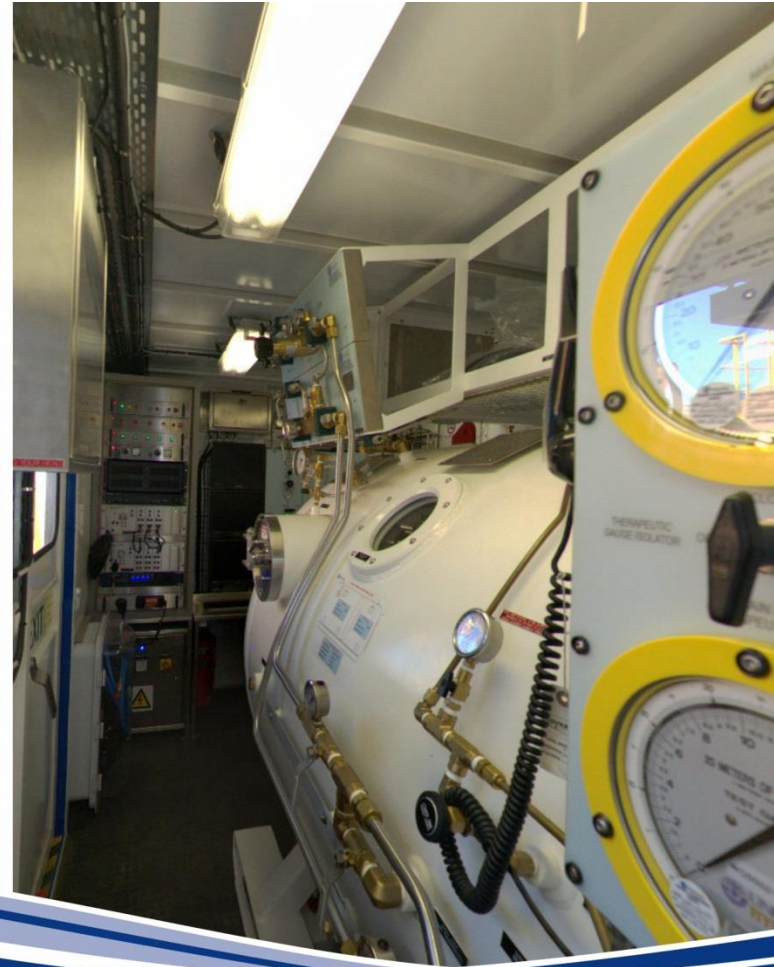
Overview of Surface Supplied Diving (Cont.)

- Decompression is typically performed by in-water stops and/or surface chamber decompression
- Air dive chambers consist of a main lock and a transfer lock
- Transfer lock allows personnel to enter and exit the main lock without reducing the pressure
- Chamber life support typically provided by ventilation with air from a compressor and/or volume tank
- Surface supplied diving systems are often modular and portable

Components of Surface Supplied Dive Systems

- Wet Bell / Dive Stage (Basket) / Ladder
- Handling System
- Deck Decompression Chamber (DDC)
- Life Support Systems
- Piping Systems
- Electrical Systems
- Control Station

Major Components of Air Dive Systems



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CONTAINERISED SYSTEM SL3.1

Open/Wet Bell



Open/Wet Bell

- Refer to Section 14/9 (all references are to ABS Underwater Rules unless otherwise noted)
- Required for operations exceeding 220 FSW (67 MSW)
- Carry at least two divers including their equipment
- Provided with one extra lifting point in line with the center of gravity of the bell
- Provided with an enclosed upper section at head and shoulder level capable of maintaining a bubble of breathing gases
- Provided with normal and emergency lighting, a suitable depth gauge (when used for in-water decompression), and a means for taking an unconscious diver into bell and securing said diver with their head in the enclosed upper section

Open/Wet Bell (cont.)

- Provided with a main supply umbilical for supplying breathing gases, hot water, electrical power, communications, etc. Umbilical to be attached by means of strain relief fitting or similar
- Bell umbilical to be provided with two independent supplies of breathing gas from the surface
- Wet bell to be provided with an onboard emergency life support independent of surface supply
- Diver's umbilicals provided with breathing gases from both surface supply and onboard emergency life support, failure of one line not to interfere with another diver's supply
- Blowing-down or flushing the enclosed upper section not to interfere with breathing gas supply to any diver

Diving Baskets/Stages



Diving Baskets/Stages

- Refer to Section 14/10
- Required for operations where the freeboard exceeds 2 meters or where in-water decompression is to be carried out
- Carry at least two divers including their equipment
- Provided with one extra lifting point in line with the center of gravity of the bell
- Provided with a means for taking an unconscious diver into diving basket and securing said diver
- Provided with on-board emergency life support system, independent of diver's surface supply, capable of supplying gases up to maximum operating depth and with capacity sufficient to supply divers during recovery including decompression stops

Handling System



Handling System

- Refer to Sections 14/9.23 and 18
- Must permit safe operation in the design sea state when the support vessel/facility is rolling, pitching, or heaving
- Must be capable of facilitating decompression stops in the water column
- Minimum dynamic loads are those resulting from simultaneous accelerations of 1 g vertical (in addition to gravity), 1 g transverse, and 1 g longitudinal (2 g, 1 g, 1 g requirement)
- Wire rope factor of safety of 5 based on design load (10 times rated load)
- Wire rope to be constructed in accordance with a recognized standard applicable to the intended service

Handling System (cont.)

- Power systems and equipment to be designed for 100% of the design load
- An independent emergency power source to be available for supplying power in case of failure of the primary
- Winches to meet applicable load and safety factor requirements, and are to have two independent braking mechanisms
- Hydraulic counterbalance valves may be used as dynamic braking mechanisms if additional requirements are met
- Load path hydraulic cylinders to be as per 4-4-1 of Steel Vessel Rules or a recognized code or standard, and meet structural factors of safety of 18/7.3 Underwater Rules
- Toughness testing required for structural members at service temperatures of -10 C and below

Deck Decompression Chamber (DDC)



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CONTAINERISED SYSTEM SL3.4

DDC Interior



- Refer to Section 14/5 as well as 4, 5, 6 and 7
- Pressure Vessels for Human Occupancy (PVHOs) treated as group 1 pressure vessels per Steel Vessel Rules
- Design must comply with either 4-4-1A1 of Steel Vessel Rules or a recognized code or standard (e.g. ASME VIII-1, EN-13445)
- Materials of pressure boundary should be as per the chosen design standard
- Designed for all anticipated pressures and loads under normal and emergency operating conditions (e.g. impact, lifting, nozzle connections, weight of installed equipment, wave loads)
- Permit ingress or egress of personnel while one compartment remains pressurized

DDC (cont.)

- Viewports must comply with requirements of Section 2 of ASME PVHO-1
- Viewports provided with means to prevent mechanical damage from inside or outside
- Sufficient number and size of viewports to allow observation of all occupants from outside
- Compartments that may be used for decompression to be provided with suitable medical/equipment locks
- All compartments to be provided with emergency and treatment gas via BIBS

Life Support Systems



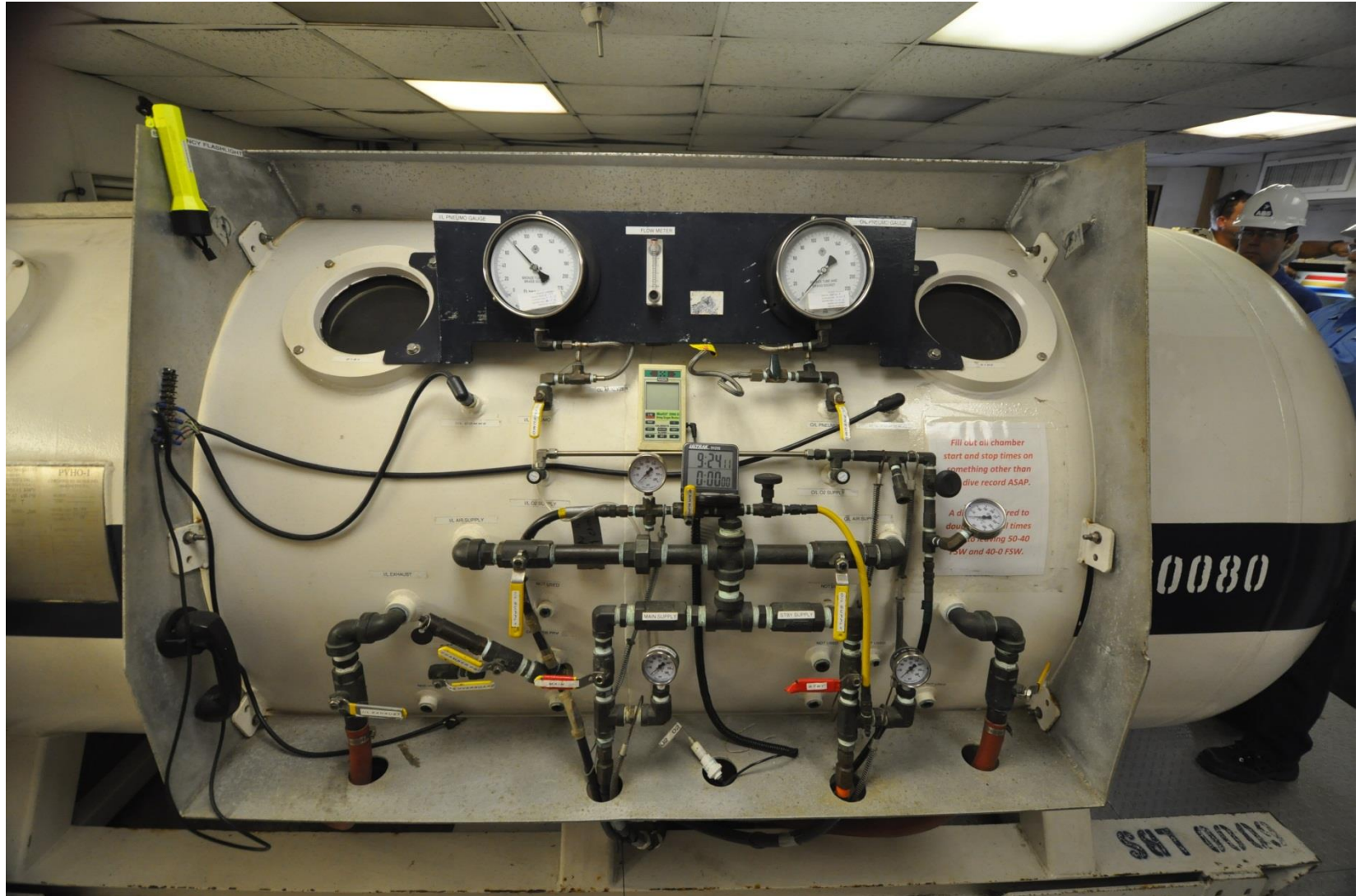
Life Support Systems

- Refer to Sections 14/3.13 and 8
- Life support calculations to be based on Standard Person table
- Oxygen supply systems to be capable of supplying oxygen at a rate of .038 kg per person per hour at 1 atmosphere
- CO₂ removal systems to be capable of maintaining CO₂ concentrations at or below 0.5 percent by volume referenced to standard temperature and pressure
- Breathing gas piping system components (piping, tubing, fittings and valves) to have a burst pressure of at least 4 times the system's MAWP
- Parameters to be monitored are oxygen content, carbon dioxide content and internal pressure

Life Support Systems (cont.)

- Life support instrumentation systems, including power supplies, are to be provided in duplicate or an alternative means of measurement is to be provided
- Means are to be provided for temperature and humidity control during all phases of operation
- Air compressors are to be provided with a nameplate indicating manufacturer, model, serial number, maximum rated outlet pressure, rated capacity and safety valve setting
- Compressed air purity for human respiration to be per CGA G-7.1 Grade D as a minimum

Piping Systems & Mechanical Equipment



Piping Systems & Mechanical Equipment

- Refer to Sections 14/3.11 and 9
- Pressure vessels, heat exchangers and heaters to comply with Group I pressure vessel requirements, 4-4-1 Steel Vessel Rules
- Alternative acceptance allowed for mass produced pressure vessels and seamless pressure vessels for gas storage
- Wall thickness of pipes and tubes to comply with 4-6, Steel Vessel Rules
- Pipe sections connecting stop valves to pressure boundary to be Sch 160 or equivalent
- Piping systems penetrating pressure boundaries to be provided with stop and/or check valves

Piping Systems & Mechanical Equipment

- Pressure vessels (including PVHOs) and piping systems to be provided with suitably sized relief valves
- Piping, pressure vessels and mechanical equipment to be color coded per US Navy or other recognized standard
- Mufflers/silencers to be provided on blowdown and exhaust outlets
- Anti-suction protective devices to be provided on the openings of exhaust outlet lines
- High pressure piping to be protected against mechanical damage

Electrical Systems



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CONTAINERISED SYSTEM SL3.6

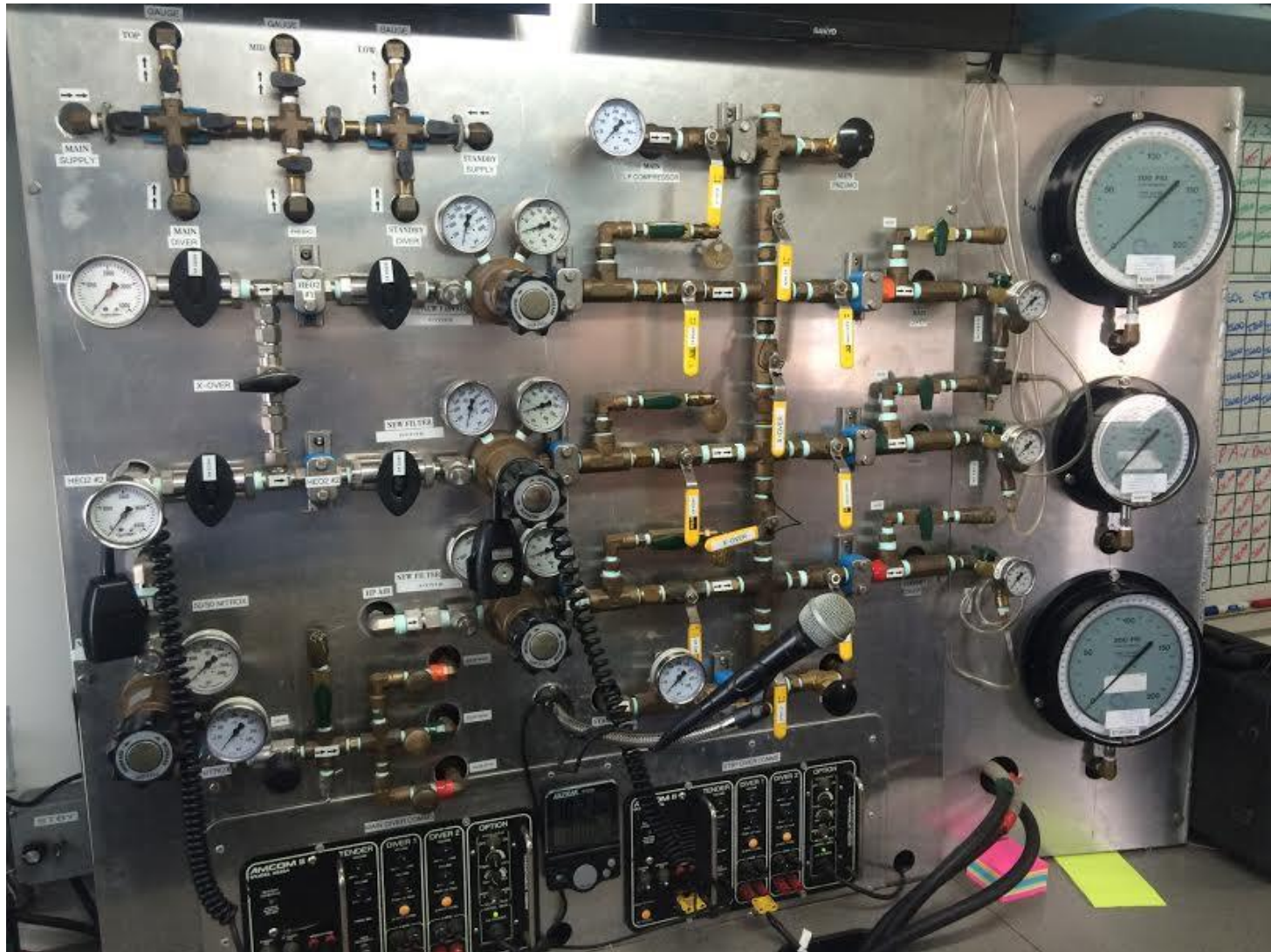
Electrical Systems

- Refer to Sections 14/3.15 and 10
- Electrical equipment to be designed for the environment it will operate in (e.g. hyperbaric, underwater, high temperature, high humidity, hazardous area)
- Electrical installations essential to the safe completion of the mission to be supplied from independent main and emergency sources of electrical power
- Emergency electrical power to be available in not more than 45 seconds
- Ground detectors or interrupters to be provided for systems above 7.5 VAC or 30 VDC
- Circuits to be protected by protective devices

Electrical Systems (cont.)

- Circuit protective devices to be circuit breakers in most cases
- Electrical penetrators and penetrator cable assemblies to be tested in accordance with Rule requirements in the presence of ABS Surveyor, and results submitted for review
- Communications to be provided between the control stand and the following: diver in water, diving bell, each compartment of chamber, diving system handling position/emergency control station, dynamic positioning system, navigation bridge
- Emergency communications to be available between control stand and divers in DDC/bell
- Generators of 100 kW and over to be certified by ABS/Flag State Administration

Dive Control Station



Dive Control Station

- Refer to Sections 14/13 and 19
- Not to be located in hazardous areas
- Provided with two means of access located as remotely from each other as practicable
- Light fixtures to provide 540 lumens/m² over all control stands, consoles and panels
- Glass windows to be of shatter-resistant type
- Enclosures to be drip proof and corrosion resistant
- Fire detection and fire fighting systems to be provided and be operable from outside of the control station

Areas of Concern

- Shipping containers modified for use as control, equipment, DDC vans to comply with ABS Cargo Container Rules or other not less effective standards (e.g. EN 12079 Offshore Containers)
- Test dive required for wet bells but not for dive stages
- Off-gas testing not required for chambers using ventilation and/or BIBS for life support
- No specific requirements for life support via ventilation
- No specific requirements for life support testing of surface supplied DDCs
- No specific provisions for modular/highly portable systems
- Section 14/17 applies to vessel or facility (e.g. hazardous areas, angles of inclination, position keeping, fastening, fire fighting)

Questions?





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