



**BUREAU  
VERITAS**

# **Rules for the Classification of Diving Systems**

**December 2016**

**Rule Note  
NR 610 DT R00 E**

---

**Marine & Offshore Division  
92571 Neuilly sur Seine Cedex – France  
Tel: + 33 (0)1 55 24 70 00 – Fax: + 33 (0)1 55 24 70 25  
Marine website: <http://www.veristar.com>  
Email: [veristarinfo@bureauveritas.com](mailto:veristarinfo@bureauveritas.com)  
© 2016 Bureau Veritas - All rights reserved**



**BUREAU  
VERITAS**

#### ARTICLE 1

1.1. - BUREAU VERITAS is a Society the purpose of whose Marine & Offshore Division (the "Society") is the classification ("Classification") of any ship or vessel or offshore unit or structure of any type or part of it or system therein collectively hereinafter referred to as a "Unit" whether linked to shore, river bed or sea bed or not, whether operated or located at sea or in inland waters or partly on land, including submarines, hovercrafts, drilling rigs, offshore installations of any type and of any purpose, their related and ancillary equipment, subsea or not, such as well head and pipelines, mooring legs and mooring points or otherwise as decided by the Society.

The Society:

- "prepares and publishes Rules for classification, Guidance Notes and other documents ("Rules");
- "issues Certificates, Attestations and Reports following its interventions ("Certificates");
- "publishes Registers.

1.2. - The Society also participates in the application of National and International Regulations or Standards, in particular by delegation from different Governments. Those activities are hereafter collectively referred to as "Certification".

1.3. - The Society can also provide services related to Classification and Certification such as ship and company safety management certification; ship and port security certification, training activities; all activities and duties incidental thereto such as documentation on any supporting means, software, instrumentation, measurements, tests and trials on board.

1.4. - The interventions mentioned in 1.1., 1.2. and 1.3. are referred to as "Services". The party and/or its representative requesting the services is hereinafter referred to as the "Client". **The Services are prepared and carried out on the assumption that the Clients are aware of the International Maritime and/or Offshore Industry (the "Industry") practices.**

1.5. - The Society is neither and may not be considered as an Underwriter, Broker in ship's sale or chartering, Expert in Unit's valuation, Consulting Engineer, Controller, Naval Architect, Manufacturer, Ship-builder, Repair yard, Charterer or Shipowner who are not relieved of any of their expressed or implied obligations by the interventions of the Society.

#### ARTICLE 2

2.1. - Classification is the appraisal given by the Society for its Client, at a certain date, following surveys by its Surveyors along the lines specified in Articles 3 and 4 hereafter on the level of compliance of a Unit to its Rules or part of them. This appraisal is represented by a class entered on the Certificates and periodically transcribed in the Society's Register.

2.2. - Certification is carried out by the Society along the same lines as set out in Articles 3 and 4 hereafter and with reference to the applicable National and International Regulations or Standards.

2.3. - **It is incumbent upon the Client to maintain the condition of the Unit after surveys, to present the Unit for surveys and to inform the Society without delay of circumstances which may affect the given appraisal or cause to modify its scope.**

2.4. - The Client is to give to the Society all access and information necessary for the safe and efficient performance of the requested Services. The Client is the sole responsible for the conditions of presentation of the Unit for tests, trials and surveys and the conditions under which tests and trials are carried out.

#### ARTICLE 3

3.1. - **The Rules, procedures and instructions of the Society take into account at the date of their preparation the state of currently available and proven technical knowledge of the Industry. They are a collection of minimum requirements but not a standard or a code of construction neither a guide for maintenance, a safety handbook or a guide of professional practices, all of which are assumed to be known in detail and carefully followed at all times by the Client.**

Committees consisting of personalities from the Industry contribute to the development of those documents.

3.2. - **The Society only is qualified to apply its Rules and to interpret them. Any reference to them has no effect unless it involves the Society's intervention.**

3.3. - The Services of the Society are carried out by professional Surveyors according to the applicable Rules and to the Code of Ethics of the Society. Surveyors have authority to decide locally on matters related to classification and certification of the Units, unless the Rules provide otherwise.

3.4. - **The operations of the Society in providing its Services are exclusively conducted by way of random inspections and do not in any circumstances involve monitoring or exhaustive verification.**

#### ARTICLE 4

4.1. - The Society, acting by reference to its Rules:

- "reviews the construction arrangements of the Units as shown on the documents presented by the Client;
- "conducts surveys at the place of their construction;
- "classes Units and enters their class in its Register;
- "surveys periodically the Units in service to note that the requirements for the maintenance of class are met.

**The Client is to inform the Society without delay of circumstances which may cause the date or the extent of the surveys to be changed.**

#### ARTICLE 5

5.1. - **The Society acts as a provider of services. This cannot be construed as an obligation bearing on the Society to obtain a result or as a warranty.**

5.2. - **The certificates issued by the Society pursuant to 5.1. here above are a statement on the level of compliance of the Unit to its Rules or to the documents of reference for the Services provided for. In particular, the Society does not engage in any work relating to the design, building, production or repair checks, neither in the operation of the Units or in their trade, neither in any advisory services, and cannot be held liable on those accounts. Its certificates cannot be construed as an implied or express warranty of safety, fitness for the purpose, seaworthiness of the Unit or of its value for sale, insurance or chartering.**

5.3. - **The Society does not declare the acceptance or commissioning of a Unit, nor of its construction in conformity with its design, that being the exclusive responsibility of its owner or builder.**

5.4. - The Services of the Society cannot create any obligation bearing on the Society or constitute any warranty of proper operation, beyond any representation set forth in the Rules, of any Unit, equipment or machinery, computer software of any sort or other comparable concepts that has been subject to any survey by the Society.

## MARINE & OFFSHORE DIVISION GENERAL CONDITIONS

#### ARTICLE 6

6.1. - The Society accepts no responsibility for the use of information related to its Services which was not provided for the purpose by the Society or with its assistance.

6.2. - **If the Services of the Society or their omission cause to the Client a damage which is proved to be the direct and reasonably foreseeable consequence of an error or omission of the Society, its liability towards the Client is limited to ten times the amount of fee paid for the Service having caused the damage, provided however that this limit shall be subject to a minimum of eight thousand (8,000) Euro, and to a maximum which is the greater of eight hundred thousand (800,000) Euro and one and a half times the above mentioned fee. These limits apply regardless of fault including breach of contract, breach of warranty, tort, strict liability, breach of statute, etc.**

**The Society bears no liability for indirect or consequential loss whether arising naturally or not as a consequence of the Services or their omission such as loss of revenue, loss of profit, loss of production, loss relative to other contracts and indemnities for termination of other agreements.**

6.3. - All claims are to be presented to the Society in writing within three months of the date when the Services were supplied or (if later) the date when the events which are relied on were first known to the Client, and any claim which is not so presented shall be deemed waived and absolutely barred. Time is to be interrupted thereafter with the same periodicity.

#### ARTICLE 7

7.1. - Requests for Services are to be in writing.

7.2. - **Either the Client or the Society can terminate as of right the requested Services after giving the other party thirty days' written notice, for convenience, and without prejudice to the provisions in Article 8 hereunder.**

7.3. - The class granted to the concerned Units and the previously issued certificates remain valid until the date of effect of the notice issued according to 7.2. here above subject to compliance with 2.3. here above and Article 8 hereunder.

7.4. - The contract for classification and/or certification of a Unit cannot be transferred neither assigned.

#### ARTICLE 8

8.1. - The Services of the Society, whether completed or not, involve, for the part carried out, the payment of fee upon receipt of the invoice and the reimbursement of the expenses incurred.

8.2. - **Overdue amounts are increased as of right by interest in accordance with the applicable legislation.**

8.3. - **The class of a Unit may be suspended in the event of non-payment of fee after a first unfruitful notification to pay.**

#### ARTICLE 9

9.1. - The documents and data provided to or prepared by the Society for its Services, and the information available to the Society, are treated as confidential. However:

- "Clients have access to the data they have provided to the Society and, during the period of classification of the Unit for them, to the classification file consisting of survey reports and certificates which have been prepared at any time by the Society for the classification of the Unit ;
- "copy of the documents made available for the classification of the Unit and of available survey reports can be handed over to another Classification Society, where appropriate, in case of the Unit's transfer of class;
- "the data relative to the evolution of the Register, to the class suspension and to the survey status of the Units, as well as general technical information related to hull and equipment damages, may be passed on to IACS (International Association of Classification Societies) according to the association working rules;
- "the certificates, documents and information relative to the Units classed with the Society may be reviewed during certifying bodies audits and are disclosed upon order of the concerned governmental or inter-governmental authorities or of a Court having jurisdiction.

The documents and data are subject to a file management plan.

#### ARTICLE 10

10.1. - Any delay or shortcoming in the performance of its Services by the Society arising from an event not reasonably foreseeable by or beyond the control of the Society shall be deemed not to be a breach of contract.

#### ARTICLE 11

11.1. - In case of diverging opinions during surveys between the Client and the Society's surveyor, the Society may designate another of its surveyors at the request of the Client.

11.2. - Disagreements of a technical nature between the Client and the Society can be submitted by the Society to the advice of its Marine Advisory Committee.

#### ARTICLE 12

12.1. - Disputes over the Services carried out by delegation of Governments are assessed within the framework of the applicable agreements with the States, international Conventions and national rules.

12.2. - Disputes arising out of the payment of the Society's invoices by the Client are submitted to the Court of Nanterre, France, or to another Court as deemed fit by the Society.

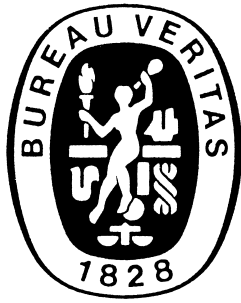
12.3. - **Other disputes over the present General Conditions or over the Services of the Society are exclusively submitted to arbitration, by three arbitrators, in London according to the Arbitration Act 1996 or any statutory modification or re-enactment thereof. The contract between the Society and the Client shall be governed by English law.**

#### ARTICLE 13

13.1. - **These General Conditions constitute the sole contractual obligations binding together the Society and the Client, to the exclusion of all other representation, statements, terms, conditions whether express or implied. They may be varied in writing by mutual agreement. They are not varied by any purchase order or other document of the Client serving similar purpose.**

13.2. - The invalidity of one or more stipulations of the present General Conditions does not affect the validity of the remaining provisions.

13.3. - The definitions herein take precedence over any definitions serving the same purpose which may appear in other documents issued by the Society.



## RULE NOTE NR 610

# NR 610 Rules for the Classification of Diving Systems

---

---

<b>Chapter 1</b>	<b>CLASSIFICATION AND CERTIFICATION PRINCIPLES</b>
<b>Chapter 2</b>	<b>DIVING SUB-SYSTEMS</b>
<b>Chapter 3</b>	<b>DESIGN AND CONSTRUCTION</b>
<b>Chapter 4</b>	<b>INSPECTION AND TESTING</b>

# CHAPTER 1

## CLASSIFICATION AND CERTIFICATION PRINCIPLES

### Section 1 General

<b>1</b>	<b>Application</b>	<b>17</b>
1.1	General	
<b>2</b>	<b>Classification principles</b>	<b>17</b>
2.1	General	
2.2	Assignment of Class	
2.3	Maintenance of certificate	
2.4	Suspension and withdrawal of class certificate	
2.5	Classification of the diving support unit	
<b>3</b>	<b>Classification notations</b>	<b>18</b>
3.1	Types of notations assigned	
3.2	Class symbol	
3.3	Construction mark	
3.4	Service notations and additional service features	
<b>4</b>	<b>Statutory requirements</b>	<b>20</b>
4.1	IMO Code of Safety for Diving Systems	
<b>5</b>	<b>Description of diving systems</b>	<b>20</b>
5.1	Surface supplied diving system	
5.2	Saturation diving system	
5.3	Bounce diving system	
5.4	Differences between diving system types	
5.5	Main components of a diving system	
<b>6</b>	<b>References</b>	<b>20</b>
6.1	Acronyms	
6.2	Definitions	
6.3	Rules and regulations	
6.4	IMCA publications	
6.5	Recognized codes and standards	

### Section 2 Certification of Material and Components

<b>1</b>	<b>General</b>	<b>24</b>
1.1	Scope	
1.2	Certification levels	
<b>2</b>	<b>Definitions</b>	<b>24</b>
2.1	Type of certification	
2.2	Type of certificates	
<b>3</b>	<b>Certification procedure</b>	<b>24</b>
3.1	General	

<b>4</b>	<b>Certification of the diving sub-systems</b>	<b>25</b>
	4.1 General	
	4.2 Marking	
<b>5</b>	<b>Certification of material and components</b>	<b>26</b>
	5.1 General	
	5.2 Symbols	
	5.3 Explanatory notes, symbols and abbreviations	

### **Section 3 Documentation to be Submitted**

<b>1</b>	<b>General</b>	<b>32</b>
	1.1 Application	
	1.2 Diving support vessel	
	1.3 Failure Modes and Effects Analysis (FMEA)	
	1.4 Master Document Register	
<b>2</b>	<b>Diving system documentation</b>	<b>32</b>
	2.1 General documents	
	2.2 Installation and commissioning instructions	
	2.3 Documents for service and maintenance	
<b>3</b>	<b>Diving bell and baskets</b>	<b>33</b>
	3.1 General	
<b>4</b>	<b>Deck decompression chambers (DDC)</b>	<b>33</b>
	4.1 General	
<b>5</b>	<b>Launch and Recovery System (LARS)</b>	<b>33</b>
	5.1 General	
	5.2 Documents to be submitted	
	5.3 Handling system of the clump weight	
<b>6</b>	<b>Hyperbaric Rescue Unit</b>	<b>33</b>
	6.1 General	

# CHAPTER 2

## DIVING SUB-SYSTEMS

### Section 1 Deck Decompression Chamber

<b>1</b>	<b>General</b>	<b>41</b>
	1.1 Application	
<b>2</b>	<b>General design requirements</b>	<b>41</b>
	2.1 General arrangement	
	2.2 Surface supplied diving	
	2.3 Supporting structure	
<b>3</b>	<b>Pressure vessel for human occupancy</b>	<b>41</b>
	3.1 General	
	3.2 Medical locks	
	3.3 Viewports	
	3.4 Safety valves	
	3.5 Overpressure alarm	
	3.6 Transfer under pressure	
	3.7 Mating device	
<b>4</b>	<b>Life support system</b>	<b>42</b>
	4.1 General	
	4.2 Gas analysis	
	4.3 Control system	
	4.4 Carbon dioxide removal	
	4.5 Temperature and humidity control	
	4.6 Breathing gas reclaim	
	4.7 BIBS	
<b>5</b>	<b>Sanitary equipment</b>	<b>42</b>
	5.1 General	
	5.2 Toilet	
	5.3 Fresh water	
<b>6</b>	<b>Electrical installations and control systems</b>	<b>43</b>
	6.1 General	
	6.2 Lighting	
	6.3 Communication	
<b>7</b>	<b>Fire safety</b>	<b>43</b>
	7.1 General	

### Section 2 Closed Diving Bell

<b>1</b>	<b>General</b>	<b>44</b>
	1.1 Application	
<b>2</b>	<b>General design requirements</b>	<b>44</b>
	2.1 Survival means	
	2.2 External layout	
	2.3 Internal layout	
	2.4 Volume	

<b>3</b>	<b>Pressure vessel for human occupancy</b>	<b>44</b>
3.1	General	
3.2	Viewport	
3.3	Access doors	
3.4	Protection against overpressure	
3.5	Mating system	
3.6	Bell clamp	
3.7	Medical lock	
<b>4</b>	<b>Life support</b>	<b>45</b>
4.1	General	
4.2	Breathing gas system	
4.3	Oxygen supply	
4.4	Gas reserve	
4.5	BIBS	
4.6	Piping, valves, fitting and hoses	
4.7	Instrumentation	
4.8	Umbilical	
4.9	Carbon dioxide removal	
4.10	Temperature and humidity control	
4.11	Breathing gas reclaim	
4.12	Control of the water level	
<b>5</b>	<b>Electrical installations and control systems</b>	<b>47</b>
5.1	General	
5.2	Communication	
5.3	Tapping code	
5.4	Emergency locating device	
5.5	Lighting	
<b>6</b>	<b>Safety systems</b>	<b>48</b>
6.1	General	
<b>7</b>	<b>Structure</b>	<b>48</b>
7.1	General	
7.2	Lifting padeyes	
<b>8</b>	<b>Emergency recovery means</b>	<b>48</b>
8.1	General	
8.2	Release of LARS	
8.3	Ballast release system	
<b>9</b>	<b>Stability and floatability</b>	<b>49</b>
9.1	General	

### **Section 3 Wet Bell and Diving Basket**

<b>1</b>	<b>General</b>	<b>50</b>
1.1	Application	
<b>2</b>	<b>General design requirements</b>	<b>50</b>
2.1	Principles	
2.2	Handling system	
2.3	Structural assessment	
2.4	Marking	

<b>3</b>	<b>Diving baskets</b>	<b>50</b>
	3.1 General	
	3.2 Emergency cylinder	
<b>4</b>	<b>Wet Bell</b>	<b>50</b>
	4.1 General	
	4.2 Breathing gas	
	4.3 Emergency air cylinder	
	4.4 Umbilical	
	4.5 Wet bell Controls	
	4.6 Wet bell Communication	

## **Section 4 Launch and Recovery System**

<b>1</b>	<b>General</b>	<b>52</b>
	1.1 Application	
<b>2</b>	<b>General design requirements</b>	<b>52</b>
	2.1 Principles	
	2.2 Marking	
<b>3</b>	<b>Structural assessment</b>	<b>52</b>
	3.1 Design loads	
	3.2 Dynamic amplification factor	
<b>4</b>	<b>Machinery</b>	<b>52</b>
	4.1 Winch	
	4.2 Hydraulics	
	4.3 Brake mechanisms	
	4.4 Heave compensation	
	4.5 Secondary means of recovery	
<b>5</b>	<b>Electrical installations and control system</b>	<b>53</b>
	5.1 Electrical installations	
	5.2 Emergency power source	
	5.3 Control system	
<b>6</b>	<b>Ropes and padeyes</b>	<b>53</b>
	6.1 Lifting rope	
	6.2 Lifting padeyes	
	6.3 Guide wires	
<b>7</b>	<b>Umbilical handling system</b>	<b>54</b>
	7.1 General	
	7.2 Surface supplied diving system	

## **Section 5 Hyperbaric Rescue Unit**

<b>1</b>	<b>General</b>	<b>55</b>
	1.1 Application	
	1.2 Rules reference	



<b>2</b>	<b>General design requirements</b>	<b>55</b>
2.1	Principles	
2.2	Autonomy	
2.3	Marking	
2.4	Sea fastening arrangements	
<b>3</b>	<b>Hyperbaric rescue method</b>	<b>56</b>
3.1	General	
3.2	Hyperbaric Rescue Chamber (HRC)	
3.3	Self-Propelled Hyperbaric Lifeboat (SPHL)	
<b>4</b>	<b>Pressure vessel for human occupancy</b>	<b>56</b>
4.1	General	
4.2	Access trunk	
4.3	Clamp interface standard	
4.4	Medical lock	
<b>5</b>	<b>Life support system</b>	<b>57</b>
5.1	Life support	
<b>6</b>	<b>Electrical installations and control systems</b>	<b>58</b>
6.1	Communication means	
6.2	Locating device	
6.3	Emergency source of power	
<b>7</b>	<b>Fire safety</b>	<b>58</b>
7.1	General	
<b>8</b>	<b>Launch and Recovery System</b>	<b>58</b>
8.1	General	
8.2	Emergency system	
8.3	Connection	
8.4	Recovery	
<b>9</b>	<b>Stability</b>	<b>58</b>
9.1	Righting moment	
9.2	Buoyancy	

# CHAPTER 3

## DESIGN AND CONSTRUCTION

### Section 1 General Design Requirements

<b>1</b>	<b>General</b>	<b>63</b>
1.1	Application	
1.2	Safety principles	
<b>2</b>	<b>Layout of the diving system</b>	<b>63</b>
2.1	General layout	
2.2	Layout of the control stations	
<b>3</b>	<b>Failure Modes and Effects Analysis (FMEA)</b>	<b>63</b>
3.1	General	
3.2	Hyperbaric evacuation	
<b>4</b>	<b>Design conditions</b>	<b>63</b>
4.1	General	
4.2	Motions and accelerations	
4.3	Environmental conditions	
<b>5</b>	<b>Constructional arrangements</b>	<b>64</b>
5.1	Materials and welding	
5.2	Structural support	
5.3	Sea fastening	

### Section 2 Pressure Vessel for Human Occupancy

<b>1</b>	<b>General</b>	<b>65</b>
1.1	Application	
1.2	Scope	
1.3	Referenced standards	
1.4	Design loads	
<b>2</b>	<b>Doors, hatches and locking devices</b>	<b>65</b>
2.1	Doors and hatches	
2.2	Locking devices	
2.3	Portholes	
2.4	Medical locks	
<b>3</b>	<b>Penetrators, valves and fittings</b>	<b>66</b>
3.1	Penetrators	
3.2	Electrical Penetrators	
3.3	Exhausts and inlets	
3.4	Pressure relief valve	
3.5	Noise reduction	
<b>4</b>	<b>Fabrication</b>	<b>66</b>
4.1	Welding	

<b>5</b>	<b>Viewports</b>	<b>66</b>
	5.1 General	
	5.2 Certification	
	5.3 Marking	
<b>6</b>	<b>Materials and pollutants</b>	<b>67</b>
	6.1 Materials	
	6.2 Internal coating and adhesives	

### **Section 3 Life Support System**

<b>1</b>	<b>General</b>	<b>68</b>
	1.1 Application	
	1.2 Applicable rules	
	1.3 Control stations	
<b>2</b>	<b>Breathing gas supply</b>	<b>68</b>
	2.1 General	
	2.2 Sources	
	2.3 Ventilation	
	2.4 Gas distribution	
	2.5 Gas exhaust	
	2.6 Protection against overpressure	
	2.7 Colour code	
	2.8 Gas mixing equipment	
<b>3</b>	<b>Breathing gas storage</b>	<b>69</b>
	3.1 Minimum capacity	
	3.2 Location	
	3.3 Pressure relief valves	
<b>4</b>	<b>Pressure control</b>	<b>69</b>
	4.1 General	
<b>5</b>	<b>Breathing gas analysis</b>	<b>69</b>
	5.1 General	
	5.2 Control of pollutants	
	5.3 Oxygen analyzers	
	5.4 Carbon dioxide analyzers	
<b>6</b>	<b>Breathing apparatus</b>	<b>70</b>
	6.1 General	
<b>7</b>	<b>Breathing gas regeneration</b>	<b>70</b>
	7.1 Carbon dioxide removal	
<b>8</b>	<b>Breathing gas reclaim system</b>	<b>70</b>
	8.1 General	
	8.2 Gas bag	
<b>9</b>	<b>Sanitary installations</b>	<b>70</b>
	9.1 General	
	9.2 Fresh water	
	9.3 Toilet, shower and hand-washing installations	

<b>10</b>	<b>Temperature and humidity control</b>	<b>71</b>
	10.1 General	
	10.2 Deck decompression chambers	
	10.3 Divers and diving bell	
<b>11</b>	<b>Piping</b>	<b>71</b>
	11.1 General	
	11.2 Piping material	
	11.3 Welding	
	11.4 Flexible hoses	
<b>12</b>	<b>Oxygen installations</b>	<b>72</b>
	12.1 General	
	12.2 Oxygen supply	
	12.3 Oxygen storage	
	12.4 Cleaning	
<b>13</b>	<b>Gas cylinders</b>	<b>73</b>
	13.1 Design and construction	
	13.2 Thickness increment	
	13.3 Gas storage installations	
<b>14</b>	<b>Compressors</b>	<b>73</b>
	14.1 General	
	14.2 Pollutant content	
	14.3 Air intake	
<b>15</b>	<b>Regulator, gauges and valves</b>	<b>73</b>
	15.1 Pressure gauges	
	15.2 Pressure regulators	
	15.3 Valves	
<b>16</b>	<b>Umbilicals</b>	<b>73</b>
	16.1 General	
	16.2 Main bell umbilical	
	16.3 Diver's umbilical	

## **Section 4 Electrical Installations, Control and Communication Systems**

<b>1</b>	<b>General</b>	<b>75</b>
	1.1 Application	
<b>2</b>	<b>General design requirements</b>	<b>75</b>
	2.1 Environment	
	2.2 Electricity under water and inside hyperbaric chambers	
	2.3 Maximum voltages	
	2.4 Lighting	
	2.5 Electric motors	
<b>3</b>	<b>Power source</b>	<b>75</b>
	3.1 General	
	3.2 Emergency source of power	
	3.3 Accumulator batteries	

<b>4</b>	<b>Distribution system</b>	<b>76</b>
	4.1 General	
	4.2 Insulation monitoring	
	4.3 Circuit protection	
	4.4 Earthing	
	4.5 Distribution panel	
	4.6 Electrical penetrators for pressure vessels	
	4.7 Electrical cables	
<b>5</b>	<b>Diving control station</b>	<b>77</b>
	5.1 General	
	5.2 Information displayed	
	5.3 Monitoring	
	5.4 Controls	
	5.5 Surface diving	
	5.6 Indicators and analyzers	
<b>6</b>	<b>Life support control station</b>	<b>78</b>
	6.1 General	
	6.2 Information displayed	
	6.3 Monitoring	
	6.4 Controls	
	6.5 Indicators and analyzers	
<b>7</b>	<b>Communication</b>	<b>79</b>
	7.1 General	
	7.2 Diving control station	
	7.3 Life support control station	
	7.4 Diving bell	
	7.5 Visual control	

## **Section 5 Fire Protection, Detection, Extinction**

<b>1</b>	<b>General</b>	<b>80</b>
	1.1 Application	
<b>2</b>	<b>Fire protection</b>	<b>80</b>
	2.1 Materials inside the hyperbaric chambers	
	2.2 Electrical equipment	
<b>3</b>	<b>Fire detection</b>	<b>80</b>
	3.1 Outer area	
	3.2 Inner area	
<b>4</b>	<b>Fire-fighting</b>	<b>80</b>
	4.1 General	
	4.2 Saturation diving system	
	4.3 Surface supplied diving system	
<b>5</b>	<b>Control stations</b>	<b>81</b>
	5.1 General	

# CHAPTER 4

## INSPECTION AND TESTING

### Section 1 Initial Inspection and Testing

<b>1</b>	<b>General</b>	<b>85</b>
	1.1 Application	
	1.2 Rules reference	
<b>2</b>	<b>Factory Acceptance Test</b>	<b>85</b>
	2.1 General	
	2.2 Electrical pressure vessel penetrators	
	2.3 Compressors	
	2.4 Gas cylinders	
	2.5 Flexible hoses	
	2.6 Umbilical	
<b>3</b>	<b>Commissioning program on-board</b>	<b>86</b>
	3.1 General	
	3.2 List of examination and testing	
	3.3 Testing procedures	
	3.4 Diving test	
<b>4</b>	<b>Diving bell</b>	<b>86</b>
	4.1 General	
<b>5</b>	<b>Deck decompression chambers</b>	<b>87</b>
	5.1 General	
<b>6</b>	<b>Pressure Vessel for Human Occupancy</b>	<b>87</b>
	6.1 General	
	6.2 Pressure testing	
	6.3 Gas leak test	
	6.4 Viewport	
	6.5 Doors, hatches and medical locks	
<b>7</b>	<b>Breathing gas system</b>	<b>87</b>
	7.1 General	
	7.2 Piping and pressure vessel	
	7.3 Breathing gas distribution panel	
	7.4 Pollutant contamination	
	7.5 Cleanliness	
<b>8</b>	<b>Environmental control unit</b>	<b>88</b>
	8.1 General	
	8.2 Thermal test	
<b>9</b>	<b>Carbon dioxide removal system</b>	<b>88</b>
	9.1 General	
<b>10</b>	<b>Breathing gas reclaim system</b>	<b>88</b>
	10.1 General	

11	Built-in Breathing System (BIBS)	88
	11.1 General	
12	Divers hot water unit	88
	12.1 General	
13	Control stations	88
	13.1 General	
14	Electrical installations	88
	14.1 General	
15	Launch and recovery system	88
	15.1 General	
	15.2 Heave compensation	
	15.3 Umbilical winch	
16	Hyperbaric Rescue Unit	89
	16.1 General	
	16.2 Launching system	

## Section 2 Scope of In-Service Surveys

1	General	90
	1.1 Application	
	1.2 Rules reference	
	1.3 Modifications and repair	
2	Survey program	90
	2.1 General	
	2.2 Service and maintenance records	
	2.3 Survey periodicity	
	2.4 Owner surveys	
3	Portable diving systems	90
	3.1 General	
	3.2 Lay-up	
4	Diving bell	91
	4.1 General	
5	Deck decompression chambers	91
	5.1 General	
6	Pressure Vessel for Human Occupancy	91
	6.1 General	
	6.2 Pressure testing	
	6.3 Gas leak test	
	6.4 Viewport	
7	Gas cylinders and pressure vessels	92
	7.1 Seamless gas cylinders and pressure vessels not taken under water - dry internal service	
	7.2 Other gas cylinders	

8	Electrical installations	92
	8.1 General	
9	Launch and recovery system	92
	9.1 General	
	9.2 Wires	
	9.3 Heave compensation	
10	Hyperbaric Rescue Unit	93
	10.1 General	

## **Appendix 1 Inspection and Testing Check-List**

1	General	94
	1.1 Application	



# **CLASSIFICATION AND CERTIFICATION PRINCIPLES**

---

- SECTION 1      GENERAL**
- SECTION 2      CERTIFICATION OF MATERIAL AND COMPONENTS**
- SECTION 3      DOCUMENTATION TO BE SUBMITTED**



# SECTION 1

# GENERAL

## 1 Application

### 1.1 General

**1.1.1** The present Note provides technical requirements for the design, construction, testing and in-service surveys of manned diving systems for which the class notations defined in [3] are granted.

#### 1.1.2 Systems and equipment covered

The present Note is applicable to diving systems used for the following diving technics:

- surface supplied diving technics with compressed air or mixed-gas and using:
  - a diving basket
  - a wet bell
- bounce diving technics using a closed diving bell
- saturation diving technics

#### 1.1.3 Systems and equipment not covered

The following systems and pieces of equipment are not in the scope of the present Note:

- atmospheric diving suits
- autonomous diving equipment (SCUBA)
- diver individual portable equipment (eg: bail-out, closed circuit breathing system)
- submersibles and underwater vehicles
- underwater habitat
- remote operated vehicles.

## 2 Classification principles

### 2.1 General

**2.1.1** The provisions of this Article prevail over those of the Ship Rules Part A, which remain applicable in general.

#### 2.1.2 Scope

The scope of classification of diving systems includes:

- design review
- manufacturing and testing survey of material and components
- inspection and testing of completed system
- in-service survey.

#### 2.1.3 Exclusion

The following is not included in the scope of classification:

- operational procedure approval
- operation survey during diving operations.

## 2.2 Assignment of Class

### 2.2.1 General

The class assigned to a diving system by the Society, following its interventions, is embodied in a Certificate of Classification and noted in the appropriate Register.

The class is assigned by the Society upon the satisfactory completion of one of the procedures detailed in [2.2.2] or [2.2.3].

#### 2.2.2 System surveyed by the Society during construction

When a diving system is surveyed by the Society during construction, it is submitted to the following requirements:

- approval of drawings and examination of documents in accordance with the requirements of Chapter 2 and Chapter 3
- completion of the certification scheme as defined in Sec 2 and concerning:
  - certification of materials
  - certification of components
  - certification of the sub-systems.
- surveillance of the installation and of the commissioning on-board in accordance with Ch 4, Sec 1.

#### 2.2.3 System classed after construction

When a diving system has been surveyed by another IACS Society during its construction and is requested to be admitted to class, it is submitted to the following requirements:

- examination of the drawings and documents

Note 1: As a Rule, these drawings are to be marked with the stamps of the organization by which they were approved upon construction.

- examination of materials and components certificates
- specific survey of the diving system performed by the Society.

Note 2: The extent of this survey depends on the existing conditions of certification, on the general maintenance conditions and on the age of the installation. As a rule, a survey equivalent to the class renewal survey is to be performed.

## 2.3 Maintenance of certificate

### 2.3.1 In-service survey

The maintenance and renewal of the certificate of classification is subject to completion of the in-service surveys described in Ch 4, Sec 2 with the periodicity defined in [2.3.2].

### 2.3.2 Survey periodicity

Diving systems are subject to the following in-service surveys witnessed by the Society:

- annual surveys - the scope of the annual survey may differ from one year to the other as the periodicity of inspection and testing may be different for each component
- intermediate surveys (every 2,5 years)
- class renewal surveys (every 5 years)
- occasional surveys for damage, repairs, reactivation and alterations.

### 2.3.3 Owner surveys

In addition to the in-service surveys witnessed by the Society, the Owner is to perform semi-annual surveys as detailed in Ch 4, Sec 2, [2.4].

These surveys are to be recorded in the Planned maintenance System.

### 2.3.4 Modifications and repairs

The Owner shall inform the Society in case of modifications or repair as detailed in Ch 4, Sec 2, [1.3].

A design review may be necessary with relevant surveys. In that case, the original certificate of classification may have to be completed with a description of the modifications.

### 2.3.5 Portable diving systems

The Owner is to inform the Society about any installation and decommissioning operations of a portable diving system.

The portable diving system is to be inspected in accordance with Ch 4, Sec 2, [3] before it is put back into service.

## 2.4 Suspension and withdrawal of class certificate

**2.4.1** The class certificate would cease to be valid if significant alterations have been made to the diving system without the agreement of the Society, except for the replacement of such equipment or fittings for the purpose of repair or maintenance, or if surveys and inspections as specified by the Society under the provisions of Chapter 4 have not been carried out.

## 2.5 Classification of the diving support unit

**2.5.1** The classification of the diving support unit is covered by the Rule Note NR609.

### 2.5.2 Integrated diving systems

When the integrated diving system is classed by the Society, it is to be mentioned in the certificate of classification of the ship.

### 2.5.3 Portable diving systems

The classification of portable diving systems and the classification of diving support units are independent.

## 3 Classification notations

### 3.1 Types of notations assigned

**3.1.1** The types of classification notations assigned to a diving system are the following:

- a) class symbol
- b) construction mark
- c) service notation with additional service feature.

**3.1.2** As an example, the classification notations assigned to a diving system may be as follows (the kind of notation shown in brackets does not form part of the classification notation indicated on the Certificate of Classification):

#### I ⌘ Diving system - integrated

(class symbol, construction mark, service notation)

#### SATURATION

(additional service feature)

### 3.2 Class symbol

**3.2.1** The class symbol expresses the degree of compliance of the diving system with the rule requirements as regards its construction and maintenance. There is one class symbol, which is compulsory for every classed diving system.

**3.2.2** The class symbol **I** is assigned to diving systems built in accordance with the requirements of the Rules or other rules recognized as equivalent, and maintained in a condition considered satisfactory by the Society.

The period of class (or interval between class renewal surveys) assigned to class symbol **I** diving systems is maximum 5 years.

### 3.3 Construction mark

#### 3.3.1 General

The construction mark identifies the procedure under which the diving system has been surveyed for initial assignment of the class.

The construction mark refers to the original condition of the diving system. However, the Society may change the construction mark when the diving system is subjected to repairs, conversion or alterations.

#### 3.3.2 System surveyed by the Society

The construction mark ⌘ is assigned to the diving system when it has been surveyed by the Society during its construction in compliance with the procedure detailed in [2.2.2].

#### 3.3.3 System classed after construction

The construction mark ⌘ is assigned to the diving system when the latter is classed after construction in compliance with the procedure detailed in [2.2.3] and it is changing class from an IACS Society at the time of the admission.

### 3.4 Service notations and additional service features

**3.4.1** The service notations define the type of diving system which has been considered for classification, according to the request for classification signed by the Interested Party. At least one service notation is to be assigned to every classed diving system.

**3.4.2** The different service notations and additional service features which may be assigned to a diving system are listed in [3.4.3] to [3.4.9] and summarized in Tab 1.

#### 3.4.3 Diving system - integrated

The service notation **diving system-integrated** is assigned to diving systems permanently installed on a diving support unit.

The service notation **diving system-integrated** is always completed by one of the following additional service features:

- **SURFACE AIR** defined in [3.4.6]
- **SURFACE MIXED GAS** defined in [3.4.7]
- **BOUNCE** defined in [3.4.8]
- **SATURATION** defined in [3.4.9].

#### 3.4.4 Diving system - portable

The notation **diving system-portable** is assigned to diving systems not permanently installed on-board and which may be transferred to another diving support unit.

The service notation **diving system-portable** is always completed by one of the following additional service features:

- **SURFACE AIR** defined in [3.4.6]
- **SURFACE MIXED GAS** defined in [3.4.7]
- **BOUNCE** defined in [3.4.8]
- **SATURATION** defined in [3.4.9].

#### 3.4.5 Hyperbaric reception facility

The service notation **hyperbaric reception facility** is assigned to special decompression chambers used to transfer the occupants from an hyperbaric rescue unit and to decompress them safely, as defined in [6.2.13].

The following requirements apply for the design and construction of hyperbaric reception facilities:

- Ch 2, Sec 1 - Deck decompression chamber
- Chapter 3 - Design and construction.

#### 3.4.6 SURFACE AIR

The additional service feature **SURFACE AIR** is assigned to surface supplied diving systems defined in [5.1]and using compressed air only.

The following requirements apply for the design and construction of surface air diving systems:

- Ch 2, Sec 1 - Deck decompression chamber
- Ch 2, Sec 3 - Wet bell and diving basket
- Ch 2, Sec 4 - Launch and recovery system
- Chapter 3 - Design and construction.

#### 3.4.7 SURFACE MIXED GAS

The additional service feature **SURFACE MIXED GAS** is assigned to surface supplied diving systems defined in [5.1]and using a breathing gas mixture.

The following requirements apply for the design and construction of surface mixed gas diving systems:

- Ch 2, Sec 1 - Deck decompression chamber
- Ch 2, Sec 3 - Wet bell and diving basket
- Ch 2, Sec 4 - Launch and recovery system
- Chapter 3 - Design and construction.

#### 3.4.8 BOUNCE

The additional service feature **BOUNCE** is assigned to diving systems using a closed bell and where divers are decompressed after each dive as defined in [5.3].

The following requirements apply for the design and construction of bounce diving systems:

- Ch 2, Sec 1 - Deck decompression chamber
- Ch 2, Sec 2 - Closed diving bell
- Ch 2, Sec 4 - Launch and recovery system
- Chapter 3 - Design and construction.

**Table 1 : List of service notations and additional service features**

Service notation	Reference	Remarks
Additional service feature	Reference	
<b>diving system - integrated</b>	[3.4.3]	Permanent diving system
<b>SURFACE AIR</b>	[3.4.6]	
<b>SURFACE MIXED GAS</b>	[3.4.7]	
<b>BOUNCE</b>	[3.4.8]	
<b>SATURATION</b>	[3.4.9]	
<b>diving system - portable</b>	[3.4.4]	Non-permanent diving system
<b>SURFACE AIR</b>	[3.4.6]	
<b>SURFACE MIXED GAS</b>	[3.4.7]	
<b>BOUNCE</b>	[3.4.8]	
<b>SATURATION</b>	[3.4.9]	
<b>hyperbaric reception facility</b>	[3.4.5]	

### 3.4.9 SATURATION

The additional service feature **SATURATION** is assigned to diving systems where the divers live in a pressurized environment as defined in [5.2].

The following requirements apply for the design and construction of saturation diving systems:

- Ch 2, Sec 1 - Deck decompression chamber
- Ch 2, Sec 2 - Closed diving bell
- Ch 2, Sec 4 - Launch and recovery system
- Ch 2, Sec 5 - Hyperbaric rescue Unit
- Chapter 3 - Design and construction.

## 4 Statutory requirements

### 4.1 IMO Code of Safety for Diving Systems

**4.1.1** The present rules for classification of diving systems include the technical provisions of IMO Code of Safety for Diving Systems as applicable to the diving system itself.

Note 1: Attention is drawn to the fact that IMO Code of Safety for Diving Systems also covers the interface between the diving system and the diving support unit.

These technical requirements are reproduced for the purpose of classification in the present rules, *printed in Italic type*. In reproducing the text, the word "Administration" is replaced by the word "Society".

## 5 Description of diving systems

### 5.1 Surface supplied diving system

**5.1.1** A surface supplied diving system is a system where interventions by divers are performed at such depth and durations that the descent onto the seabed, the work and the decompression are carried out in the water (without resorting to the use of a closed diving bell).

The breathing gas is supplied from the supporting vessel through an umbilical.

The breathing gas may be:

- pure compressed air, or
- mixed gas with enriched oxygen or helium.

The surface supplied diving installation generally includes as the case may be:

- means of getting into water
- means to recover the divers
- a decompression chamber
- means adapted to the diving method used.

### 5.2 Saturation diving system

**5.2.1** A saturation diving system is a system where the divers live in a pressurized environment which may be maintained for several days or weeks. Divers are generally decompressed to surface pressure only once, at the end of their tour of duty.

### 5.3 Bounce diving system

**5.3.1** A bounce diving system is a system using a closed diving bell and where the divers are decompressed on-board in a deck decompression chamber after each dive.

### 5.4 Differences between diving system types

**5.4.1** The main differences between surface supplied, bounce and saturation diving systems are:

- the size of the deck decompression chambers
- the divers' heating system
- the breathing gas mixtures
- the size of the control stands
- the presence of means for transfer under pressure
- the presence of an Hyperbaric Rescue Unit.

### 5.5 Main components of a diving system

**5.5.1** Diving systems generally include, but are not limited to, the main components listed in Sec 2, [4].

## 6 References

### 6.1 Acronyms

**6.1.1** The following acronyms are commonly used within the industry:

BIBS	: Built-In Breathing System
DDC	: Deck Decompression Chamber [6.2.6]
ECU	: Environment Control Unit
FAT	: Factory Acceptance Test
FME(C)A:	Failure Modes and Effects (and Criticality) Analysis
HES	: Hyperbaric Evacuation System [6.2.12]
HRC	: Hyperbaric Rescue Chamber
HRF	: Hyperbaric Reception Facility [6.2.13]
HRU	: Hyperbaric Rescue Unit [6.2.14]
LARS	: Launch and Recovery System [6.2.15]
LSS	: Life Support System [6.2.16]
MAWP	: Maximum Allowable Working Pressure
MBL	: Minimum Breaking Load [6.2.20]
MSW	: Metres of Sea Water [6.2.19]
NDT	: Non-Destructive Testing
PMS	: Planned Maintenance System
PRV	: Pressure Relief Valve
PVHO	: Pressure Vessel for Human Occupancy
SCUBA	: Self-Contained Underwater Breathing Apparatus
SDC	: Submersible Diving Chamber
SPHL	: Self-Propelled Hyperbaric Lifeboat
SWL	: Safe Working Load
TUP	: Transfer Under Pressure.

## 6.2 Definitions

### 6.2.1 Absolute pressure

Pressure measured with reference to void.

### 6.2.2 Bail-out bottle

Diver's emergency gas supply cylinder used as a backup system in case of a failure of the primary source of breathing gas.

### 6.2.3 Bottle

Pressure container for the storage and transport of gases under pressure. Also called gas cylinders.

### 6.2.4 Breathing gas

All gases and mixtures of gases which are used for breathing during diving operations.

### 6.2.5 Closed diving bell

Manned underwater compression chamber, including its fitted equipment, for transfer of diving personnel under pressure between the work location and the deck chambers.

Also known as a Personnel Transfer Capsule (PTC) or submersible compression chamber

### 6.2.6 Deck Decompression Chamber (DDC)

Pressure vessel for human occupancy which does not go under water and may be used as a deck chamber during saturation diving or diver decompression during surface diving. Also called compression chamber, recompression chamber, deck chamber or surface compression chamber.

### 6.2.7 Depth

Water depth or equivalent pressure to which the diver is exposed at any time during a dive or inside a surface compression chamber or a diving bell.

### 6.2.8 Diver

Worker carrying out interventions or works in immersed condition and subjected to pressures higher than atmospheric one.

### 6.2.9 Diving basket

Man-riding equipment used for transfer of diving personnel at ambient sea pressure between the work location and the diving support unit.

### 6.2.10 Diving bell

Means for personnel transfer underwater which can be a closed bell, a wet bell or a diving basket.

### 6.2.11 Diving system

The whole plant and equipment necessary for conducting diving operations.

### 6.2.12 Hyperbaric Evacuation System (HES)

The whole plant and equipment necessary for the evacuation of divers in saturation from a deck decompression chamber to the Hyperbaric Reception Facility (HRF) where

decompression can be carried out. The main components of a hyperbaric evacuation system include the Hyperbaric Rescue Unit (HRU), its handling system, the Hyperbaric Reception Facility and the evacuation procedures.

### 6.2.13 Hyperbaric Reception Facility (HRF)

Normally a shore based facility (but could be installed off-shore) which is capable of accepting a HRU and mating it to a decompression chamber such that the evacuated occupants can be transferred into that chamber and safely decompressed.

### 6.2.14 Hyperbaric Rescue Unit (HRU)

Floating unit used to evacuate divers under pressure safely from a ship or a floating structure to a location where decompression can be carried out.

It may be a Hyperbaric Rescue Chamber (HRC) or a Self-Propelled Hyperbaric Lifeboat (SPHL). Also known as Hyperbaric Evacuation Unit (HEU).

### 6.2.15 Launch and Recovery System (LARS)

Plant and equipment necessary for raising, lowering and transporting the diving bell between the work location and the surface compression chamber.

### 6.2.16 Life Support System (LSS)

The Life Support System includes the equipment used to maintain a suitable life environment for the divers in the pressurized compartments (DDC, closed bell, wet bell, HRU).

The main functions are to prepare the breathing gas mixtures, supply the gases to the pressurized compartments, adjust the temperature and the humidity and monitor the life support parameters.

### 6.2.17 Mating device

Equipment necessary for the connection and disconnection of a diving bell to a deck decompression chamber for transfer under pressure operations.

### 6.2.18 Maximum operating depth

Depth in metres of sea water equivalent to the maximum pressure for which the diving system is designed to operate.

### 6.2.19 Metres of sea water (MSW)

Metres of sea water are sometimes used to express a water depth equivalent to a pressure. For the purpose of the design and testing of pressure vessels, the values in msw are to be converted into pressure units.

### 6.2.20 Minimum Breaking Load (MBL)

The Minimum Breaking Load of wire ropes and fibre ropes are provided by the manufacturer in accordance with NR216.

### 6.2.21 Open diving bell

See wet diving bell.

### 6.2.22 Partial pressure

Pressure of gas within a mixture which would prevail if the gas would fill by itself alone, the full volume occupied by the mixture. The sum of the partial pressures of the consistent parts of the mixture, proportional to volumetric fractions, is equal to the total absolute pressure of the mixture.

### 6.2.23 Portable diving systems

Portable equipment not remaining onboard but installed periodically for the purpose of specific works related to diving.

### 6.2.24 Pressure vessel

Container capable of withstanding an internal maximum working pressure greater than or equal to 1 bar.

### 6.2.25 Relative pressure

Pressure measured with reference to local barometric pressure and generally read on the pressure gauge.

### 6.2.26 Safe Working Load

The Safe Working Load (SWL) of a lifting appliance is defined as the maximum load which may be lifted by the appliance in a safe manner, in kN.

### 6.2.27 Submersible Diving Chamber

See closed diving bell.

### 6.2.28 Umbilical

Link between the diving support unit and the diving bell. It may contain surveillance, communication and power supply cables, breathing gas and hot water hoses.

### 6.2.29 Wet diving bell

Bell with a closed top section, capable of containing a dry gaseous atmosphere to provide a refuge for the divers. It is not a pressure vessel. Also called an open bell.

## 6.3 Rules and regulations

### 6.3.1 Ship Rules

Ship Rules means Rules for the Classification of Steel Ships (NR467).

### 6.3.2 NR216

When reference is made to NR216, the latest version of the Rules on Materials and Welding for the Classification of Marine Units is applicable.

### 6.3.3 NR266

When reference is made to NR266, the latest version of the Requirements for Survey of Materials and Equipment for the Classification of Ships and Offshore Units is applicable.

### 6.3.4 NR320

When reference is made to NR320, the latest version of the Certification scheme of material and equipment for classification of marine units is applicable.

### 6.3.5 NR526

When reference is made to NR526, the latest version of the Rules for the Certification of Lifting Appliances onboard Ships and Offshore Units is applicable.

### 6.3.6 NR595

When reference is made to NR595, the latest version of the Rules for the Certification of Offshore Handling Systems is applicable.

### 6.3.7 NR609

When reference is made to NR609, the latest version of the Rules for the Classification of diving support vessels is applicable.

### 6.3.8 IMO - Code of Safety for Diving Systems

International Maritime Organization (IMO) - Code of Safety for Diving Systems means the Code of Safety adopted by IMO Resolution A.831(19), as amended.

### 6.3.9 IMO - Guidelines and Specifications for Hyperbaric Evacuation Systems

International Maritime Organization (IMO) - Guidelines and Specifications for Hyperbaric Evacuation Systems adopted by Resolution A.692(17), as amended.

### 6.3.10 IMO - International Convention for the Safety of Life at Sea - SOLAS

IMO - SOLAS Convention adopted in 1974, as amended.

## 6.4 IMCA publications

6.4.1 International Marine Contractors Association (IMCA) is the editor of various publications providing guidelines for commercial diving. The main publications for the design inspection and testing of diving systems are listed below:

- IMCA D 002 - Battery packs in pressure housings
- IMCA D 004 - The initial and periodic examination, testing and certification of hyperbaric evacuation launch systems
- IMCA D 011 - Annual auditing of diving systems
- IMCA D 012 - Stainless steel in oxygen systems
- IMCA D 018 - Code of practice on the initial and periodic examination, testing and certification of diving plant and equipment
- IMCA D 023 - Diving Equipment Systems Inspection Guidance Note (DESIGN) for Surface Oriented (Air) Diving Systems
- IMCA D 024 - Diving Equipment Systems Inspection Guidance Note (DESIGN) for Saturation (Bell) Diving Systems
- IMCA D 037 - Diving Equipment Systems Inspection Guidance Note (DESIGN) for Surface supplied Mixed Gas Diving Systems
- IMCA D 039 - FMEA guide for diving systems
- IMCA D 040 - Diving Equipment Systems Inspection Guidance Note (DESIGN) for Mobile /Portable Surface supplied Systems
- IMCA D 043 - Markings and colour coding of gas cylinders, quads and banks for diving application



- IMCA D 045 - Code of practice for the safe use of electricity in water
- IMCA D 047 - Acrylic plastic viewports
- IMCA D 051 - Hyperbaric Evacuation Systems (HES) interface recommendations.

## 6.5 Recognized codes and standards

**6.5.1** The following technical codes and standards are recognized for the purpose of the present rules.

Pressure Vessel for Human Occupancy:

- ASME PVHO 1- Safety standard for pressure vessels for human occupancy
- EN 13445 - Unfired pressure vessels

Gas cylinders and other pressure vessels:

- EN 1964 - Specification for the design and construction of refillable transportable seamless steel gas cylinders of water capacities from 0,5 l up to and including 150 l
- EN ISO 11120 - Gas cylinders - Refillable seamless steel tube of water capacity between 150 l and 3 000 l - Design, construction and testing
- PD 5500 - Specification for unfired fusion welded pressure vessels

Breathing gas and oxygen piping system:

- EN 738 - Pressure regulators for use with medical gases
- ASTM G93- Standard Practice for Cleaning Methods and Cleanliness Levels for Materials and Equipment Used in Oxygen-Enriched Environments
- EN 12021 - Respiratory protective devices - Compressed air for breathing apparatus.

Synthetic flexible hoses:

- SAE J 517 - Hydraulic hoses
- EN 853 and 856- Rubber hoses and hose assemblies.

Metallic flexible hoses:

- ISO 10 380 - Pipework - Corrugated metal hoses and hose assemblies

Umbilicals:

- ISO 13628- 5 - Subsea control umbilical
- API 17 E - Specification for Subsea Production Control Umbilicals
- ISO 15333 - Open circuit umbilical supplied compressed gas diving apparatus

Fire extinguishing systems:

- NFPA 99 - Health care facilities code
- EN 16081 - Hyperbaric chambers - Specific requirements for fire extinguishing systems - Performance, installation and testing

## SECTION 2

# CERTIFICATION OF MATERIAL AND COMPONENTS

### 1 General

#### 1.1 Scope

**1.1.1** The present Section provides the certification scheme for materials and equipment intended to be part of the diving system classed by the Society.

**1.1.2** This certification scheme may be extended to conformity assessment with other standards as specified in NR320.

#### 1.2 Certification levels

**1.2.1** The classification of a diving system involves 3 levels of certification for the sub-components:

- a) certification of the main sub-systems, as defined in [4]
- b) certification of the components, as defined in [5]
- c) certification of the materials, as defined in [5].

### 2 Definitions

#### 2.1 Type of certification

##### 2.1.1 Individual certification

For one-off production for which an individual certification is requested, the following phases are involved:

- design assessment
- fabrication survey
- testing survey.

##### 2.1.2 Type approval with individual certification

For serial production for which a type approval is requested, the following phases are involved:

- design assessment
- prototype fabrication survey
- prototype testing survey.

The product is then subject to fabrication type surveys and type testing surveys as defined in NR320.

#### 2.2 Type of certificates

##### 2.2.1 Product certificate

A product certificate is a certificate issued by the Society.

##### 2.2.2 Manufacturer certificate

A manufacturer certificate is a document stating the results of the tests performed and/or stating compliance with the approved type (as applicable) and issued by the manufacturer itself.

##### 2.2.3 Certificate issued by another recognized independent inspection body

Where applicable, the Society may accept a product certificate issued by another recognized independent inspection body.

##### 2.2.4 Work recognition certificate

As defined in NR320, a work recognition certificate is issued by the Society to a manufacturer upon satisfactory completion of a documentation review and audit.

### 3 Certification procedure

#### 3.1 General

##### 3.1.1 General certification scheme

The general certification scheme is described in NR320 Certification scheme of materials and equipment for the classification of marine units.

##### 3.1.2 Application form

The application form for certification shall identify if specific mandatory requirements are applicable in the areas where the diving system is intended for.

##### 3.1.3 Design assessment

A design assessment may be included in the certification of sub-systems and components.

In this case, the party applying for certification is to provide the reference of the technical standards used for the design of the product.

##### 3.1.4 Fabrication survey

The certification of components and sub-systems involves the surveillance of the fabrication and the examination of the manufacturer's procedures.

##### 3.1.5 Testing survey

Testing of the main sub-systems and components is to be witnessed by the Society when required.

## 4 Certification of the diving sub-systems

### 4.1 General

4.1.1 The diving sub-systems specified in Tab 1 and Fig 1 are to be certified, as applicable for the type of diving system, with a product certificate issued by the Society.

The scope of certification for the main sub-systems include:

- inspection of the material and components certificates as specified in [5]
- design review
- survey of the fabrication or assembly

- testing survey
- inspection of the marking defined in [4.2].

### 4.1.2 Hyperbaric Rescue Unit

Self-propelled hyperbaric lifeboats and their launching systems should also comply with Life Saving Appliances requirements according to IMO SOLAS convention.

### 4.2 Marking

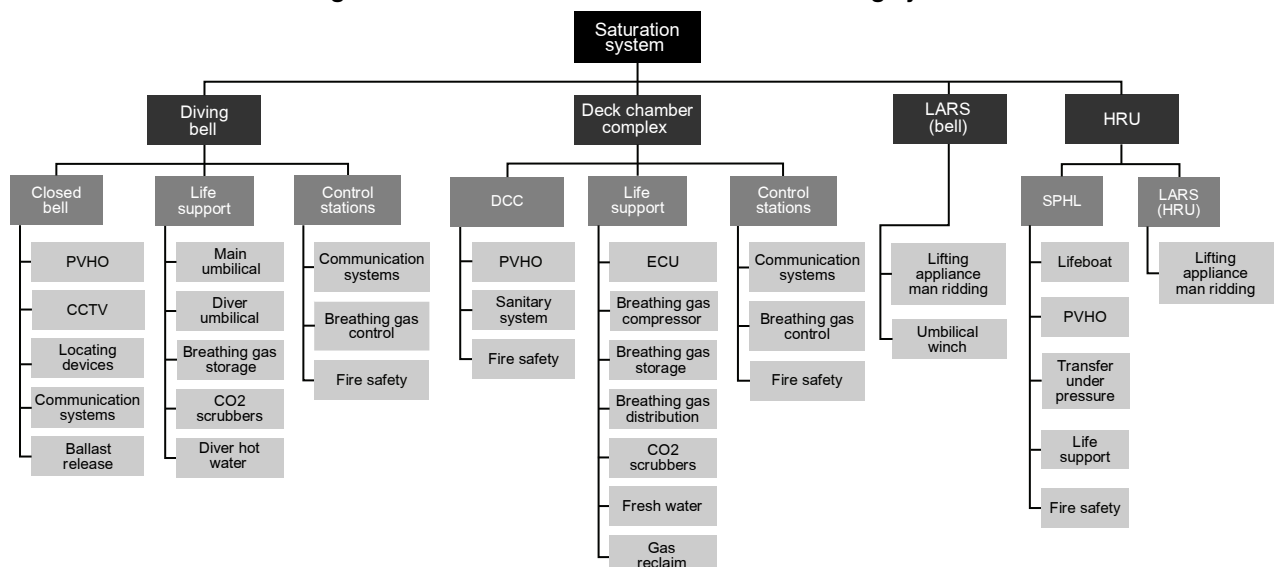
4.2.1 Each main sub-systems of the diving plant should be stamped with an official number or other distinctive identification which should be given on the Certificate.

Table 1 : Diving plant main sub-systems

Items	Saturation diving	Bounce diving	Surface diving
Closed diving bell Ch 2, Sec 2	X	X	
Wet diving bell Ch 2, Sec 3			X
Diving basket Ch 2, Sec 3			X
Main bell umbilical Ch 3, Sec 3	X	X	X (1)
Dive control station Ch 3, Sec 4]	X	X	X
Bell launch and recovery system Ch 2, Sec 4]	X	X	X
Deck decompression chamber Ch 2, Sec 1]	X	X	X
Saturation control station Ch 3, Sec 4]	X		
Life support systems Ch 3, Sec 3]			
• breathing gas storage and distribution	X	X	X
• CO2 scrubbers	X	X	X
• helium reclaim system	X		
• environmental control unit (heater and chiller)	X		
• diver hot water system.	X		
Hyperbaric Rescue Unit (HRU) Ch 2, Sec 5]	X		
HRU launching appliance Ch 2, Sec 5]	X		

(1) For wet diving bell

Figure 1 : General architecture of saturation diving system



## 5 Certification of material and components

### 5.1 General

**5.1.1** The certification procedure and requirements specified in Tab 2 are to be completed by the manufacturer within the scope of the classification of the diving system.

**5.1.2** The Society reserves the right to modify the requirements given in the present Note to formulate new ones or to change their application in order to take into account the particulars of a given construction, as well as local circumstances.

**5.1.3** The particular conditions and requirements expressed by National Flag Authorities, owners, shipyards or manufacturers may lead to additional surveys or other services to be specified and agreed in each case by the concerned parties.

### 5.2 Symbols

**5.2.1** Symbols used in Tab 2 are consistent with the definitions of NR266 Requirements for Survey of Materials and Equipment for the Classification of Ships and Offshore Units.

### 5.3 Explanatory notes, symbols and abbreviations

**5.3.1** Symbols used in Tab 2 have the following meaning: "C" indicates that a BV product certificate is required with invitation of the Surveyor to attend the tests unless otherwise agreed, in addition to the manufacturer's document stating the results of the tests performed and/or compliance with the approved type as applicable.

"W" indicates that a manufacturer's document is required, stating the results of the tests performed and/or stating compliance with the approved type (as applicable).

"X" indicates that examinations and tests are required.

Where fitted, each additional index (h, ndt) indicates a specific type of test:

h : Hydraulic pressure test (or equivalent)

ndt : Non-destructive tests as per Rules.

#### 5.3.2 Column 1 (item code)

Column 1 contains an alpha-numeric code for ease of reference equipment or component.

#### 5.3.3 Column 2 (item name)

Column 2 contains the name of the equipment or component with, eventually, its sub-systems.

#### 5.3.4 Column 3 (design assessment / approval index)

Column 3 contains the design assessment / approval index. The meaning of letters TA and DA is the following:

TA : Type Approval is required

TA<sub>HBV</sub> : Type Approval is required with work's recognition (HBV scheme as per NR320)

DA : Design assessment / Appraisal of the product is required; this one may be carried out as applicable:

- either for a specific unit, or
- using the Type Approval procedure.

Note 1: Where nothing is mentioned in column 3, a design assessment/approval of the specific unit is not required.

#### 5.3.5 Column 4 (raw material certificate)

Column 4 indicates the nature of the document that is to be submitted by the manufacturer or supplier of the concerned raw material. Consistently with the Rules or agreed specifications, this document includes data such as material tests (chemical composition and mechanical properties), non-destructive tests and surface hardness (if hardened).

#### 5.3.6 Column 5 (examination and testing)

Column 5 indicates that examination and/or testing are required, and are to be carried out by the manufacturer. For the type of examination and/or testing required, reference is to be made to the relevant provisions of the present Note.

Note 1: As a general rule, even if a cross "X" is not fitted in a cell under column 5, examination and tests during fabrication may be required with invitation/attendance of the Society's Surveyor.

#### 5.3.7 Column 6 (product certificate)

Column 6 indicates the nature of the document to be supplied by the manufacturer of the concerned product.

#### 5.3.8 Column 7 (remarks)

Column 7 indicates the remarks (if any) associated to the concerned equipment or component.

Table 2 : Examination and survey for diving system components

N°	Item	Design assessment	Raw Material certificate	Examination & Testing	Product certificate	Remarks
1	PRESSURE VESSEL FOR HUMAN OCCUPANCY	DA	C (1)	X h ndt	C (1)	Including supports and lifting padeyes. The overpressure test report is to indicate whether the viewports are in place during testing. The welding procedures are to be examined.
1.1	Viewports		W (1)	X h	C (1)	Certificates according to ASME PVHO
1.2	Piping penetrations		W	X h ndt	W	
1.3	Electrical penetrations		W	X h ndt	W	
1.4	Valves		W	X h	C (1)	When the valves are of welded type, the welding procedures are to be examined.
1.5	Pressure relief valve		W	X h	C (1)	When the valves are of welded type, the welding procedures are to be examined.
1.6	Overpressure alarm			X	W	
1.7	Doors and mating device		C	X h	W	
1.8	Clamp and mating device		C	X h	W	
2	COMMUNICATION SYSTEM					
2.1	Communication equipment: - wired - wireless			X X	(1) C / W C / W	
2.2	CCTV				W	
2.3	Emergency through water communication system			X	C / W	
2.4	Diving bell emergency location system	DA or TA		X	C / W	
3	DDC FIXED FIRE FIGHTING SYSTEM	DA		X	C	
3.1	Pressure vessel and piping	DA	W	X	C / W	Depending on item, refer to NR266. In case of welded construction, the welding procedures are to be examined.
3.2	Sprinkler and nozzle		W	X h	W	
3.3	Valves and fittings		W	X h	W	When the valves and fittings are of welded type, the welding procedures are to be examined.
(1)	Product certificate issued by an other recognized inspection body may be submitted in lieu of a certificate issued by the Society, on a case-by-case basis. In any case, the documents listed in Sec 3 are to be submitted.					

N°	Item	Design assessment	Raw Material certificate	Examination & Testing	Product certificate	Remarks
4	DDC FIRE SAFETY EQUIPMENT					
4.1	Portable hyperbaric fire extinguisher	DA or TA		X	C (1)	
4.2	Fire detection and alarm	TA <sub>HBV</sub>		X	C / W	Refer to NR266 item C
5	INSTRUMENTATION					
5.1	Pressure gauges			X	W	Calibration certificate to be provided
5.2	High-Low oxygen alarm (in enclosed space)	TA <sub>HBV</sub>		X	C / W	
5.3	Oxygen analyzers			X	W	
5.4	CO2 analyzers			X	W	
5.5	Temperature and humidity gauges			X	W	
5.6	Other electronic instruments				W	
6	BREATHING GAS DISTRIBUTION PANEL					
6.1	Oxygen piping	DA		X h	C	
6.2	Oxygen valves, regulators and fitting		W	X h ndt	C	As per class 1 defined in NR467
6.3	Other gas piping		W	X h	C / W	When the valves and fittings are of welded type, the welding procedures are to be examined. NDT to be performed if of welded construction.
6.4	Flexible hoses and couplings	TA		X h	C (1)	
6.5	Other valves, regulators and fittings		W	X h	C / W	As per class 1 defined in NR467. NDT to be performed if of welded construction.
6.6	Gas mixing equipment			X	C / W	
6.7	Pressure relief valve		X	X h	C / W	When the valves are of welded type, the welding procedures are to be examined.
6.8	Manifold			X	C / W	When the manifolds are of welded type, the welding procedures are to be examined.
6.9	Filters			X	W	
6.10	Built-In Breathing System			X	W	
(1)	Product certificate issued by an other recognized inspection body may be submitted in lieu of a certificate issued by the Society, on a case-by-case basis. In any case, the documents listed in Sec 3 are to be submitted.					

N°	Item	Design assessment	Raw Material certificate	Examination & Testing	Product certificate	Remarks
7	BREATHING GAS COMPRESSOR	DA		X	C	As per class 1 defined in NR467. Depending on installed power.
7.1	Compressor or blower				C / W	
7.2	Prime mover				C / W	Refer to Electrical Installations
7.3	Electrical switchboard				C / W	Refer to Electrical Installations
7.4	Filter				W	
7.5	Cracked plate detector				W	
7.7	Piping and fitting				W	In case of welded construction, the welding procedures are to be examined.
7.8	Safety valve			X	W	In case of welded construction, the welding procedures are to be examined.
7.9	Hoses			X	C / W	Refer to BREATHING GAS DISTRIBUTION
8	BREATHING GAS STORAGE					
8.1	Gas cylinders (V ≥ 0,5L)	DA	C / W	X h ndt	C (1)	
8.2	Master valve		W	X h ndt	C	As per class 1 defined in NR467. In case of welded construction, the welding procedures are to be examined and NDT is to be performed.
9	GAS RECLAIM SYSTEM	DA		X	C	
9.1	Compressors			X	C / W	See BREATHING GAS COMPRESSOR
9.2	CO2 scrubbers			X h	C / W	
9.3	Filters				W	
9.4	Gas bag (P ≤ 1 bar)				W	
10	ELECTRICAL INSTALLATIONS					
10.1	Switchboards	DA		X	C	
10.2	Electrical motors and generators ≥ 100 kW	DA / TA	C	X	C	Refer to NR266
10.3	Electrical motors and generators < 100 kW	TA <sub>HV</sub>	W	X	W	
10.4	Batteries			X	C	
(1)	Product certificate issued by an other recognized inspection body may be submitted in lieu of a certificate issued by the Society, on a case-by-case basis. In any case, the documents listed in Sec 3 are to be submitted.					

N°	Item	Design assessment	Raw Material certificate	Examination & Testing	Product certificate	Remarks
10.5	Safety lighting in spaces containing breathing gas	TA		X	C	Refer to NR266 for safety electrical equipment
10.6	Programmable Logic Controller (PLC) and computers used for tasks essential to safety, all components related to safety functions			X	C / W	As per conditions set in the Type Approval. Refer to NR467 Pt C Ch 3.
10.7	Control, protective and connecting devices	TA / TA <sub>HIBV</sub>		X	C / W	
10.8	Electric cable	TA / TA <sub>HIBV</sub>		X	C / W	
10.9	Electrical penetrators for PVHO	Refer to 1. PVHO				
11	DIVER HOT WATER UNIT	DA		X h	C	
11.1	Manifolds			X h	W	
11.2	Pressure vessel			X h	W	In case of welded construction, the welding procedures are to be examined.
11.3	Thermostat				W	
11.4	Pump				W	
11.5	Flexible hoses	TA		X	C (1)	
11.6	Piping, valves and fittings			X h	W	Depending on class of pressure vessel as per NR467 Pt C Ch 1. In case of welded construction, the welding procedures are to be examined.
12	ENVIRONMENTAL CONTROL UNIT (Hyperbaric heating / cooling system)	DA		X h	C	Depending on class of pressure vessel as per NR467 Pt C Ch 1
12.1	Boiler			X	C / W	
12.2	Cooling system / chiller			X	C / W	
12.3	Pressure vessel			X h	W	In case of welded construction, the welding procedures are to be examined.
12.4	Heat exchanger			X	W	
12.5	Thermostat				W	
12.6	Pumps				W	
12.7	Piping, valves and fittings			X	W	Depending on class of pressure vessel as per NR467 Pt C Ch 1. In case of welded construction, the welding procedures are to be examined.
(1)	Product certificate issued by an other recognized inspection body may be submitted in lieu of a certificate issued by the Society, on a case-by-case basis. In any case, the documents listed in Sec 3 are to be submitted.					



N°	Item	Design assessment	RawMaterial certificate	Examination & Testing	Product certificate	Remarks
13	DDC FRESH / POTABLE WATER UNIT	DA		X h ndt	C	
13.1	Pumps				W	
13.2	Pressure vessel		W	X h	W	In case of welded construction, the welding procedures are to be examined.
13.3	Piping and fittings			X	W / C	Depending on class of pressure vessel as per NR467 Pt C Ch 1. In case of welded construction, the welding procedures are to be examined.
14	DDC SEWAGE SYSTEM	DA		X h ndt	C	
14.1	Sewage tank			X h	C / W	Depending on class of pressure vessel as per NR467 Pt C Ch 1
14.2	Piping and fittings			X	C / W	Depending on class of pressure vessel as per NR467 Pt C Ch 1. In case of welded construction, the welding procedures are to be examined.
15	DIVING MAIN UMBILICAL			X h	C	
15.1	Breathing gas hose	TA		X h	C	
15.2	Communication and instrumentation cable	TA <sub>HIV</sub>			W	
15.3	Electrical cable	TA <sub>HIV</sub>		X	W	
15.4	Hot water hose	TA <sub>HIV</sub>			W	
16	DIVING BELL					
16.1	Bell ballast release			X	C / W	
16.2	Excursion umbilical			X h	C	Each hose to be certified. Refer to DIVING MAIN UMBILICAL
16.3	CCTV				W	
17	LARS - Closed bell					As applicable to lifting appliances (NR526) or offshore handling systems (NR595). Refer to NR266.
18	LARS - Wet bell & diving basket					As applicable to lifting appliances (NR526) or offshore handling systems (NR595). Refer to NR266.
19	UMBILICAL WINCH - closed bell	DA	W	X	C	Refer to NR266 as applicable to NR595 OHS
19.1	Swivel			X	C / W	
(1)	Product certificate issued by an other recognized inspection body may be submitted in lieu of a certificate issued by the Society, on a case-by-case basis. In any case, the documents listed in Sec 3 are to be submitted.					

## SECTION 3

## DOCUMENTATION TO BE SUBMITTED

### 1 General

#### 1.1 Application

**1.1.1** The documents listed in this Section are to be provided, as a minimum. Any additional information deemed necessary may be required by the Society.

#### 1.2 Diving support vessel

**1.2.1** The requirements for the documentation of the interface with the diving support vessel are specified in the Rule Note NR609.

#### 1.3 Failure Modes and Effects Analysis (FMEA)

**1.3.1** A FMEA is to be conducted at an early stage of the project.

**1.3.2** It is recommended to update the FMEA for each modification of the diving system.

**1.3.3** A guidance to conduct to FMEA is proposed in the document IMCA D039 - FMEA guide for diving systems.

#### 1.4 Master Document Register

**1.4.1** All the documentation submitted are to be listed in a Master Document Register (MDR) with the latest revision of each document.

### 2 Diving system documentation

#### 2.1 General documents

**2.1.1** The documents listed in Tab 1 are to be submitted, as a minimum.

##### 2.1.2 Design basis

A design basis including the following is to be submitted:

- maximum operating depth (and equivalent design pressure)
- maximum operating time
- maximum number of divers in water and in the DDC
- maximum time of occupancy expected in the DDC
- maximum operational wave height
- minimum and maximum sea and air temperature
- safety concept

##### 2.1.3 Specification of the diving system

The diving system specification is to include:

- the description of the system
- the list of diving equipment with reference and name of the manufacturer
- the emergency evacuation plan when divers are in hyperbaric chamber, when relevant

##### 2.1.4 Design loading conditions

The design loading conditions of the bell, its connection to the LARS and the umbilical are to be submitted.

### 2.2 Installation and commissioning instructions

#### 2.2.1 Installation manual

The installation manual provides a description of the procedure for the installation on-board.

This document is to be submitted for portable diving systems.

#### 2.2.2 Commissioning and testing

Description of the commissioning program and test protocol for the complete diving system and for each sub-system is to be provided as defined in Ch 4, Sec 1, [3.3].

### 2.3 Documents for service and maintenance

#### 2.3.1 Operating manual

The manufacturer of the diving equipment is to provide an operating manual with detailed information on the method to use the decompression system.

- the user instructions to operate the system
- operational limitations
- evacuation procedure

#### 2.3.2 Equipment and certificate register

An equipment and certificate register as defined in IMCA D014 is to be kept on-board.

#### 2.3.3 Service record book

The Owner is to establish and maintain a service record book which is to be submitted to the Society for in-service inspections.

The service record book is to contain all service and maintenance operations.

The service record book is to be available on-board.

### 2.3.4 Planned Maintenance System (PMS)

A planned maintenance system, as defined in IMCA D 018, is to be submitted to the Society.

The PMS is to include the requirements for all the periodic surveys required in Sec 1, [2.3].

The PMS should ensure the traceability of the maintenance works carried out and the routine replacement of the components on the diving plant.

The PMS is to include the identification markings of the diving equipment.

## 3 Diving bell and baskets

### 3.1 General

**3.1.1** The documents listed in Tab 2 are to be submitted, as a minimum.

**3.1.2** The documents to be submitted for the PVHO are listed in Tab 4.

## 4 Deck decompression chambers (DDC)

### 4.1 General

**4.1.1** The documents listed in Tab 3 are to be submitted, as a minimum.

**4.1.2** The documents to be submitted for the PVHO are listed in Tab 4.

## 5 Launch and Recovery System (LARS)

### 5.1 General

**5.1.1** The documents listed in [5.2.1] to [5.2.4] are to be submitted in addition to the documents listed in the Rule Note NR526, as applicable for a lifting appliance with the additional class notation ALS, or in the Rule Note NR595.

### 5.2 Documents to be submitted

#### 5.2.1 Data

The following data are to be submitted for information:

- operational limitation, when relevant
- weight of diving device to be lifted in air and in water
- maximum hoisting speed
- safe working load
- the force diagram in service condition
- the specification of the steel wires or fiber ropes including end termination details and minimum breaking load
- the list of all items of loose gears, marked in accordance with the relevant drawings and specifying the SWL and the test load of each of item.

### 5.2.2 Calculation notes

Calculation of the design loads for the handling system including rope data.

### 5.2.3 Drawings and documents

The followings drawings and documents are to be submitted for approval:

- general arrangement of the handling system and showing the working area and the different path of the rope
- general arrangement of the handling system showing clearly the reeving of the ropes and the number of parts of purchase tackles. All items of loose gears are to be marked and numbered on these drawings
- construction drawings
- material specifications
- power unit and driving system specifications and general drawings
- hydraulic and electric system specifications
- drawings of the load carrying hydraulic cylinders.

### 5.2.4 Specifications of winches

A technical file is to be submitted for information. This file is to include a detailed technical specification, an operating manual, a general drawing, the constructional drawings of the main items and complete calculations of the Manufacturer. The test programme contemplated is to be sent for approval.

## 5.3 Handling system of the clump weight

### 5.3.1 General

The documentation of the clump weight handling system is to be submitted, including:

- design basis
- characteristics of the guide wires
- structural drawing of the framing
- description and characteristics of the winches.

## 6 Hyperbaric Rescue Unit

### 6.1 General

**6.1.1** The documents listed in Tab 5 are to be submitted, as a minimum.

**6.1.2** The documents to be submitted for the PVHO are listed in Tab 4.

**6.1.3** For self-propelled hyperbaric lifeboats, additional documents are to be submitted, as applicable for the certification of a lifeboat and its launching arrangement for compliance with the IMO LSA Code.

Table 1 : General documents to be submitted

No.	Documents to be submitted	I / A (1)
1.1	Diving system general documents defined in [2.1]: <ul style="list-style-type: none"> <li>• design basis</li> <li>• technical specification</li> <li>• design loading conditions.</li> </ul>	I I I
1.2	Installations and commissioning instructions defined in [2.2] <ul style="list-style-type: none"> <li>• installation manual (for portable diving systems)</li> <li>• commissioning and testing procedures.</li> </ul>	I I / A
1.3	Documents for service and maintenance defined in [2.3] <ul style="list-style-type: none"> <li>• operating manual</li> <li>• equipment register</li> <li>• service record book</li> <li>• planned Maintenance System.</li> </ul>	I I I I
1.4	FMEA or FMECA report	I
1.5	Diving system general arrangement	I
1.6	Description of the sea fastening of the diving equipment on-board, when relevant	A
Electrical installations and control systems		
2.1	General layout of the control stations and their control panels	I
2.2	General description of the electrical installations and control systems	I
2.3	Description of electrical supply principles, failure scenarios, redundancy principles, emergency arrangement, load balance, storage batteries capacity etc.	I
2.4	Single line distribution diagram and detailed diagram of the installation, including description and characteristics of cable, fuse and switchgears	A
2.5	Description of the automation system	A
2.6	Descriptions and details of the communication means between diving control station and diving systems, including single line diagram	A
2.7	General layout showing the electrical equipment, batteries, lighting and cable trays	I
Safety features		
3.1	List of materials inside the hyperbaric enclosures with their characteristics of flammability	I
3.2	Fire-fighting equipment details	A
3.3	Description of the fire detection and alarm systems	A
Life support system		
4.1	Breathing gas single line diagram and piping details	A
4.2	Description of the gas storage arrangement	I
4.3	Structural drawings of the gas cylinders	A
4.4	Description of the safety relief valves	A
4.5	Description of the valves and fittings	A
4.6	Description of the piping material and scantling	A
4.7	Description of the welding details for piping	A
4.8	Description of the oxygen piping cleaning procedure	I
4.9	Description of the DDC environmental control unit	A
4.10	FAT procedure of the environmental control unit	I
(1)	A: To be submitted for approval I: To be submitted for information.	

No.	Documents to be submitted	I / A (1)
4.11	Description of the flexible hoses (reference standard, testing procedure, etc)	A
4.12	Description of the fresh water unit	A
4.13	FAT procedure of the fresh water unit	I
4.14	Description of the breathing gas reclaim unit	A
4.15	FAT procedure of the breathing gas reclaim unit	I
4.16	Description of the gas transfer system	A
4.17	FAT procedure of the gas transfer system	I
4.18	Description of the diving hot water unit	A
4.19	FAT procedure of the diving hot water unit	I
4.20	Description of the diving umbilical: <ul style="list-style-type: none"> <li>• specification, drawing, reference standard</li> <li>• flexible hose description (see above)</li> <li>• electrical and communication wire description.</li> </ul>	I
4.21	Testing program of the diving umbilical: <ul style="list-style-type: none"> <li>• FAT</li> <li>• qualification testing.</li> </ul>	I
<b>(1)</b> A: To be submitted for approval I: To be submitted for information.		

**Table 2 : Diving bell - Documents to be submitted**

No.	Documents to be submitted	I / A (1)
1	Design basis including characteristics, limitations, loading conditions etc.	I
2	Specification including the description of: <ul style="list-style-type: none"> <li>• calculation of internal volume</li> <li>• emergency means of recovery</li> <li>• ballast release system</li> <li>• communication systems</li> <li>• interface with the LARS</li> <li>• Interface with the DDC</li> <li>• interface with the main umbilical</li> <li>• interface with the divers' umbilicals</li> <li>• list of equipment.</li> </ul>	I
3	Mass estimate	I
4	Calculation note of buoyancy and stability	I
5	General layout	I
6	Description of the control panel in the bell <ul style="list-style-type: none"> <li>• layout of the control panel</li> <li>• single line diagram of the piping, electrical and communication systems.</li> </ul>	A
7	PVHO documentation listed in Tab 4, as a minimum	I / A
8	Description of the electrical installations and control including electricity production and storage, distribution, consumers' list etc.	A
9	Description of the heating system	I
10	Drawings of the diving bell structure including padeyes	A
11	Inspection and testing procedure	I
<b>(1)</b> A: To be submitted for approval I: To be submitted for information.		

**Table 3 : Deck decompression chambers - Documents to be submitted**

No.	Documents to be submitted	I / A (1)
1	Design basis including characteristics, limitations, loading conditions etc.	I
2	Specification including the description of: <ul style="list-style-type: none"> <li>• internal dimensions and volume</li> <li>• communication systems</li> <li>• Interface with the diving bell</li> <li>• interface with the HRU</li> <li>• interface with the life support control station</li> <li>• list of equipment</li> <li>• list of all the material in the deck chambers with their flammability characteristics.</li> </ul>	I
3	Mass estimate	I
4	General arrangement of the deck chambers interconnections	I
5	Description of arrangements for expansion allowances (interconnected chambers)	A
6	Layout of each deck chamber	I
7	PVHO documentation listed in Tab 4, as a minimum	I / A
8	Description of the electrical installations and control including production and storage, distribution, consumers' list etc.	A
9	Description of the fire-fighting system inside the deck chamber	A
10	Description of the environmental control unit	A
11	Description of the sanitary systems and equipment	A
12	Description of the carbon dioxide scrubber system	A
13	Drawings of the deck chamber supports and padeyes	A
14	Inspection and testing procedure	I
(1) A: To be submitted for approval I: To be submitted for information.		

**Table 4 : PVHO - Documents to be submitted**

No.	Documents to be submitted	I / A (1)
1	Design basis and general specification	I
2	Geometric description of the pressure vessel	I
3	Description of the viewports and their material	I
4	Specification of the pressure vessel material	I
5	Description of markings	A
6	Specification of the thermal and fire insulation material	A
7	Specification of the coating system	I
8	Description of the welding procedure	A
9	Description of the welding details	A
10	Description of the heat treatment	I
11	Specification of the safety valves and the pressure relief valves	I
12	Justification of the pressure vessel scantling	I
13	Justification of the means for expansion allowance of the interconnected pressure vessels	I
14	Drawings of the pressure vessel structure	A
15	Drawings of the supporting structure and padeyes	A
16	Drawings of doors, clamping systems, mating devices and locks	A
17	Drawings of the penetrations	A
18	Specification and extent of Non-Destructive Examination (NDE)	A
19	Inspection and Testing procedure	I
20	Inspection and testing reports: <ul style="list-style-type: none"> <li>• report from fabrication inspection</li> <li>• report from dimensional control</li> <li>• report from Non-Destructive Examination (NDE)</li> <li>• report from pressure testing.</li> </ul>	I
(1) A: To be submitted for approval I: To be submitted for information.		

Table 5 : HRU - Documents to be submitted

No.	Documents to be submitted	I / A (1)
1	Design basis including characteristics, limitations, loading conditions etc.	I
2	Specification including the description of: <ul style="list-style-type: none"> <li>• evacuation procedure</li> <li>• means of recovery on-board</li> <li>• means of towing</li> <li>• communication systems</li> <li>• life support system</li> <li>• internal dimensions and volume</li> <li>• interface with the LARS</li> <li>• Interface with the DDC</li> <li>• interface with the hyperbaric reception facility.</li> </ul>	I
3	IMO Life saving appliance certificate for the lifeboat and its launching system (SPHL only)	I
4	Mass estimate	I
5	Calculation note of buoyancy and stability	I
6	General layout	I
7	Description of the life support control panel <ul style="list-style-type: none"> <li>• layout of the control panel</li> <li>• single line diagram of the piping, electrical and communication systems.</li> </ul>	A
8	PVHO documentation listed in Tab 4, as a minimum	I / A
9	Description of the electrical installations including production and storage, distribution, consumers' list etc.	A
10	Description of the environmental control unit	A
11	Description of the carbon dioxide scrubber system	A
12	Description of the sanitary system	A
13	Inspection and testing procedure	I
<b>(1)</b> A: To be submitted for approval I: To be submitted for information.		





## **DIVING SUB-SYSTEMS**

---

- SECTION 1      DECK DECOMPRESSION CHAMBER**
- SECTION 2      CLOSED DIVING BELL**
- SECTION 3      WET BELL AND DIVING BASKET**
- SECTION 4      LAUNCH AND RECOVERY SYSTEM**
- SECTION 5      HYPERBARIC RESCUE UNIT**



# SECTION 1

# DECK DECOMPRESSION CHAMBER

## 1 General

### 1.1 Application

**1.1.1** The present Section provides the requirements for the design and construction of Deck Decompression Chambers (DDC) including:

- hyperbaric chambers (PVHO)
- control stations
- means for transfer under pressure
- sanitary systems
- fire safety systems.

**1.1.2** The requirements given in the present Section are additional to the requirements given in Chapter 3.

**1.1.3** Inspection and testing requirements are provided in:

- Ch 4, Sec 1 for initial inspection and testing
- Ch 4, Sec 2 for in-service surveys.

## 2 General design requirements

### 2.1 General arrangement

**2.1.1** There must be one bunk for each intended occupant. Each bunk should be well designed and firmly supported. They should also be wide and long enough to allow a normal person to lie in comfort.

**2.1.2** *A diving system should, as a minimum, include either one deck decompression chamber with two separate compartments, or two interconnected separate chambers so designed as to permit ingress or egress of personnel while one compartment or chamber remains pressurized. All doors should be designed so that locking mechanisms, if provided, can be operated from both sides.*

**2.1.3** *Where a deck decompression chamber is to be used in circumstances in which a person is intended to remain under pressure for a continuous period of more than 12 hours, it should be so arranged as to allow most divers to stand upright and to stretch out comfortably on their bunks. The smaller of the two compartments should be large enough for at least two persons. One of these compartments should be a living compartment.*

**2.1.4** *The living compartment and other compartments intended to be used for decompression should have a lock through which provisions, medicine and equipment may be passed into the chamber while its occupants remain under pressure.*

**2.1.5** *A deck decompression chamber should provide a suitable environment and facilities for the persons who use it, having regard to the type and duration of the diving operation. Where the chamber is intended to be occupied for more than 12 hours, toilet and sanitary facilities should also be provided. Toilet facilities capable of discharging the waste to the outside should be fitted with suitable interlocks and safety devices.*

### 2.2 Surface supplied diving

**2.2.1** Deck decompression chambers in surface supplied diving are to comply with general provisions regarding deck chambers.

Their conditions of use are as follow:

- the filling gas is compressed air or mixed gas
- the regeneration of the hyperbaric atmosphere is performed by ventilation
- Built-in Breathing Systems (BIBS) are available for breathing over oxygenated mixes and pure oxygen
- an oxygen analyzer is to be available
- if the chamber is not installed in a temperate room, it is to be fitted with a thermal protection and environmental control unit, as relevant.

### 2.3 Supporting structure

**2.3.1** The supporting structure of the DDC is to be designed to withstand the motions and accelerations of the supporting unit as defined in Ch 3, Sec 1 and the loading conditions due to internal load.

## 3 Pressure vessel for human occupancy

### 3.1 General

**3.1.1** The pressure vessel forming the deck chamber should be designed as a pressure vessel for human occupancy according to Ch 3, Sec 2.

**3.1.2** The volume of the deck chamber is to be accurately known to allow gas calculations to be carried out.

### 3.2 Medical locks

**3.2.1** The size of the medical locks are to be adapted to the size of the equipment which may be transferred.

Note 1: Attention is drawn toward national regulation which may provide further requirements.

### 3.3 Viewports

**3.3.1** *Each pressure compartment should have viewports to allow observation of all occupants from the outside.*

### 3.4 Safety valves

**3.4.1** Penetrations for safety valves shall be provided with shut-off valves on both sides of the shell plating.

These shut off valves shall be sealed in the open position.

### 3.5 Overpressure alarm

**3.5.1** Visual and audible overpressure alarm alerting the operators at the control station shall be provided.

### 3.6 Transfer under pressure

**3.6.1** *Saturation and bounce diving systems should be capable of allowing the safe transfer of a person under pressure from the diving bell to the deck decompression chamber (and vice versa).*

**3.6.2** A display of the internal pressure of the hub is to be available at the control station of the opening.

**3.6.3** When the transfer is vertical (bell coming above the deck chamber) a safety device is to be fitted to retain the door that may fall onto the personnel.

### 3.7 Mating device

**3.7.1** *For saturation and bounce diving systems where a power actuating system is used for mating operations, an auxiliary power actuating system or an appropriate means should be provided to connect a diving bell to the deck decompression chambers, in the event of failure of the normal power actuating system.*

**3.7.2** The interlock system should have a safety device to prohibit the opening of the clamp when a pressure above atmospheric pressure remains in the trunk.

## 4 Life support system

### 4.1 General

**4.1.1** Requirements regarding life support systems are given in Ch 3, Sec 3.

### 4.2 Gas analysis

**4.2.1** Gas piping used for analysis purpose is to be kept to the minimum diameter.

**4.2.2** Gas analyzers are to be provided in deck decompression chambers.

### 4.3 Control system

**4.3.1** The deck decompression chambers are to be equipped with gauges and other fittings necessary to indicate and control the internal pressures of each compartment from outside the deck chambers and inside each compartment.

**4.3.2** *Deck decompression chambers should be equipped with such valves, gauges and other fittings as necessary to control and indicate the internal pressure and safe environment of each compartment from outside the chamber at a centralized position.*

### 4.4 Carbon dioxide removal

**4.4.1** Regeneration system used for the removal of the carbon dioxide is to comply with Ch 3, Sec 3, [7].

### 4.5 Temperature and humidity control

**4.5.1** Temperature and humidity control units are to comply with Ch 3, Sec 3, [10].

### 4.6 Breathing gas reclaim

**4.6.1** The breathing gas reclaim system, when fitted, is to comply with the requirements of Ch 3, Sec 3, [8].

### 4.7 BIBS

**4.7.1** In each compartment of the chamber there must be at least one BIBS (Built-in Breathing System) connection and mask for each intended occupant plus one spare.

**4.7.2** BIBS are to comply with requirements defined in Ch 3, Sec 3, [6].

## 5 Sanitary equipment

### 5.1 General

**5.1.1** Deck decompression chambers used for saturation diving are to be provided with a sanitary room accessible by each diver in saturation.

### 5.2 Toilet

**5.2.1** An hyperbaric toilet is to be provided in each sanitary room.

**5.2.2** The toilet bowl is to be designed in order not to be sealed when a person is seated on it.

**5.2.3** The sewage system is to comply with Ch 3, Sec 3, [9].

### 5.3 Fresh water

**5.3.1** Hot and cold potable water are to be provided in each sanitary room.

**5.3.2** The fresh water system is to comply with Ch 3, Sec 3, [9].

## **6 Electrical installations and control systems**

### **6.1 General**

**6.1.1** The electrical installation and control system is to comply with the requirements of Ch 3, Sec 4.

### **6.2 Lighting**

**6.2.1** There must be sufficient internal lighting to allow valves and controls to be operated safely. It must also be sufficient to allow surveillance from outside.

**6.2.2** Lighting system is to comply with Ch 3, Sec 4, [2.4].

### **6.3 Communication**

**6.3.1** Communication systems are to comply with Ch 3, Sec 4.

## **7 Fire safety**

### **7.1 General**

**7.1.1** Fire safety requirements inside the hyperbaric chambers are given in Ch 3, Sec 5.

## SECTION 2

## CLOSED DIVING BELL

### 1 General

#### 1.1 Application

**1.1.1** This Section provides requirements for the design and construction of closed diving bells.

**1.1.2** The requirements given in the present Section are additional to the requirements given in Chapter 3.

**1.1.3** Inspection and testing requirements are provided in:

- Ch 4, Sec 1 for initial inspection and testing
- Ch 4, Sec 2 for in-service surveys.

### 2 General design requirements

#### 2.1 Survival means

##### 2.1.1 Autonomy

The duration of working of all survival means embarked is to be at least 24 hours.

The survival means should include at least:

- reserves of breathing gas
- beverage
- food
- breathing gas regeneration means
- thermal protection
- lighting
- emergency communications
- ultra-sonic pinger
- visual beacon.

This assessment is to be carried out at the maximum immersion, in fully disconnected situation.

##### 2.1.2 Survival Equipment

Means independent from surface supplies are to be provided to maintain the diver's body temperature and reduce CO<sub>2</sub> for a minimum period of 24 hours in an emergency. This will normally be by means of survival bags and emergency individual scrubbers.

Note 1: The heating requirement only applies to areas of the world where the ambient water temperature at the diving depth requires the divers to be heated. The CO<sub>2</sub> reduction requirement will apply in all circumstances.

#### 2.2 External layout

**2.2.1** *The diving bell should be provided with adequate protection against mechanical damage during handling operation.*

**2.2.2** *The diving bell should be equipped with means whereby each diver using the bell is able to enter and leave it safely as well as with means for taking an unconscious diver up into a dry bell.*

#### 2.3 Internal layout

**2.3.1** *The diving bell should provide a suitable environment and facilities for the persons who use it, having regard to the type and duration of the diving operation.*

**2.3.2** *Diving bells should be so designed as to provide adequate space for the number of occupants envisaged, together with the equipment.*

**2.3.3** A seat with safety belt is to be available for each occupant.

#### 2.4 Volume

**2.4.1** The diving bell should have the following minimum volume, although this is very dependent on the configuration (whether one umbilical is carried outside etc):

- 2 occupants: 3 m<sup>3</sup>
- 3 occupants: 4.5 m<sup>3</sup>
- 4 occupants: 6.0 m<sup>3</sup>.

**2.4.2** Volume of the bell is to be accurately known to allow breathing gas and stability calculations to be carried out.

### 3 Pressure vessel for human occupancy

#### 3.1 General

**3.1.1** The pressure vessel for human occupancy forming the bell and its viewports is to comply with the applicable requirements of Ch 3, Sec 2.

**3.1.2** The diving bell is normally designed in order to have a resistance against external pressure at least equal to the one against internal operating pressure. If not, restrictive operational conditions are to be taken into account.

#### 3.2 Viewport

**3.2.1** At least one viewport is to allow internal/external vision. Viewports are to be protected from mechanical damages and excessive heat.

**3.2.2** *Each diving bell should have view ports that as far as practicable allow an occupant to observe divers outside the bell.*

### 3.3 Access doors

**3.3.1** *Diving bell doors should be so designed as to prevent accidental opening during normal operations. All doors should be so designed that locking mechanisms, if provided, can be operated from both sides*

**3.3.2** Where doors are not autoclave, these may be operated from both sides, a safety device is to prevent un-locking if the pressure of both sides is not balanced

**3.3.3** The handling of doors of vertical accesses is to be assisted.

**3.3.4** A safety device is to be fitted to allow the coming-in going-out of the divers even if the bell is standing on the seabed.

**3.3.5** The lower opening devoted to the going-out of divers should have a minimum passing through diameter of 800 mm.  
Note 1: The opening is to be not less than 710 mm of diameter.

**3.3.6** The lower outer hatch may be closed from the inside of the bell.

### 3.4 Protection against overpressure

**3.4.1** Means are to be provided to avoid over-pressurization of the diving bell. This may be a relief valve or an over-pressure alarm.

### 3.5 Mating system

**3.5.1** *Mating devices should enable easy and firm connection or disconnection of a diving bell to a deck decompression chamber, even under conditions where the supporting unit is rolling, pitching or listing to predetermined degrees.*

**3.5.2** *For saturation and bounce diving systems where a power actuating system is used for mating operations, an auxiliary power actuating system or an appropriate means should be provided to connect a diving bell to the deck decompression chambers, in the event of failure of the normal power actuating system.*

**3.5.3** The interlock system should have a safety device to prohibit the opening of the clamp when a pressure above atmospheric pressure remains in the trunk.

### 3.6 Bell clamp

**3.6.1** For saturation or bounce diving systems, a safety interlock system is to be fitted to the clamping mechanism in order to secure the diving bell to the deck decompression chamber.

**3.6.2** This interlock is to prevent the clamp opening of there is still pressure inside the trunk and to avoid gas tight seal on the trunk if the clamp is not properly closed.

### 3.7 Medical lock

**3.7.1** A medical lock is to be provided as necessary for transferring equipment and supplies.

## 4 Life support

### 4.1 General

**4.1.1** In addition to the present Article, the life support system of the closed bell is to comply with the relevant requirements of Ch 3, Sec 3.

### 4.1.2 External connections

*The diving bell should be fitted with a manifold at a suitable point close to the main lifting attachment which should include connections for the following services:*

- *3/4 inch NPT (female) - for hot water*
- *1/2 inch NPT (female) - for breathing mixture.*

*The manifold should be clearly marked and suitably protected*

### 4.2 Breathing gas system

**4.2.1** There must be a means by which the divers in the bell can analyze the atmosphere for O<sub>2</sub> and CO<sub>2</sub> independent of the surface.

**4.2.2** Consideration should be given to providing a means of monitoring the bell atmosphere for hydrocarbons and H<sub>2</sub>S.

**4.2.3** There must be a powered scrubber unit to provide primary CO<sub>2</sub> removal from the atmosphere

**4.2.4** Each diver's gas supply must be arranged so that if one line fails then this does not interfere with the gas supply to another diver.

**4.2.5** There should be an alarm fitted to alert the bellman if the diver(s) supply switches over to the on-board gas.

### 4.3 Oxygen supply

**4.3.1** The externally carried oxygen supply must be fitted with a means whereby it is regulated to a low pressure before it enters the bell. High pressure oxygen must not be available inside the bell.

**4.3.2** The oxygen coming into the bell must be fitted with a system which limits either the rate of flow or the volume which can enter in order to minimize the risk of excess O<sub>2</sub> building up in the bell.

## 4.4 Gas reserve

**4.4.1** *The diving bell should be designed with a self-contained breathing gas system capable of maintaining a satisfactory concentration of breathing gas for the occupants for a period of at least 24 hours at its maximum operating depth.*

**4.4.2** The reserves of breathing gas outside the bell are to be sufficient:

- to empty the bell filled with 50% of water at the maximum operating depth, or
- to support each working diver plus the bellman outside the bell for a minimum of 30 minutes at a breathing rate of 40 liters/minute at the maximum depth of the diving operation.

### 4.4.3 Oxygen

Sufficient oxygen must be available for metabolic consumption by the maximum number of divers at 0.5 liters/minute per diver for at least 24 hours at the end of a bell run.

## 4.5 BIBS

**4.5.1** Built-in breathing system is to comply with the relevant requirements of Ch 3, Sec 3, [6].

**4.5.2** An oral/nasal or full face BIBS mask must be supplied for each occupant of the bell. This should be capable of providing breathing gas either from the surface or from the on-board cylinders

## 4.6 Piping, valves, fitting and hoses

**4.6.1** Piping bringing fluids in the bell are to be fitted inside with isolating valves and outside with non-return valves.

**4.6.2** Wall penetrations devoted to the passage of hot sea water are to be protected against corrosion.

**4.6.3** Internal compression and decompression controls are to be made by means of "dead man" safety valves which close when the handle is released.

**4.6.4** The system of injection of pure oxygen is to be such that an unintentional addition may not induce an unacceptable rise of the partial pressure of oxygen.

**4.6.5** The piping of the safety valve is to be fitted, inside with an isolating valve sealed in open position.

**4.6.6** Valves must be free of corrosion and should move freely through their full range of operation.

**4.6.7** Any open ended exhaust pipe work must be fitted with guards to prevent suction hazard.

**4.6.8** Any gas inlet pipe work should be fitted with some form of diffuser.

**4.6.9** There should be a valve fitted to allow partial flooding of the bell by the bellman. This should be in an easily accessible position and clearly visible. This valve should be in addition to the internal hull stop valve.

## 4.7 Instrumentation

**4.7.1** General requirements regarding life support instrumentation are given in Ch 3, Sec 3.

**4.7.2** *Valves, gauges and other fittings should be provided outside the bell as necessary to control and indicate the pressure and safe environment within the diving bell. The external pressure on the diving bell should also be indicated inside the bell.*

**4.7.3** Gauges must be provided inside the bell to let the divers know both the internal and external pressure.

**4.7.4** The relative pressure of gas supplies (normal and emergency) may be read inside the bell.

**4.7.5** The temperature (and possibly the flow rate) of hot water devoted to the heating of the diver may be read inside the bell.

## 4.8 Umbilical

**4.8.1** Diving bells are to be provided with a main supply umbilical for supplying breathing gases, hot water, electrical power, communication, etc., to the bell.

**4.8.2** Umbilicals are to be securely attached to the bell by means of a strength member or strain relief fitting so that the individual connections are not subjected to loads.

## 4.9 Carbon dioxide removal

**4.9.1** Regeneration system used for the removal of the carbon dioxide is to comply with Ch 3, Sec 3, [7].

**4.9.2** As required in [2.1.2], the diving bell is to be provided with an emergency CO<sub>2</sub> scrubber system with sufficient capacity to keep the bell with an acceptable partial pressure of CO<sub>2</sub> for 24 hours considering the maximum number of occupants.

## 4.10 Temperature and humidity control

**4.10.1** Temperature and humidity control units are to comply with Ch 3, Sec 3, [10].

**4.10.2** *As required in [2.1.2], there should be means to maintain the divers within the diving bell in thermal balance in an emergency for at least 24 hours. Such requirements may be satisfied by use of passive means carried in the bell.*



## 4.11 Breathing gas reclaim

**4.11.1** The breathing gas reclaim system, when fitted, is to comply with the requirements of Ch 3, Sec 3, [8].

## 4.12 Control of the water level

**4.12.1** When means to control the water level inside the bell are fitted, it is to automatically limit the upper level in order to protect the equipment which may be damaged when immersed.

The valve actuating the water level is to be accessible to a diver inside the access hub.

**4.12.2** Means are to be provided to empty a tilted bell partially filled with water.

## 5 Electrical installations and control systems

### 5.1 General

**5.1.1** General requirements regarding electrical installations and control systems are given in Ch 3, Sec 4.

**5.1.2** In case of disconnection from the supporting unit, the electrical installation is to comply with the requirements of [2.1].

### 5.2 Communication

**5.2.1** Communication systems are to comply with Ch 3, Sec 4.

### 5.3 Tapping code

**5.3.1** In addition to the communication means defined in [5.2], a standard bell emergency communication tapping code is to be adopted as given in Tab 1 for use between persons in the bell and rescue divers.

A copy of this tapping code is to be displayed inside and outside the bell and also in the diving control station.

### 5.4 Emergency locating device

#### 5.4.1 General

Diving bells are to be provided with an emergency locating device with a frequency of 37.5 kHz designed to assist personnel on the surface in establishing and maintaining contact with the submerged diving bell if the umbilical to the surface is severed. The device should include a transponder and a diver-held interrogator/receiver.

#### 5.4.2 Transponder

The transponder is to be provided with a pressure housing capable of operating to a depth of at least 200 m containing batteries and equipped with salt water activation contacts. The batteries are to be of the readily available "alkaline" type and, if possible, be interchangeable with those of the diver and surface interrogator/receiver.

The transponder is to be designed to operate with the characteristics defined in Tab 2.

**Table 1 : Bell emergency communication tapping code**

Tapping code	Situation
3.3.3	Communication opening procedure (inside and outside)
1	Yes or affirmative or agreed
3	No or negative or disagreed
2.2	Repeat please
2	Stop
5	Have you got a seal?
6	Stand by to be pulled up
1.2.1.2	Get ready for through water transfer (open your hatch)
2.3.2.3	You will NOT release your ballasts
4.4	Do release your ballast in 30 minutes from now
1.2.3	Do increase your pressure
3.3.3	Communication closing procedure (inside and outside)

**Table 2 : Transponder**

Common emergency reply frequency	37.5 kHz
Individual interrogation frequencies:	
• Channel A	38.5 ±0.05 kHz
• Channel B	39.5 ±0.05 kHz
Receiver sensitivity	+15 dB referred to 1 micro bar
Minimum interrogation pulse width	4 ms
Turnaround delay	125.7 ± 0.2 ms
Reply frequency	37.5 ±0.05 kHz
Maximum interrogation rates:	
• more than 20% of battery life remaining	Once per second
• less than 20% of battery life remaining	Once per 2 seconds
Minimum transponder output power	85 dB referred to 1 micro bar at 1 m
Minimum transducer polar diagram	-6 dB at ± 135° solid angle, centered on the transponder vertical axis and transmitting towards the surface
Minimum listening life in water	10 weeks
Minimum battery life replying at 85 dB	5 days

### 5.4.3 Diver-held interrogator/receiver

The interrogator/receiver is to be provided with a pressure housing capable of operating to a depth of at least 200 m with pistol grip and compass. The front end is to contain the directional hydrophone array and the rear end the 3-digit LED display readout calibrated in meters. Controls are to be provided for "on/off receiver gain" and "channel selection". The battery pack is to be of the readily available "alkaline" type and, if possible, be interchangeable with that of the interrogator and transponder.

The interrogator/receiver should be designed to operate with the characteristics defined in Tab 3

**Table 3 : Interrogator/receiver**

Common emergency reply frequency	37.5 kHz
Individual interrogation frequencies:	
• Channel A	38.5 kHz
• Channel B	39.5 kHz
Minimum transmitter output power	85 dB referred to 1 micro bar at 1 m
Transmit pulse	4 ms
Directivity	± 15°
Capability to zero range on transponder	
Maximum detectable range	more than 500 m

## 5.5 Lighting

**5.5.1** Means of normal and emergency lighting are to comply with the requirements of Ch 3, Sec 4.

**5.5.2** An autonomous flashing light located on the emerged part of the diving bell when floating at the surface is to be provided.

## 6 Safety systems

### 6.1 General

**6.1.1** Locations are to be provided for the storage of the following safety equipment:

- emergency breathing equipment
- first aid kit
- sanitary bags
- reserve food and beverage
- appropriate thermal protection means
- adequate repair tools
- checks, instructions and safety procedures lists
- reserves of products for regeneration (soda lime/sorb)
- emergency lighting.

## 7 Structure

### 7.1 General

**7.1.1** The structure of the diving bell is to be checked against lifting loads.

### 7.2 Lifting padeyes

**7.2.1** The lifting rope attachment to the diving device is to be a properly designed lifting padeye.

Note 1: Refer to NR595 App 1 Offshore Handling Systems

**7.2.2** The diving bell should be equipped with one extra lifting point designed to take the entire dry weight of the bell including ballast and equipment as well as the weight of the divers staying on in the bell.

**7.2.3** There should be a secondary attachment point on the diving bell if the main one is damaged. This secondary point should also be a properly designed pad eye or similar (it may be a second hole in the same pad eye).

**7.2.4** The connection of the lifting rope to the padeye is to have two retaining means for the removable pin (eg: nut locked with a split spin).

## 8 Emergency recovery means

### 8.1 General

**8.1.1** In the event of single component failure of the main handling system, an alternative means should be provided whereby the bell can be returned to the deck decompression chamber.

**8.1.2** In addition, provisions should be made for emergency retrieval of the bell if the main and alternative means fail.

If this involves buoyant ascent, the bell should have sufficient stability to maintain a substantially upright position and means should be provided to prevent accidental release of the ballast weights.

### 8.2 Release of LARS

**8.2.1** Provisions are to be taken in order that it will be possible to release from the inside of the bell the following:

- suspension ropes
- guide ropes
- umbilical.

**8.2.2** These systems are to be actuated through two voluntary actions from the personnel and are to be efficiently protected against undue actions.

One of these systems is to be of mechanical type, for each release system.

### 8.3 Ballast release system

**8.3.1** A ballast release system may be fitted and designated for use as an emergency recovery means.

**8.3.2** The release of the ballast weight is to work in a safe way in the most unfavorable attitudes specified for the bell.

**8.3.3** At least, one mechanical system is to be fitted.  
This release system may be actuated through two voluntary actions from the personnel and is to be efficiently protected from undue actuation.

**8.3.4** If the release mechanism is operated by means of pressurization (gas or hydraulic) then isolations need to be in place such that they cannot be activated accidentally by external water pressure or internal gas pressure.

**8.3.5** The ballast weights must not be capable of being shed accidentally, for example if the bell is inadvertently tilted.

**8.3.6** If the system uses only one weight then there must be no single component whose failure could cause the weight to become detached. This requirement does not apply if there are two or more weights operating independently.

**8.3.7** The amount of positive buoyancy is to be carefully considered in case of ballast release in order that the bell is not moving up too fast.

## 9 Stability and floatability

### 9.1 General

**9.1.1** When buoyant ascent of the diving bell may be used as an emergency means of recovery, the bell ability to remain in upright position is to be checked.

## SECTION 3

## WET BELL AND DIVING BASKET

### 1 General

#### 1.1 Application

**1.1.1** The present Section provides requirements for the design and construction of wet bells and diving baskets used in surface supplied diving systems.

**1.1.2** The requirements given in the present Section are additional to the requirements given in Chapter 3.

**1.1.3** Inspection and testing requirements are provided in:

- Ch 4, Sec 1 for initial inspection and testing
- Ch 4, Sec 2 for in-service surveys.

### 2 General design requirements

#### 2.1 Principles

**2.1.1** Wet bell or diving basket is used as safe means of getting into water for the divers.

**2.1.2** Arrangements must be in place to recover an injured or unconscious diver from the water to the deck.

**2.1.3** Wet bells /diver baskets should be designed for the carriage of at least two divers, including their equipment. The bells are to have suitable dimensions to carry the divers in an uncramped position.

**2.1.4** Wet bells /diver baskets are to be provided with internal handholds to support the divers.

#### 2.2 Handling system

**2.2.1** Each wet bell/ diving basket is to be provided with a handling system to ensure safe transportation between the subsea work location and the surface. Handling systems for wet bell/ diving baskets are to meet the applicable requirements of Sec 4.

**2.2.2** There must be a main lift point to attach the lift wire to the wet bell / diving basket.

This can be a padeye, a shackle point or a captive ring.

There must be a suitable place to attach a secondary lift wire if the main lift point fails (the secondary lift does not need to be fitted).

**2.2.3** The launching device has to enable that the decompression phases in the water are reliably and exactly observed.

#### 2.3 Structural assessment

**2.3.1** The structure of the wet bell / diving basket is to be checked against lifting loads.

#### 2.4 Marking

**2.4.1** The SWL is to be clearly marked on the wet bell / diving basket.

### 3 Diving baskets

#### 3.1 General

**3.1.1** Diving baskets are to be fitted with a gate or chain to prevent divers from falling out.

**3.1.2** Diving baskets are to be fitted with protection at the top to prevent injury to the divers from dropped objects.

#### 3.2 Emergency cylinder

**3.2.1** There is to be at least one emergency air cylinder fitted in the basket, fitted with a content gauge and a first stage regulator.

**3.2.2** An individual diving equipment is to be provided including SCUBA mouthpiece and valved flexible hose connection for air supply.

### 4 Wet Bell

#### 4.1 General

**4.1.1** Wet bells are to be provided with an enclosed upper section that provides an envelope capable of maintaining a bubble of breathing gases for the divers.

**4.1.2** Wet bells are to be fitted with a gate or chain to prevent divers from falling out.

#### 4.2 Breathing gas

##### 4.2.1 Masks

The wet bell is to be fitted with masks for each diver plus one spare.

#### 4.2.2 Oxygen

When designed to breath pure oxygen inside the wet bell, the oxygen is stored on board and delivered through breathing masks fitted with a device returning gases to the outside (diverter of the wet bell). This oxygen circuit is to be marked and arranged in compliance with applicable rules regarding piping.

#### 4.2.3 Gas exhaust

The wet-bell is to be fitted with an exhaust system operated by a spring-loaded valve that closes when the valve handle is released.

### 4.3 Emergency air cylinder

**4.3.1** In addition to the main umbilical supply, wet bells are to be provided with emergency supplies of breathing gas sufficient to supply the divers at nominal diving depth for a period covering the recovery of the divers including decompression (minimum two hours) and with an emergency breathing mask for each diver.

**4.3.2** There is to be at least two emergency air cylinder fitted in the wet bell, fitted with a content gauge and a first stage regulator.

**4.3.3** An individual diving equipment is to be provided including SCUBA mouthpiece and valved flexible hose connection for air supply.

### 4.4 Umbilical

**4.4.1** Wet bells are to be provided with a main supply umbilical for supplying breathing gases, hot water, electrical power, communication, etc., to the bell. The umbilical is to be securely attached to the bell by means of a strength member or strain relief fitting so that the individual connections are not subjected to loads.

### 4.5 Wet bell Controls

#### 4.5.1 Depth gauge

The wet bell is to be provided with a depth gauge.

#### 4.5.2 Lighting

Main and emergency lighting are to be provided to allow the divers to see and operate all controls.

#### 4.5.3 Video monitoring

A visual monitoring of the wet bell and the operating site by video system is recommended.

### 4.6 Wet bell Communication

**4.6.1** An emergency communication system is to be fitted on the wet bell to communicate with the surface.

## SECTION 4

## LAUNCH AND RECOVERY SYSTEM

### 1 General

#### 1.1 Application

**1.1.1** The present Section provides requirements for the design and construction of Launch And Recovery Systems (LARS) of diving bells.

**1.1.2** The requirements given in the present Section are additional to the requirements applicable for lifting appliances or offshore handling systems according to respectively the Rule Note NR526 Certification of lifting appliances, as applicable for appliances granted with the additional class notation **ALS**, and the Rule Note NR595 Classification of Offshore Handling Systems, as applicable for appliances granted with the additional class notation **OHS**.

**1.1.3** The requirements given in the present Section are additional to the requirements given in Chapter 3.

**1.1.4** Inspection and testing requirements are provided in:

- Ch 4, Sec 1 for initial inspection and testing
- Ch 4, Sec 2 for in-service surveys.

### 2 General design requirements

#### 2.1 Principles

**2.1.1** *A diving system should be equipped with a main handling system to ensure safe transportation of the diving device between the work location and the deck decompression chamber.*

**2.1.2** *The handling system should be designed with adequate safety factors considering the environmental and operating conditions, including the dynamic loads which are encountered while handling the diving bell through the air-water interface.*

**2.1.3** *The handling system should enable smooth and easily controllable handling of the diving bell.*

**2.1.4** *The lowering of diving devices under normal conditions should not be controlled by brakes, but by the drive system of the winches.*

**2.1.5** The handling system is to be suitable for man riding.

**2.1.6** *Handling systems should enable easy and firm connection or disconnection of a closed diving bell to a deck decompression chamber, even under conditions where the support ship or floating structure is rolling, pitching or listing to predetermined degrees.*

### 2.2 Marking

#### 2.2.1 SWL

The SWL is to be clearly marked on every winch and on the A frame, trolley or similar.

### 3 Structural assessment

#### 3.1 Design loads

**3.1.1** The Applicant is to submit the envelope loads considered for the design of the bell, the LARS including the wires and padeyes and the main bell umbilical.

**3.1.2** The static design load is to be taken as a minimum, equal to the maximum weight of the diving device in full load condition, that is with the maximum number of divers onboard with their equipment.

**3.1.3** The possible overweight of water and solids swept along during ascent so as suction resistance due to the sea ground is to be taken into account.

#### 3.2 Dynamic amplification factor

**3.2.1** The design of the LARS structure is to take into account the dynamic effects due to the motions of the support and the effect of breaking through the air/water interface, due to the generally significant difference between the buoyant weight and the weight in the air.

**3.2.2** The global amplification factor is the product of the dynamic amplification (DAF) due to the vessel motion with the DAF due to the appliance self motion.

**3.2.3** As a rule, a minimum global amplification factor of 2.0 is to be considered, in the vertical direction and the weight lifted is to be applied in the transverse directions as a minimum.

### 4 Machinery

#### 4.1 Winch

**4.1.1** The winch rated pull capacity is to take into account allowance for dynamic effects.

**4.1.2** The winch raise/lower control must be designed to return to the neutral position when released by the operator.

**4.1.3** If any sort of clutch mechanism is fitted to the winch, there must be a positive means of preventing it becoming disengaged during operation.

**4.1.4** The winch drum must be able to accept the full length of wire being used. This means that there should be a clear space between the outside of the top layer of wire and the edge of the drum flange of at least 2.5 times the wire diameter.

**4.1.5** Any winch used to handle the diving bell is to have:

- a second motor
- means to ensure that the wire being recovered is correctly spooled
- means by which the winch operator can see how much of the main bell lift wire and main bell umbilical have been paid out. This may be by line-out meters or at its simplest by marking the bell wire and umbilical at 10 metres intervals, using the same marking system.

## 4.2 Hydraulics

**4.2.1** When the LARS is powered by hydraulics, the hoses used are to be suitably supported and secured at intervals not exceeding 2 m.

## 4.3 Brake mechanisms

**4.3.1** *If the energy supply to the handling system fails or the operating lever is returned to neutral position, brakes should be engaged automatically.*

**4.3.2** Winch for personnel hoisting is to be provided with double brakes.

**4.3.3** In addition to the normal brake, the winch shall be equipped with a mechanically and operationally independent secondary brake with separate control system.

## 4.4 Heave compensation

**4.4.1** If a heave compensation system is fitted, a warning (light) is to be visible at the dive control stand and the LARS control stand when the system is in operation.

## 4.5 Secondary means of recovery

**4.5.1** *In the event of single component failure of the main handling system, an alternative means should be provided whereby the bell can be returned to the deck decompression chamber.*

**4.5.2** In case of failure of the main handling system, there is to be a secondary means of recovering the diving device to the surface, bringing it onboard and mating it to the chamber system. This must be independent of the main recovery system.

**4.5.3** The secondary recovery system must have a certified SWL which is at least equal to the weight of the fully loaded diving device in air and in water, in addition to its main task when relevant.

**4.5.4** When the notation **SATURATION** or **BOUNCE** is granted, the winch used for secondary recovery from the water to the deck should meet all of the man riding requirements given in the present Section, except the need for a second motor specified in [4.1.5] and if a wire rope is used, it should meet the requirements in [6.1] and [6.2].

## 5 Electrical installations and control system

### 5.1 Electrical installations

**5.1.1** Electrical installations of the LARS are to comply with the requirements of NR526 Rules for Lifting appliances, as applicable for a man-riding equipment.

### 5.2 Emergency power source

**5.2.1** An independent (secondary) power source must be available in case of failure of the primary power.

**5.2.2** The emergency power source is to comply with the requirements provided in Ch 3, Sec 4, [3.2].

### 5.3 Control system

**5.3.1** The control system of the LARS is to comply with the requirements of NR526 Rules for Lifting appliances, as applicable for a man-riding equipment.

## 6 Ropes and padeyes

### 6.1 Lifting rope

**6.1.1** The lifting rope is to be of non-rotating type.

**6.1.2** Operating the release system of the main lifting rope is to be dependent on 2 independent self-willed actions.

**6.1.3** The wire rope is to be adequately protected against corrosion.

#### 6.1.4 Safety factors

The Minimum Breaking Load of the lifting rope is to be not less than  $\eta \times \text{SWL}$  where  $\eta$  is a safety factor given in Tab 1.

**Table 1 : Lifting rope safety factor**

Item	Safety factor $\eta$
Steel wire rope	8
Fibre rope	10
<b>Note 1:</b> Lower values of safety factors may be accepted by the Society when duly justified.	

### 6.2 Lifting padeyes

**6.2.1** The lifting rope attachment to the diving device is to be a properly designed lifting padeye.

Note 1: Refer to NR595 App 1 Offshore Handling Systems

**6.2.2** The connection of the lifting rope to the padeye is to have two retaining means for the removable pin (eg: nut locked with a split pin).

### **6.3 Guide wires**

**6.3.1** For saturation diving systems, a system is to be provided to restrict excessive lateral or rotational movement of the diving device in the water. Usually, this system consists in a pair of guide wires stabilized with a weight.

**6.3.2** This system may be used as an emergency means of recovery.

## **7 Umbilical handling system**

### **7.1 General**

**7.1.1** Provisions should be made in order that the handling system of the umbilical is not used to lift the diving device, unless it is designed for that function.

**7.1.2** The winding diameter (reel, sheave) should be at least 3 times the umbilical natural curvature radius.

### **7.2 Surface supplied diving system**

**7.2.1** Umbilicals in surface supplied diving systems are to be marked in order for the LARS operator to know the amount of umbilical paid out at any time during the diving operation.



## SECTION 5

## HYPERBARIC RESCUE UNIT

### 1 General

#### 1.1 Application

**1.1.1** The present Section provides requirements for the design and construction of Hyperbaric Rescue Units (HRU) including:

- self-propelled hyperbaric lifeboat (SPHL)
- hyperbaric rescue chamber (HRC) non propelled.

**1.1.2** Saturation diving systems are to be provided with an Hyperbaric Rescue Unit.

**1.1.3** The requirements given in the present Section are additional to the requirements given in Chapter 3.

**1.1.4** Inspection and testing requirements are provided in:

- Ch 4, Sec 1 for initial inspection and testing
- Ch 4, Sec 2 for in-service surveys.

#### 1.2 Rules reference

**1.2.1** In addition to the requirements of the present Section, HRU should comply with the requirements of:

- IMO Guidelines and Specification for Hyperbaric Evacuation Systems Resolution A692 (17)
- IMCA D024, Diving Equipment Systems Inspection Guidance Note for Saturation (Bell) Diving Systems
- IMCA D051, Hyperbaric evacuation System (HES) - Interface recommendation
- IMCA D052, Guidance on Hyperbaric Evacuation System
- IMCA D053, DESIGN for the Hyperbaric Reception Facility (HRF) forming part of a Hyperbaric Evacuation System (HES)

**1.2.2** Other applicable standards may be accepted subject to Society approval.

### 2 General design requirements

#### 2.1 Principles

**2.1.1** An evacuation system should be provided having sufficient capacity to evacuate all divers under pressure, in the event of the ship having to be abandoned, and should be in accordance with the provisions of IMO Guidelines and specifications for hyperbaric evacuation systems Resolution A692.

**2.1.2** The design and construction of the hyperbaric evacuation system should be such that it is suitable for the environmental conditions envisaged, account being taken of the horizontal or vertical dynamic snatch loads that may be imposed on the system and its lifting points particularly during evacuation and recovery.

**2.1.3** On floating units intended for drilling, production or storage of hydrocarbon, the HRU is to have means of propulsion or other method to ensure it can rapidly move clear of the site.

**2.1.4** Arrangement is to be provided to enable an unconscious diver to be taken into the unit.

#### 2.2 Autonomy

**2.2.1** The HRU is to be capable of maintaining the divers at the correct pressure and with life support for a minimum of 72 hours.

#### 2.3 Marking

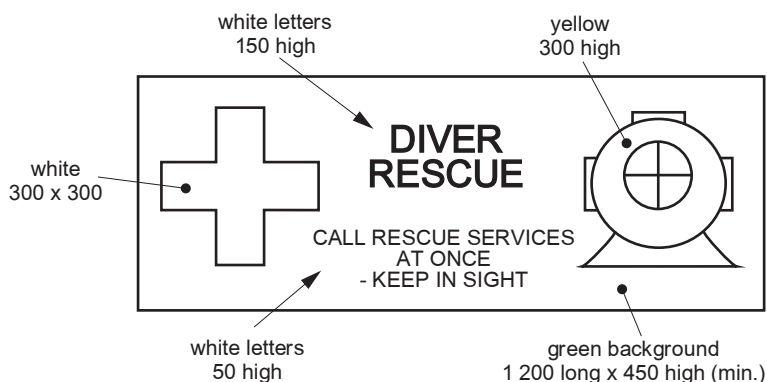
**2.3.1** Dedicated hyperbaric rescue units should be coloured orange (internal distress orange) and be provided with retro-reflective material to assist in their location during hours of darkness.

**2.3.2** Each hyperbaric rescue unit designed to be waterborne should be marked with at least three identical signs as shown in Fig 1. One of these markings should be on top of the unit and be clearly visible from the air and the other two be mounted vertically on either side and as high as possible and be capable of being seen while the unit is afloat.

**2.3.3** Where applicable, the following instructions and equipment should be clearly visible and be kept readily available while the unit is afloat:

- towing arrangements and buoyant towline
- all external connections, particularly for the provision of emergency gas, hot/cold water and communications
- maximum gross weight of unit in air
- lifting points
- name of the parent ship and port of registration and
- emergency contact telephone.

Figure 1 : Marking



### 2.3.4 Warning instructions

Where appropriate, the following instructions should be permanently displayed on every hyperbaric rescue unit in two separate locations so as to be clearly visible while the unit is afloat:

“Unless specialised diving assistance is available:

- do not touch any valves or other controls
- do not try to get occupants out
- do not connect any gas, air, water or other supplies
- do not attempt to give food, drinks or medical supplies to the occupants and
- do not open any hatches”.

## 2.4 Sea fastening arrangements

2.4.1 Where hyperbaric rescue units are designed to be placed on board a rescue vessel, attachment points should be provided on the unit to enable it to be secured to the deck.

## 3 Hyperbaric rescue method

### 3.1 General

3.1.1 Various methods are available for evacuating divers and the suitability of the various options depends on a number of factors including geographical area of operation, environmental conditions, and any available offshore or onshore medical and support facilities.

Options available to diving system operators include:

- hyperbaric self-propelled lifeboats
- hyperbaric rescue chambers which may or may not be towable suitable for off loading on to an attendant facility
- transfer of the diving bell to another facility
- transfer of the divers from one diving bell to another when in the water and under pressure
- negatively buoyant unit with inherent reserves of buoyancy, stability and life support capable of returning to the surface to await independent recovery.

3.1.2 The Hyperbaric Rescue Unit (HRU) can be an Hyperbaric Rescue Chamber or a Self-Propelled Hyperbaric Lifeboat.

## 3.2 Hyperbaric Rescue Chamber (HRC)

3.2.1 The hyperbaric rescue chamber is a deck chamber specially fitted to be launched and to work continuously and passively during the specified minimum autonomy.

3.2.2 This implies:

- an interface with handling means
- a stability study
- a protection against impact
- a specific thermal protection
- means of making vital and communication functions autonomous in floatation condition.

The set of drawings and calculations notes corresponding to these items are to be submitted to the Society for approval.

## 3.3 Self-Propelled Hyperbaric Lifeboat (SPHL)

3.3.1 The SPHL is to comply with international regulations applicable to rescue craft (IMO LSA code).

3.3.2 It is recommended to have 100% diver capacity on each side of the diving support vessel.

If the capacity is less, it has to be justified in the risk analysis.

3.3.3 A non-pressurized steering and control station is to be provided for at least one sailor and one deck chamber operator.

3.3.4 The deck chamber operator is to be able to watch inside the chamber from its control panel through a viewport.

## 4 Pressure vessel for human occupancy

### 4.1 General

4.1.1 Pressure vessels for human occupancy used in HRU are to comply with the requirements specified Ch 3, Sec 2.

### 4.2 Access trunk

4.2.1 The access trunk is to be part of the resistant structure. It should allow the personnel to easily pass through.

**4.2.2** There is to be emergency means of lighting of the access trunk.

### 4.3 Clamp interface standard

#### 4.3.1 Connection with the Deck Decompression Chamber (DDC)

*The means provided for access into the HRU chamber should be such as to allow safe access to or from the deck decompression chambers. Interlocks should be provided to prevent the inadvertent release of the hyperbaric rescue unit from the deck decompression chamber while access trunking is pressurized. The mating flange should be adequately protected from damage at all times including during the launch and recovery stages.*

#### 4.3.2 Connection with the Hyperbaric Reception Facility (HRF)

The design and construction of the interface between the HRU and HRF should comply with the recommended standard defined in IMCA D051 Hyperbaric Evacuation Systems (HES) - Interface Requirements.

### 4.4 Medical lock

**4.4.1** *A medical lock should be provided and be so designed as to prevent accidental opening while the HRU chamber is pressurized. Where necessary, interlock arrangements should be provided for this purpose. The dimensions of the medical lock should be adequate to enable essential supplies, including CO<sub>2</sub> scrubber canisters, to be transferred into the HRU chamber, and be of such dimensions as to minimize the loss of gas when the lock is being used.*

## 5 Life support system

### 5.1 Life support

#### 5.1.1 General

Assessment of reserves in soda lime, heating/ refrigerating means, survival rations, reserves of gas, etc. is to be made considering the required autonomy.

#### 5.1.2 Breathing gas reserve

Breathing gas reserves and gas reclaim are to cover the consumption of the designed number of persons as well as the compensation of possible leaks.

The embarked gas reserve is to allow at least to keep the chamber of the HRU at its operating pressure during the survival duration.

#### 5.1.3 Breathing gas system

*Two separate distribution systems should be provided for supplying oxygen to the decompression chamber. Components in the system should be suitable for oxygen service.*

#### 5.1.4 BIBS

*A Built-In Breathing System should be provided with a sufficient number of masks for all the occupants under pressure plus one spare.*

BIBS should be overboard dump type with exhausts piped both outside the chamber and outside the enclosed cockpit area in the case of lifeboat type.

#### 5.1.5 Decompression process

*Where it is intended that divers may be decompressed within the hyperbaric rescue unit, provision should be made for the necessary equipment and gases, including therapeutic mixtures, to enable the decompression process to be carried out safely.*

#### 5.1.6 External connections

*Provision should be made external to the hyperbaric rescue unit, and in a readily accessible place, for the connection of emergency hot or cold water and breathing therapeutic mixture. The dimensions of the connections provided should be as follows:*

- 3/4 in. NPT (female) - hot or cold water
- 1/2 in. NPT (female) - breathing mixture.

*The connections are to be clearly and permanently marked and be suitably protected.*

#### 5.1.7 Comfort

*The decompression chamber should provide a suitable environment and adequate facilities, including, where appropriate, seat belts, for the maximum number of persons for which the unit is designed. The seating or other arrangements provided should be designed to provide an adequate degree of protection to the divers from impact collisions during launch and while the unit is afloat.*

#### 5.1.8 Sanitary functions

*Where the HRU is intended to be occupied for more than 12 h, arrangements for the collection or discharge of human waste should be provided. Where discharge arrangements are provided they should be fitted with suitable interlocks.*

#### 5.1.9 Controls

*In addition to any controls and equipment fitted externally, decompression chambers should be provided with adequate controls within for supplying and maintaining the appropriate breathing mixtures to the occupants, at any depth down to the maximum operating depth. The persons operating the chamber, whether they are within or outside it, should be provided with adequate controls to provide life support. As far as practicable, the controls should be capable of operation without the person who operates them having to remove his/her seat belt.*

## 6 Electrical installations and control systems

### 6.1 Communication means

**6.1.1** Communication means are to be provided between the HRU decompression chamber and:

- the HRU launching station
- the DDC control station.

**6.1.2** *If breathing mixtures containing helium or hydrogen are used, a self-contained primary communication system fitted with an unscrambler device should be arranged for direct two-way communication between the divers and those outside the compression chamber. A secondary communication system should also be provided.*

**6.1.3** *A standard bell emergency communication tapping code should be provided which meets the requirements of the diving bell in Sec 2. Copies of the tapping code should be permanently displayed inside and outside the hyperbaric rescue unit.*

### 6.2 Locating device

**6.2.1** The HRU is to be fitted with: flashing light and radar deflector.

- radar deflector
- strobe light
- radio location devices (EPIRB or similar).

### 6.3 Emergency source of power

**6.3.1** *Where a power-actuated system is used for the connection or disconnection of the hyperbaric rescue unit and the deck decompression chambers, then a manual or stored power means of connection or disconnection should also be provided.*

## 7 Fire safety

### 7.1 General

**7.1.1** *Fire-extinguishing system should be provided in the hyperbaric rescue unit which should be suitable for exposure to all depths down to the maximum operating depth.*

Note 1: Portable hyperbaric extinguishers may be used.

**7.1.2** *Hyperbaric rescue units on supporting units required to be provided with fire-protected lifeboats should be provided with a similar degree of fire protection.*

## 8 Launch and Recovery System

### 8.1 General

**8.1.1** The launching system of the HRU is to comply with IMO SOLAS Convention and IMO International Life Saving Appliances Code (LSA Code).

### 8.2 Emergency system

**8.2.1** *Where the primary means of launching depends on the ship's main power supply, then a secondary and independent launching arrangement should be provided.*

**8.2.2** *If the power to the handling system fails, brakes should be engaged automatically. The brake should be provided with manual means of release.*

### 8.3 Connection

**8.3.1** *The launching arrangements provided should be designed to ensure easy connection or disconnection of the hyperbaric rescue unit from the surface and for the transportation and removal of the unit from the ship under the same conditions of trim and list as those for the ship's other survival craft.*

**8.3.2** *The hyperbaric rescue unit should be capable of being recovered by a single point lifting arrangement and means should be provided on the unit to permit a swimmer to hook on or connect the lifting arrangement.*

### 8.4 Recovery

**8.4.1** *Special arrangements and instructions should be provided externally to enable the hyperbaric rescue unit to be recovered safely. The instructions should be located where they will be legible when the hyperbaric rescue unit is floating.*

## 9 Stability

### 9.1 Righting moment

**9.1.1** *Hyperbaric rescue units designed to float should be provided with adequate stability for all envisaged operating and environmental conditions and be self-righting. In determining the degree of stability to be provided, consideration should be given to the adverse effects of large righting moments on the divers. Consideration should also be given to the effect which equipment and rescue personnel, required to be placed on the top of the system to carry out a recovery from the sea, may have on the stability of the hyperbaric rescue unit.*

**9.1.2** *Towing attachment points should be so situated that there is no likelihood of the hyperbaric rescue unit being capsized as a result of the direction of the tow line. Where towing harnesses are provided they should be lightly clipped or secured to the unit and, so far as is possible, be free from snagging when pulled free.*

## **9.2 Buoyancy**

**9.2.1** *Hyperbaric rescue units designed to float should have sufficient reserves of buoyancy to enable the necessary rescue crew and equipment to be carried.*



## **DESIGN AND CONSTRUCTION**

---

- SECTION 1      GENERAL DESIGN REQUIREMENTS**
- SECTION 2      PRESSURE VESSEL FOR HUMAN OCCUPANCY**
- SECTION 3      LIFE SUPPORT SYSTEM**
- SECTION 4      ELECTRICAL INSTALLATIONS, CONTROL AND COMMUNICATION  
SYSTEMS**
- SECTION 5      FIRE PROTECTION, DETECTION, EXTINCTION**





## SECTION 1

## GENERAL DESIGN REQUIREMENTS

### 1 General

#### 1.1 Application

**1.1.1** The present Section provides general requirements for the design and construction of diving systems.

#### 1.2 Safety principles

**1.2.1** *As far as reasonable and practicable, a diving system should be designed to minimize human error and constructed so that the failure of any single component (determined, if necessary, by an appropriate risk assessment) should not lead to a dangerous situation.*

**1.2.2** *Diving systems and components thereof should be designed for the conditions under which they are certificated to operate.*

In particular, PVHO and pressure vessels which are part of the life support system are to be designed with a design pressure at least equivalent to the maximum operating depth.

**1.2.3** *All components in a diving system should be so designed, constructed and arranged as to permit easy cleaning, disinfection, inspection and maintenance.*

**1.2.4** *A diving system should include the control equipment necessary for safe performance of diving operations.*

**1.2.5** *The diving system should be capable of allowing the safe transfer of a person under pressure between the diving bell to the deck compression chambers.*

### 2 Layout of the diving system

#### 2.1 General layout

**2.1.1** Requirements on the general layout of the diving system and the interface with the supporting vessel are given in NR609 Classification of diving support units.

#### 2.2 Layout of the control stations

**2.2.1** *The diving system is to be so arranged as to ensure that centralized control of the safe operation of the system can be maintained under all weather conditions.*

**2.2.2** The control station is to provide control of diving operations and deck chambers, either in a unique location or in two distinct control stations with suitable means of communication.

**2.2.3** Requirements for the arrangements of the control stations are given in Sec 4.

### 3 Failure Modes and Effects Analysis (FMEA)

#### 3.1 General

**3.1.1** A FMEA is to be conducted at an early stage of the project.

**3.1.2** Reference is made to IMCA D039 - FMEA guide for diving systems, which is a recognized guidance to conduct FMEA.

#### 3.2 Hyperbaric evacuation

**3.2.1** For hyperbaric evacuation, reference is made to contingency plan defined in IMO Res. 692(17).

### 4 Design conditions

#### 4.1 General

**4.1.1** Any component of the diving system is to be designed to operate under the design conditions given in [4].

#### 4.2 Motions and accelerations

**4.2.1** Unless an hydrodynamic analysis of the diving support unit is performed to assess the maximum motions and accelerations, the rule values given Tab 1 and Tab 2 are to be considered.

**Table 1 : Design motions**

	Roll (1)	List (2)	Pitch (1)	Trim (2)
Deck equipment on ship or barge	±22.5°	±15°	±10°	±5°
Deck equipment on Column Stabilized semi-submersible unit		±15°		±15°
Diving bell	±45°	±22.5°	±45°	±22.5°
(1) Dynamic angle (2) Static angle				

**Table 2 : Design accelerations**

Vertical acceleration	2.0 g
Horizontal acceleration	1.0 g

## 4.3 Environmental conditions

### 4.3.1 Design temperature

In general, diving systems are designed to operate between -10 °C and +60°C.

### 4.3.2 Cold weather conditions

When the design air temperature is below 0°C, special protection against icing should be provided.

In this case, the applicable winterization requirements defined for additional class notation **COLD** should be complied with.

Note 1: When the design air temperature is below -10°C, the steel grade selection is to be specially considered.

### 4.3.3 Humidity

The diving system is to be designed to operate with a humidity content of 100%.

## 5 Constructional arrangements

### 5.1 Materials and welding

**5.1.1** *Materials for diving system components should be suitable for their intended use.*

**5.1.2** Metallic materials are to comply with the requirements of NR216 Rules for materials and welding, unless otherwise specified.

### 5.2 Structural support

**5.2.1** The foundations of the diving systems and their handling systems are to be strong enough to sustain the efforts arising from operating, emergency and stowage conditions.

### 5.3 Sea fastening

**5.3.1** *Provision should be made to ensure that the diving system and auxiliary equipment are securely fastened to the ship or floating structure and that adjacent equipment is similarly secured. Consideration should be given to the relative movement between the components of the system. In addition, the fastening arrangements should be able to meet any required survival conditions of the ship or floating structure.*

**5.3.2** When bolts are used for load carrying connections, the bolts characteristics and the reference technical standard are to be submitted.

## SECTION 2

## PRESSURE VESSEL FOR HUMAN OCCUPANCY

### 1 General

#### 1.1 Application

**1.1.1** The present Section provides requirements for the design and construction of Pressure Vessels for Human Occupancy (PVHO) intended for diving systems.

**1.1.2** Inspection and testing requirements are provided in:

- Ch 4, Sec 1 for initial inspection and testing
- Ch 4, Sec 2 for in-service surveys.

#### 1.2 Scope

**1.2.1** Pressure vessels for human occupancy are to comply with the requirements of one of the standards referenced in [1.3] in addition to the provisions of the present Section.

**1.2.2** The referenced standard is to be complied with regarding:

- material
- structural scantling
- welders qualification
- welding procedure and testing
- testing
- marking.

#### 1.3 Referenced standards

**1.3.1** The following standards are recognized for the design and construction of PVHO:

- ASME-PVHO
- EN 13445.

Other recognized standard may be accepted subject to the approval of the Society.

Note 1: Attention is drawn to further requirements from National regulations which may apply.

#### 1.4 Design loads

##### 1.4.1 Design parameters

The following design parameters are to be submitted:

- maximum allowable working pressure (internal/ external)
- design temperature (maximum/minimum)
- hydrostatic test pressure
- local loads
- accelerations due to handling loads defined in [1.4.2]
- number of design load cycles.

##### 1.4.2 Handling loads

*In the design of pressure vessels including accessories such as doors, hinges, closing mechanisms and penetrators, the effects of rough handling and accidents should be considered in addition to design parameters such as pressure, temperature, vibration, operating and environmental conditions.*

### 2 Doors, hatches and locking devices

#### 2.1 Doors and hatches

**2.1.1** The design of doors and hatches is to comply with the following:

- the clear opening diameter is to be at least 600 mm
- means of opening and closing is to be operable from both sides
- reverse overpressurization of the door is not to cause catastrophic failure of the locking device
- opening is not possible if the pressure is not equal on both sides
- means for securing the door in fully open position is to be provided
- a safety interlock system is to be fitted if pressure acts to open or unseat the hatch or door. This interlock system is not to allow pressurization of the door or hatch unless it is fully engaged.

Note 1: minimum clear opening diameter of the diving bell hatch is specified in Ch 2, Sec 2.

#### 2.2 Locking devices

**2.2.1** *Locks should be designed to prevent accidental opening under pressure and, where necessary, interlocks should be provided for this purpose.*

**2.2.2** Locking devices are to be provided whenever the pressure do not act to close the lock, the door or the mating device.

**2.2.3** The locking device is to be fitted with an approved mechanical locking system.

**2.2.4** A safety device is to prevent un-locking if the internal pressure of the hub is not balanced with respect to ambient pressure.

#### 2.3 Portholes

**2.3.1** Portholes fitted in doors or hatches are to comply with the requirements on viewport in Article [5].

## 2.4 Medical locks

**2.4.1** Pressure gauges on medical locks are to be so arranged that if the exhaust line of the medical lock is obstructed from the inside, the gauge will still indicate the correct pressure inside the lock.

## 3 Penetrators, valves and fittings

### 3.1 Penetrators

**3.1.1** Hull penetrators are not to create weak points in the pressure resistant shell. Requirements from a recognized standard regarding location of openings are to be complied with.

**3.1.2** *All hull penetrators on chambers should be fitted with two shut off devices as close to the penetration as practicable. Where appropriate, one device should be a non-return valve.*

Note 1: Except for the bores of medical and equipment locks in internal chamber.

Note 2: When a non-return valve is used, it should be inside the PVHO and the other valve outside.

**3.1.3** These valves are to be of quick closing type.

**3.1.4** These valves are to be mounted directly on each side of the chamber shell plating or close to the chamber shell provided that the piping between the valve and the shell complies with the design standard of the PVHO.

Note 1: Special arrangement may be allowed for drain water inside the PVHO

**3.1.5** The position of each of these valves is to be clearly visible. They are to be secured in open position for normal operation but it is to be possible to override this locking.

**3.1.6** Where high diameter hull penetrations, likely to induce an hazardous decompression in case of breakage of the piping, are used in an external regeneration system, the internal safety isolating valves are to be replaced by a non-return for the in-coming piping, by an excess flow valve for the out-going piping (flow-fuse or flow rate sensitive valve).

### 3.2 Electrical Penetrators

**3.2.1** Requirements for electrical penetrators are given in Sec 4.

### 3.3 Exhausts and inlets

**3.3.1** Piping and fittings are to comply with applicable requirements of Sec 3.

**3.3.2** Any open ended exhaust pipe work must be fitted with guards for finger protection, including those located in transfer trunkings and medical locks. The design of the guards should minimise the risk of injury the divers using the trunk.

**3.3.3** The use of flow-fuse or flow rate sensitive valve is to be considered to limit the exhaust rate.

**3.3.4** Any gas inlet pipe work are to be fitted with some form of diffuser inside the PVHO, except those located in transfer trunkings.

Note 1: Special attention should be given to noise level inside the PVHO.

### 3.4 Pressure relief valve

**3.4.1** As a rule, all PVHO are to be fitted with a pressure relief valve rated to the design pressure.

As an alternative, overpressure alarm may be provided as allowed by [3.4.2].

**3.4.2** *All deck decompression chambers and diving bells which may be pressurized separately should be fitted with overpressure alarms or pressure relief valves.*

**3.4.3** *If pressure relief valves are fitted, a quick-operating manual shut off valve should be installed between the chamber and the pressure relief valve and should be wired opened with a frangible wire. This valve should be readily accessible to the attendant monitoring the operation of the chamber. All other pressure vessels and bottles should be fitted with a pressure relief device.*

### 3.5 Noise reduction

**3.5.1** *Pipe systems should be so designed as to minimize the noise inside the diving bell and the deck decompression chambers during normal operation.*

## 4 Fabrication

### 4.1 Welding

**4.1.1** The welds are to be tested according to the standard applied for the design and construction of the PVHO.

## 5 Viewports

### 5.1 General

#### 5.1.1 Definition

The term viewport means both the window and its sealing.

#### 5.1.2 Design and fabrication

Viewports are to be designed and constructed in accordance with ASME PVHO-1.

### 5.1.3 Operating limitations

The viewports are subject to the following operating limitations:

- the pressurization /depressurization rate is to be less than 10 bar/s
- the number of pressure cycles is not to exceed 10 000 or the total duration is not to exceed 40 000 hours
- the minimum design temperature is -18°C and the maximum design temperature is +66°C.

### 5.1.4 Design life

The design life of the viewports is not to exceed 10 years from the date of fabrication, in accordance with ASME PVHO-1 Safety standard for pressure vessels for human occupancy.

## 5.2 Certification

**5.2.1** The viewports are to be certified and tested in accordance with ASME PVHO-1 Safety standard for pressure vessels for human occupancy.

**5.2.2** The certification process of the viewports includes:

- design review
- fabrication procedure
- material certification
- material testing
- pressure testing.

Note 1: The pressure test may be done with the viewport installed on the chamber.

## 5.3 Marking

**5.3.1** The marking of viewports is to give the following indications (units used are to be specified):

- design pressure
- maximum and minimum operating temperatures
- referenced certification standard
- name or symbol of the certification body
- serial number or equivalent
- year and month of fabrication.

**5.3.2** The marking is to be performed by means of a stencil in a legible and indelible way, preferably on the edge of the viewport and in accordance with ASME PVHO-1.

The marking is not to cause any damage to the viewport which may cause a crack propagation.

## 6 Materials and pollutants

### 6.1 Materials

**6.1.1** The construction of the PVHO is to be such as to minimize hazard of smoke and fire. Systems shall be designed and equipped to avoid sources of ignition and minimize flammable materials. Toxicity of combustion products and flame-spread characteristics shall be considered in material selection.

### 6.2 Internal coating and adhesives

**6.2.1** All the materials used in the inner spaces and likely to be in contact with the atmosphere, such as coating, adhesives and lubricants are to be selected in order not to give off toxic, irritant or disagreeable gases or which may become so after passing through the regeneration system.

## SECTION 3

## LIFE SUPPORT SYSTEM

### 1 General

#### 1.1 Application

**1.1.1** The present Section provides requirements for the design and construction of the life support system intended for diving systems.

**1.1.2** The life support system includes the following functions and installations:

- breathing gas storage, mixture and distribution
- oxygen installations
- breathing gas analysis
- breathing gas regeneration
- pressure control
- temperature and humidity control
- fresh water installations
- sewage installations
- umbilicals from surface to diving bell
- gas cylinders
- piping, valves and fittings
- filters and compressors.

**1.1.3** Inspection and testing requirements are provided in:

- Ch 4, Sec 1 for initial inspection and testing
- Ch 4, Sec 2 for in-service surveys

#### 1.2 Applicable rules

**1.2.1** When relevant, the machinery and piping systems are to comply with the requirements of the Ship Rules Part C, Chapter 1 in addition to the present Section.

#### 1.3 Control stations

**1.3.1** The requirements for the control stations are given in Sec 4.

## 2 Breathing gas supply

### 2.1 General

**2.1.1** *Each deck decompression chamber and diving bell should be fitted with adequate equipment for supplying and maintaining the appropriate breathing mixtures to its occupants at all depths down to maximum operating depth. When adding pure oxygen to the chamber, a separate piping system should be provided.*

**2.1.2** *Piping systems containing gases with more than 25% oxygen should be treated as systems containing pure oxygen.*

Such piping systems are to comply with Article [12] in addition to the present Article.

### 2.2 Sources

**2.2.1** Any diving bell or deck chamber is to be supplied with two independent sources of breathing gas.

**2.2.2** When automatic, the commutation from one gas source to the other is to trigger an alarm.

**2.2.3** Minimum rate of gas supply is to be ensured in order to compensate for any leak.

### 2.3 Ventilation

**2.3.1** On PVHO designed for operation in a continuous ventilation mode, means of indicating the rate of flow of ventilation gas are to be provided.

### 2.4 Gas distribution

**2.4.1** The distribution is to be so arranged as to allow isolation of any filter, regulator and valve without interrupting gas supply.

### 2.5 Gas exhaust

#### 2.5.1 Inlet end inside the chambers

*Exhaust lines should be fitted with an anti-suction device on the inlet side.*

Anti-suction devices in deck chambers are to comply with requirements defined in Sec 2, [3.3]

#### 2.5.2 Outlet end

*Gases vented from the diving system should be vented to the open air away from sources of ignition, personnel or any area where the presence of those gases could be hazardous.*

### 2.6 Protection against overpressure

**2.6.1** *Piping systems which may be subjected to a higher pressure than designed for should be fitted with a pressure relief device.*

**2.6.2** The flow rates of the safety valves or the discharge valves fitted to pumps and compressors are to be determined so that the pressures in these units are not exceeding by more than 10% the design pressure when operating with the discharge shut.

**2.6.3** Every breathing gas piping system is to be provided with means for manually reducing the pressure.

## 2.7 Colour code

**2.7.1** For piping systems and gas storage bottles/pressure vessels, the colour codes defined in Tab 1 are to be used.

*In addition, each bottle/pressure vessel is to be marked with the name and symbol of the gases it contains. The marking and colour coding of the gas storage bottles is to be visible from the valve end.*

**Table 1 : Colour code - IMO Code of Safety for diving systems**

Name	Symbol	Colour code
Oxygen	O <sub>2</sub>	white
Nitrogen	N <sub>2</sub>	black
Air	Air	white and black
Carbon dioxide	CO <sub>2</sub>	grey
Helium	He	brown
Oxygen-helium mix gas	O <sub>2</sub> -He	white and brown

## 2.8 Gas mixing equipment

**2.8.1** Efficient ventilation of the breathing mixture is to be provided for in order to obtain a proper homogeneity of the breathable mixture.

**2.8.2** The oxygen content at the gas mixing equipment location is to be measured in compliance with [5.3].

**2.8.3** In case of oxygen content failing to comply with the tolerances set, the gas supply is to be switched to a secondary source.

This should be documented in the FMEA of the diving system.

## 3 Breathing gas storage

### 3.1 Minimum capacity

**3.1.1** The quantities of breathing gas and pure oxygen to carry on-board is to be assessed for each diving campaign and justified by a risk analysis.

Note 1: Minimum requirements are provided by IMCA D050 - Minimum quantities of gas required offshore.

**3.1.2** As a minimum, the gas storage capacity should be sufficient to pressurize twice all the deck chambers and the HRU to the maximum rated pressure.

## 3.2 Location

**3.2.1** Breathing gas storage and associated equipment should not be located in a machinery space not associated with the diving system.

**3.2.2** If the breathing gas is located in an enclosed space, the requirements of NR609 Sec 7 are to be complied with.

## 3.3 Pressure relief valves

**3.3.1** Pressure vessels and gas cylinders are to be fitted with relief valves and shut-off valves.

**3.3.2** Any relief valves or bursting discs should be piped to dump overboard and not in to the enclosed space.

## 4 Pressure control

### 4.1 General

**4.1.1** Inside each hyperbaric enclosure, pressure is to be measured by means of at least two independent devices.

**4.1.2** Pressure control equipment are to comply with [15].

## 5 Breathing gas analysis

### 5.1 General

**5.1.1** The composition, pressure and temperature of the breathing mixture, especially where dangerous gases are likely to be emitted, are to be subject of the utmost attention.

**5.1.2** Suitable devices are to be provided to analyze the following content in the breathing gas:

- oxygen content
- carbon dioxide content
- content of each dangerous gas likely to occur (eg: carbon monoxide)
- An appropriate sensor, in the diving bells which contain batteries, and in working enclosures where explosive mixtures (hydrogen and hydrocarbons) are likely to originate.

**5.1.3** The following oxygen analyzers are to be provided:

- 1 analyzer in the diving bell
- 2 analyzers in each compartment of the deck decompression chamber
- 1 analyzer on each gas distribution panel
- 1 analyzer in the gas supply panel
- 1 analyzer directly at the output of the gas reclaim system.

### 5.2 Control of pollutants

**5.2.1** The pollution content in the breathing gas is to be in accordance with EN 12021.

## 5.3 Oxygen analyzers

### 5.3.1 Standards and regulations

Oxygen analyzers are to comply with:

- EU directive on marine equipment
- EN 50104 Design and performance
- IEC 60079 Inspections in service.

### 5.3.2 Calibration

In case of long missions (exceeding 24 hours), a calibration system of the checking devices by means of known and stable mixtures or a device of equivalent reliability is to be provided.

### 5.3.3 Accuracy

The oxygen analyzer for the oxygen partial pressure (PPO<sub>2</sub>) is to have an accuracy of +/- 0.015 bar of partial pressure (PPO<sub>2</sub>) of O<sub>2</sub> or +/- 1% in concentration of O<sub>2</sub> at atmospheric pressure.

## 5.4 Carbon dioxide analyzers

**5.4.1** The analyzer for the carbon dioxide partial pressure (PPCO<sub>2</sub>) is to have an accuracy of +/- 0.001 bar of CO<sub>2</sub> partial pressure.

**5.4.2** Carbon dioxide gas is to be provided for calibration purpose.

## 6 Breathing apparatus

### 6.1 General

**6.1.1** *In addition to the main breathing gas system, each deck decompression chamber and diving bell should contain a separately controlled built-in breathing system (BIBS) for oxygen, therapeutic gas or bottom mix gas.*

*Means are to be provided to prevent any dangerous accumulation of gases.*

**6.1.2** BIBS are to be overboard dump type with exhausts piped outside the PVHO.

## 7 Breathing gas regeneration

### 7.1 Carbon dioxide removal

**7.1.1** Closed diving bell and each compartment of the deck chambers are to be provided with carbon dioxide (CO<sub>2</sub>) removal systems.

**7.1.2** CO<sub>2</sub> removal systems are to be redundant for each separately pressurized PVHO.

**7.1.3** Carbon dioxide scrubbers are to have the capacity to maintain acceptable level of CO<sub>2</sub> partial pressure considering the maximum number of occupant in the deck chamber or diving bell.

## 8 Breathing gas reclaim system

### 8.1 General

**8.1.1** Gas reclaim systems are to be designed to reduce the content of bacteria and contaminants in the reclaimed gas to the maximum allowable.

### 8.2 Gas bag

**8.2.1** When used, gas bag are to be fitted with an overpressure protection device.

## 9 Sanitary installations

### 9.1 General

**9.1.1** Sanitary installations are to be provided in deck decompression chambers intended to be occupied for more than 12 hours.

When the DDC is intended to be occupied for less than 24 hours, the following is to be provided:

- hand washing facilities
- provisions for handling sanitary waste.

When the DDC is intended to be occupied for more than 24 hours, the following is to be provided:

- flushing toilet
- shower
- hand-washing sink
- external holding tank.

### 9.2 Fresh water

**9.2.1** The fresh water system includes the means for pressurizing and heating the fresh water to be delivered to the deck chamber.

**9.2.2** The potable water unit is to comply with the Ship rules.

### 9.3 Toilet, shower and hand-washing installations

**9.3.1** The sanitary and sewage installations are to comply with ASME PVHO-1 or an equivalent standard.

**9.3.2** The toilet arrangement is to prevent from flushing meanwhile somebody is sitting on the toilet.



## 10 Temperature and humidity control

### 10.1 General

**10.1.1** *The diving system should include adequate plant and equipment to maintain the divers in safe thermal balance during normal operations.*

**10.1.2** The heating and cooling systems are to comply with the Ship rules.

**10.1.3** For saturation diving systems, the heating and cooling systems are to be 100% redundant in case of power failure.

### 10.2 Deck decompression chambers

**10.2.1** There must be suitable means to provide heating/cooling and humidity control inside each deck chamber.

**10.2.2** External heating coils are to be fitted with 2 temperature indicators.

**10.2.3** Means for controlling the humidity content is to be provided in the deck chambers.

### 10.3 Divers and diving bell

**10.3.1** For saturation diving, means for heating the breathing gas of the divers are to be provided.

**10.3.2** Means for reading the heating medium temperature and its flow rate are to be provided inside the diving bell.

**10.3.3** The diver heating system is to include a low and high temperature level alarm at the diving control station.

## 11 Piping

### 11.1 General

**11.1.1** Piping arrangement and materials used for breathing gas is to comply with Class I requirements of the Ship rules.

#### 11.1.2 Protection against mechanical damage

*All high-pressure piping is to be protected against mechanical damage.*

Note 1: Generally piping is considered under high pressure between cylinders or compressors and pressure reducing devices.

#### 11.1.3 Segregation

Piping carrying breathing gas is to be kept away from electrical cables.

### 11.2 Piping material

**11.2.1** The materials of the piping system is to comply with the relevant provisions of the NR216 Rules on Materials and Welding for the Classification of Marine Units.

**11.2.2** Ordinary cast iron is not permitted. Spheroidal graphite cast iron with a ferritic structure may be used where the design temperature does not exceed 300°C.

**11.2.3** As a rule, ordinary bronze is not permitted for accessories where the design pressure exceeds 15 bars.

**11.2.4** Copper and copper alloy pipes are to be of a type without longitudinal seam.

### 11.3 Welding

**11.3.1** Welding material and welders qualification are to comply with the relevant requirements of the Ship rules.

### 11.4 Flexible hoses

**11.4.1** Flexible hoses are to be designed and constructed in accordance with a recognized standard (see Ch 1, Sec 1, [6.5]).

**11.4.2** *Flexible hoses, except for umbilicals, should be reduced to a minimum.*

**11.4.3** Flexible hoses are to be kept as short as practically possible.

In general, flexible hoses and expansion joints are to be limited to a length necessary to provide for relative movement between fixed and flexibly mounted items of machinery/equipment or systems.

**11.4.4** Description and drawings of the flexible hoses are to be submitted to the Society. They are mainly to show:

- the design temperature
- the chemical and mechanical properties of the material used
- the type of connectors and the nature of their constituting materials
- the way these connectors are connected to the flexible hoses or sleeves.

The location of the flexible hoses is to be clearly shown on the drawings submitted.

**11.4.5** Flexible hoses and associated couplings are to be selected with a minimum burst pressure the greatest of:

- $P_B = 4 \times DP + 5$
- $P_B = 20$ .

Where:

$P_B$  : Minimum burst pressure, in bar

$DP$  : Design Pressure, in bar

**11.4.6** As a rule, flexible hoses intended to carry breathing gas at a pressure greater than 10 bar, as well as those carrying oil, are to be metal braided.

In addition to its mechanical strength, the function of the metal braid is to conduct heat in case of fire.

The metal braid is to be made of stainless steel.

Note 1: ANSI 316 L or equivalent.

**11.4.7** The radius of curvature of the flexible hose is not to be less than the minimum recommended by the manufacturer.

**11.4.8** Shut-off devices are to be provided to allow isolating the flexible hose.

**11.4.9** Provisions are to be taken in such a way that flexible hoses may not accidentally un-tie and whip in case of rupture.

**11.4.10** All flexible hoses other than charging whips are to be appropriately supported and secured at intervals not exceeding 2.0 m.

**11.4.11** When carrying oxygen, flexible hoses are to comply with the relevant provisions of Article [12]

## 12 Oxygen installations

### 12.1 General

**12.1.1** A recognized standard is to be applied for the design of the oxygen installation and submitted to the Society for approval.

Note 1: Such as ASTM G88 or CGA G4.4

**12.1.2** *Special attention should be paid to the design and choice of material for the construction of pressure vessels containing oxygen.*

**12.1.3** Breathing gas mixtures containing more than 25% of oxygen are to be considered like pure oxygen for installation purpose.

### 12.2 Oxygen supply

**12.2.1** *Any material used in a plant which is intended to carry oxygen is to be compatible with oxygen at working pressure and flow rate.*

**12.2.2** Piping carrying pure oxygen or mixtures containing more than 25% in volume of oxygen are to be fitted with copper fire-arrestors. In addition, accessories made of ferrous materials are not allowed in this case.

**12.2.3** *The use of high-pressure oxygen piping is to be minimized by the fitting of pressure reducing devices, as close as practicable to the storage cylinders.*

**12.2.4** Valves carrying oxygen must not be quarter turn.

**12.2.5** *Oxygen systems with pressure greater than 1.72 bar must have slow-opening shutoff valves except pressure boundary shutoff valves.*

**12.2.6** Hoses for oxygen are to be of fire-retardant construction and type approved.

**12.2.7** The partial pressure of oxygen is to be maintained within physiologically acceptable limits taking into account the duration of the mission

## 12.3 Oxygen storage

**12.3.1** *Oxygen and gases with an oxygen volume percentage higher than 25 per cent should be stored in bottles or pressure vessels exclusively intended for such gases.*

**12.3.2** *Oxygen bottles should be installed in a well-ventilated location.*

**12.3.3** *Oxygen bottles are not to be stored near flammable substances.*

**12.3.4** As far as practicable, oxygen should be stored on an open deck or in enclosed space specially intended for that purpose.

**12.3.5** A visual and audible high-low oxygen alarm is to be fitted when oxygen is stored in an enclosed space.

**12.3.6** The pressure of oxygen or mixes containing over 25% oxygen should be regulated down at the quad or cylinder to a maximum of 40 bar for breathing gas or 60 bar for supplies to gas blenders

## 12.4 Cleaning

**12.4.1** Any materials used in a plant which is intended to carry oxygen is to be cleaned of hydrocarbons and debris to avoid explosions. Formal cleaning procedures for such equipment are to be developed and implemented.

**12.4.2** Reference is to be made to ASTM G93 - Oxygen cleaning method - or an equivalent standard.

**12.4.3** All valves and pipe work must be cleaned for oxygen service when used for gas mixes containing more than 25% oxygen. This may be demonstrated by means of a suitable procedure to ensure cleanliness which is applied when any components are new or after there has been any significant alteration.

## 13 Gas cylinders

### 13.1 Design and construction

**13.1.1** The gas cylinders are to be designed, constructed and tested in accordance with:

- EN 1964, for gas cylinders of water capacities from 0,5 l up to and including 150 l
- EN ISO 11120, for gas cylinders of water capacities from 150 l up to and including 3000 l.

**13.1.2** Cylinders and quads must be colour coded and marked with the name and chemical symbol of the contents, in accordance with [2.7].

**13.1.3** Gas cylinders intended for oxygen storage are to comply with [12].

### 13.2 Thickness increment

**13.2.1** Thickness increment of the cylinder shell of typically 1 mm is to be considered for wastage allowance.

### 13.3 Gas storage installations

**13.3.1** Individual cylinders or multiple cylinders grouped together by means of a manifold, are to be provided with:

- an isolation valve rated for the maximum allowable working pressure of the cylinder
- a protective device to relieve excess pressure
- means for eliminating moisture when used for gas reclaim purpose.

## 14 Compressors

### 14.1 General

**14.1.1** Compressors are to comply with Ship Rules Part C chapter 1.

**14.1.2** Diaphragm type compressors are to be fitted with a cracked plate detector which will automatically stop the compressor in the event of failure.

**14.1.3** Any compressor or pump intended for pumping oxygen or any gas mixture containing more than 25% oxygen must be designed for that purpose

**14.1.4** Any compressor used for gas transfer, and not intended for use with gases containing over 25% oxygen, should be fitted with a protective device which will shut the compressor down if the oxygen percentage entering the compressor exceeds 25%.

**14.1.5** Safety relief valves are to exhaust to a safe location.

Note 1: For pure air compression, safety valves may exhaust locally.

### 14.2 Pollutant content

**14.2.1** The breathing gas delivered from compressors has to meet the requirements of EN 12021 Respiratory protective devices - Compressed air for breathing apparatus, or an equivalent standard.

### 14.3 Air intake

**14.3.1** The intakes of all air compressors must be sited in an area where they are not exposed to any pollution – particularly exhaust fumes.

## 15 Regulator, gauges and valves

### 15.1 Pressure gauges

**15.1.1** Pressure gauges are to comply with a recognized standard.

**15.1.2** The accuracy of the measurement is to be related to the diving method.

### 15.2 Pressure regulators

**15.2.1** Pressure regulators used on breathing gas systems are to meet the standard EN 738 - Pressure regulators for use with medical gases.

### 15.3 Valves

**15.3.1** Valves used on the breathing gas system are to comply with a recognized standard.

## 16 Umbilicals

### 16.1 General

**16.1.1** As a rule, umbilicals are to be designed and constructed in accordance with a recognized standard (see Ch 1, Sec 1, [6.5]).

**16.1.2** The following information are to be submitted to the Society:

- applied technical standard
- mechanical properties including minimum breaking strength
- design load envelope: maximum tension, bending etc.
- minimum Bending Radius (MBR) with respect to applied tensile load
- design life
- arrangement and diameter of sheaves and winch drum.

**16.1.3** Flexible hoses used in umbilicals are to comply with the provisions of [11.4].

**16.1.4** Electrical cables used in umbilicals are to comply with the provisions of Sec 4.

**16.1.5** Hoses and electrical cables used in umbilicals are not to have any intermediate connection.

**16.1.6** Sheathing is to be such that internal overpressure arising from the leakage of a hose be prevented from being built-up.

## **16.2 Main bell umbilical**

**16.2.1** The main bell umbilical ensures the connection between the diving bell and the surface.

**16.2.2** The diving bell umbilical may include means for the transfer of:

- breathing gas
- hot water
- communication, video and controls
- electrical power
- hydraulic oil.

### **16.2.3 Marking**

When the main bell umbilical is paid out manually, it is to be marked at regular intervals in order for the operator to know exactly the amount paid out at any time during the diving operation.

## **16.3 Diver's umbilical**

**16.3.1** The diver's umbilical ensures the connection between the diving bell and the diver.

## SECTION 4

# ELECTRICAL INSTALLATIONS, CONTROL AND COMMUNICATION SYSTEMS

### 1 General

#### 1.1 Application

**1.1.1** The present Section provides requirements for the design and construction of electrical installations and control systems, in addition to the requirements defined in the Ship rules Part C Chapter 2 and 3.

### 2 General design requirements

#### 2.1 Environment

**2.1.1** *All electrical equipment and installations, including power supply arrangements, should be designed for the environment in which they will operate to minimize the risk of fire, explosion, electrical shock and emission of toxic gases to personnel, and galvanic corrosion of the deck decompression chamber or diving bell.*

#### 2.2 Electricity under water and inside hyperbaric chambers

**2.2.1** Reference is made to IMCA D045 Code of practice of the safe use of electricity under water, as amended.

**2.2.2** The use of electricity inside hyperbaric chambers is to be kept to a minimum. Equipment used is to be of adequate design and construction against hyperbaric and oxygen enriched environment.

**2.2.3** Electrical receptacles installed inside the deck chambers are to be waterproof.

#### 2.3 Maximum voltages

##### 2.3.1 Inside the deck chamber

Inside the deck chambers, the voltage should not exceed:

- 30 V D.C for plugs, portable equipment and communication, monitoring and remote control systems and lighting
- 250 V A.C for power system

A.C Systems with voltage between 7.5 V and 250 V are to be protected against accidental touching and fitted with suitable earth leakage protection.

Higher voltage may be allowed provided that effective protection is fitted and subject to agreement from the Society.

##### 2.3.2 Inside the bell

Inside the bell, the voltage should not exceed 30 V D.C.

#### 2.4 Lighting

**2.4.1** Main and emergency lighting is to be provided in spaces containing diving equipment.

**2.4.2** *Each deck decompression chamber and diving bell should have adequate means of normal and emergency lighting to allow an occupant to read gauges and operate the system within each compartment.*

**2.4.3** Lighting equipment installed inside PVHO are to be rated at a pressure equal to 1.5 times the MAWP.

#### 2.5 Electric motors

##### 2.5.1 Inside hyperbaric enclosures

Electrical motors inside the deck chambers or diving bell are to be suitable for the intended use as required in [2.2].

### 3 Power source

#### 3.1 General

**3.1.1** The electrical installations are to be supplied from two independent sources of electrical power, a main and an emergency source of power.

#### 3.2 Emergency source of power

**3.2.1** *In the event of failure of the main source of electrical power supply to the diving system, an independent source of electrical power is to be available for the safe termination of the diving operation. It is admissible to use the unit's emergency source of electrical power as an emergency source of electrical power if it has sufficient electrical power capacity to supply the diving system and the emergency load for the vessel at the same time.*

**3.2.2** *The emergency source of electrical power is to be located outside the machinery casings to ensure its functioning in the event of fire or other casualty causing failure to the main electrical installation.*

**3.2.3** As a minimum, the emergency source of power is to be of sufficient capacity to supply the following emergency services:

- the breathing gas supply, analysis and regeneration systems
- the emergency communication system
- the emergency lighting in the deck decompression chambers, the diving bell and the control stations
- the launch and recovery system of the diving bell
- the handling system required for emergency launching of the HRU
- any emergency system necessary for life support.

**3.2.4** The emergency source of power is to be capable of supplying the emergency services specified in [3.2.3] for a minimum period in accordance with the intended procedure to decompress or evacuate the divers in a safe manner, and as defined in the operating manual.

Note 1: When a minimum period is required by the National Authorities' regulations, it shall prevail.

**3.2.5** The emergency source of electrical power is to be self-contained and independent of the main electrical installation and may be either a generator or an accumulator battery.

**3.2.6** The following emergency services are to remain available during switching from main to emergency source of power:

- emergency lighting
- diving alarm systems
- life support alarm systems
- emergency communication systems.

**3.2.7** Where the emergency source of electrical is a generator, it is to be started automatically upon failure of the main source of electrical power in order to supply the required emergency loads in less than 45 s.

**3.2.8** A transitional source of emergency electrical power is to be provided, so arranged as to supply automatically and for half an hour the services referred to in [3.2.6] or for which a permanent or temporary degradation may occur during the switchover period.

**3.2.9** When an accumulator battery is used as the emergency source of power or as a transitional source of power, it shall operate without recharging while maintaining the voltage of the battery throughout the discharge period within 12% above or below its nominal tension.

**3.2.10** When switching from the main source of power to the emergency source of power, an audible and visible alarm is to be actuated in the diving and life support control stations, with the indication of the source of power connected.

### 3.3 Accumulator batteries

#### 3.3.1 General

Storage batteries are not to be located inside the diving bells nor the deck decompression chambers.

#### 3.3.2 Indicators and alarms

Any battery devoted to supply essential services is to be fitted with an indicator of the status of charging and a low level alarm.

#### 3.3.3 Pressure housing

When batteries are used within an hyperbaric enclosure, reference is made to IMCA D002 Battery packs in pressure housings, as amended.

In particular, the following is to be observed when using batteries in pressure housing:

- battery terminals/leads must be adequately insulated to protect against short circuit
- periodic examination, testing and renewal of the cells as necessary should be included within the planned maintenance system
- as a general rule shunt diodes should be provided across each cell of a primary battery to avoid the possibility of polarity-reversal occurring in any cell under discharge conditions
- the battery housing must be fitted with an appropriate pressure relief device
- the battery casing should not be opened in a confined space and should be fully vented
- lead acid batteries should not be used in a hyperbaric environment.

## 4 Distribution system

### 4.1 General

**4.1.1** The distribution system is to be of an insulated neutral type (IT).

**4.1.2** The structure or hull return distribution system is not permitted.

**4.1.3** The distribution system is to be such that the failure of a single circuit will not endanger or render any other circuit inoperative for longer periods.

**4.1.4** When the system is supplied through a distribution board, at least two sections of this board are to be supplied by two independent electrical power circuits.

## 4.2 Insulation monitoring

**4.2.1** Every insulated distribution system for power, heating or lighting, shall be provided with a device capable of continuously monitoring the insulation level to earth (i.e. the values of electrical insulation to earth) and of giving an audible and visual indication of abnormally low insulation values.

## 4.3 Circuit protection

**4.3.1** Circuit breakers and fuses are to be provided on all conductors in order to protect the circuit against overload and short-circuit.

**4.3.2** Fuses and circuit breakers are not to be fitted within the bell or the deck decompression chambers.

## 4.4 Earthing

**4.4.1** Deck chambers and bells are to be provided with earthing connection.

## 4.5 Distribution panel

**4.5.1** Distribution panels are to comply with the requirements of the Ship Rules Part C Chapters 2 and 3.

**4.5.2** The distribution panel is to be readily accessible from the control stations.

**4.5.3** It is to be possible to disconnect each deck decompression chamber separately.

## 4.6 Electrical penetrators for pressure vessels

**4.6.1** Electrical penetrators on the boundary of the pressure vessels are to be specially designed and manufactured for that purpose and approved by the Society.

**4.6.2** Electrical penetrators in pressure vessels are to remain gas tight and watertight under the design pressure of the vessel, even if the electrical cable passing through the penetrator is damaged.

**4.6.3** Electrical penetrators are to be tested under pressure as specified in Ch 4, Sec 1.

## 4.7 Electrical cables

**4.7.1** Electrical cables and wiring are to comply with Ship rules Part C, Chapter 2, Sec 3 [9].

**4.7.2** Electrical cables are to be separated from piping installations carrying breathing gas.

## 5 Diving control station

### 5.1 General

**5.1.1** The control station of the diving bell is to provide the diving supervisor with all information, controls, monitoring systems and means of communication needed for the command of the diving operation and the diving bell.

**5.1.2** As a minimum, the control station is to include the items listed in:

- [5.2] [5.4] for saturation and bounce diving systems
- [5.5] for surface diving systems.

**5.1.3** The control panel is to be provided with the diagram of the gas flow lines.

### 5.2 Information displayed

**5.2.1** The information on the control panel is to include:

- internal pressure of the bell
- depth of immersion of the bell: by measurement of the external pressure and by measurement of the paid-out suspension rope length
- indications on the proper paying-out of the umbilical (information on the length paid-out, view on the pay-out device, information from the bell etc.)
- depth of immersion of each divers working outside the bell
- pressure of the gases supplied at the diving bell
- pressure before and after all pressure reducers on the gas flow lines
- pressure in the storage gas cylinders
- results of the breathing gas analysis defined in Sec 3:
  - partial pressure of oxygen served out in umbilical
  - partial pressure of oxygen in the bell
  - partial pressure of carbon dioxide
  - partial pressure of helium (in case of 3 gases mix)
  - content of pollutants if any.
- controls parameters of heating means:
  - temperature of the hot water being supplied to the divers
  - flow rate.
- alarms including:
  - low and high level alarm for the oxygen partial pressure of the breathing gas supplied to the divers
  - alarm when main source of power is failing
  - alarm for electrical insulation fault with an indication of the concerned circuit
  - alarm for the failure of the station keeping system
- indication of the source of electrical power connected
- information regarding tools (hydraulic plant, cutting, high pressure cleaning etc.)
- communication
- video watching of the diving bell
- clock.

**5.2.2** Provisions should be made within the bell for an independent means of monitoring oxygen and carbon dioxide levels.

## 5.3 Monitoring

**5.3.1** A monitoring system is to be provided to continuously record the oxygen and carbon dioxide content in the bell.

## 5.4 Controls

**5.4.1** The diving control station is to include the following direct and remote controls:

- electrical controls of the bell (lighting, video, communication, gas reclaim systems, etc)
- controls of the supply of the umbilical: breathing gas for each diver, hot water, etc.)
- control of the sources of energy for the tools.

**5.4.2** When emergency source of power is to be manually actuated, the manual switch is to be provided in the control station.

**5.4.3** The bell diving supervisor should have control of the bell blow-down at all times.

## 5.5 Surface diving

**5.5.1** For surface diving, the diving control station where the diving supervisor operates is to gather:

- the information needed for the control of the dive:
  - communication and video
  - measurement of the immersion of the wet bell/diving basket
  - Pressure of the breathing gas storage
  - partial pressure of oxygen (for surface mixed gas diving)
  - clock.
- controls actuating:
  - main and emergency supply
  - pure oxygen supply (if needed).
- The input pressure of the umbilical of the wet bell/diver basket if the umbilical is independent from the supply of the divers.

## 5.6 Indicators and analyzers

**5.6.1** Indicators and analyzers are to comply with Sec 3.

**5.6.2** Oxygen analyzers are to be provided in control stations.

# 6 Life support control station

## 6.1 General

**6.1.1** The control station of the deck decompression chambers is to provide the operator with all information, controls and means of communication needed for the command of the life support operations.

**6.1.2** As a minimum, the control station is to include the items listed in [6.2] to [6.5].

**6.1.3** The control panel is to be provided with the diagram of the gas flow lines.

## 6.2 Information displayed

**6.2.1** The information on the control panel is to include:

- pressure in each compartment of the deck chambers including the trunks
- pressure inside the diving bell
- pressure of supply of the breathing gases into the deck chambers
- pressure of the storage gas cylinders
- pressure before and after all pressure reducers on the gas flow lines
- results of the breathing gas analysis defined in Sec 3:
  - partial pressure of oxygen in each compartment
  - partial pressure of carbon dioxide in each compartment
  - partial pressure of oxygen served out at Built-in Breathing Apparatus (BIBS)
  - content of pollutants if any.
- alarms including:
  - low and high level alarm for the oxygen partial pressure
  - alarm when main source of power is failing
  - alarm for electrical insulation fault with an indication of the concerned circuit
  - alarm for the failure of the station keeping system.
- indication of the source of electrical power connected
- temperature and humidity content in each compartment of the deck chambers
- video watching of each compartment of the deck chambers.

## 6.3 Monitoring

**6.3.1** A monitoring system is to be provided to continuously record the oxygen, the carbon dioxide content and the helium content if a 3 gases mix is used.

## 6.4 Controls

**6.4.1** The life support control station is to include the following controls:

- compression and decompression of each compartment
- command of valves for each gas supply
- gas supply for the Built-in Breathing Apparatus (BIBS)



- switching on and off the electrical equipment of the chamber:
  - lighting, video, communication
  - regeneration
  - addition of oxygen
  - electrical sensor (pressure, ppO<sub>2</sub>...).
- switching on and off the electrical power (1 general electrical switch for each chamber)
- actuation of the fixed fire-fighting system in the deck chambers
- selection of the gas bank
- amount of oxygen supply for each compartment
- manual switching from main to emergency electrical power, when applicable
- control of the opening of the transfer from the bell to the deck chambers.

## 6.5 Indicators and analyzers

**6.5.1** Indicators and analyzers are to comply with Sec 3.

**6.5.2** Oxygen analyzers are to be provided in control stations.

## 7 Communication

### 7.1 General

**7.1.1** Communication means described in the present Article are to be provided in control stations, diving bell and DDC.

**7.1.2** *Alternative means of communication with divers in the deck decompression chamber and diving bell should be available in case of emergency.*

**7.1.3** *Each deck decompression chamber and diving bell should be connected to a speech unscrambler when used with gas systems, including helium.*

### 7.2 Diving control station

**7.2.1** The communication system should be arranged for direct 2-way communication between the diving control station and:

- the life support control station
- the divers in water
- the divers in the diving bell
- each compartment of the deck chambers
- the LARS operator

- the dynamic positioning control station
- the ship command centre
- the hyperbaric evacuation system launch point
- inside the hyperbaric rescue unit (inside and outside the PVHO)
- any other person involved in works being performed underwater: subsea crane operator, ROV operator etc.

**7.2.2** *The diving control station is also to include communication with the bell and divers through an ultra-sonic system in damaged condition.*

### 7.3 Life support control station

**7.3.1** The life support control station is to include the following means of communication with:

- each compartment of the deck chambers, including interphone with unscrambler, when relevant
- the diving control station
- the ship command centre
- the launching station of the hyperbaric rescue unit
- inside the hyperbaric rescue unit (inside and outside the PVHO).

**7.3.2** There must be two-way communications between the divers inside each compartment of the chamber.

**7.3.3** A secondary (back up) communication system (such as a sound powered phone) should exist between the divers inside each compartment of the chamber and those outside at the life support control station.

### 7.4 Diving bell

**7.4.1** *A self-contained through-water communication system should be provided for emergency communication with diving bells when operating under water.*

### 7.5 Visual control

#### 7.5.1 Diving bell

For deep diving systems, means for visual control of the divers in the diving bell from the diving control stand are to be provided.

#### 7.5.2 Deck chamber

All compartments of the deck chambers are to be provided with means for visual control.

## SECTION 5

## FIRE PROTECTION, DETECTION, EXTINCTION

### 1 General

#### 1.1 Application

**1.1.1** The present Section provides design and construction requirements regarding the fire protection, detection and extinction applicable to diving systems.

**1.1.2** Requirements for fire protection, detection and fire-fighting of spaces containing the diving system are specified in NR609 Rules for the classification of diving support units.

### 2 Fire protection

#### 2.1 Materials inside the hyperbaric chambers

**2.1.1** *All materials and equipment used in connection with the diving system should be, as far as is reasonably practicable, of fire-retardant type in order to minimize the risk of fire and sources of ignition.*

**2.1.2** All materials used in the diving system and especially in the inner area of the hyperbaric chambers, are to be selected so as to offer a minimum risk of combustion and a flame propagation velocity as slow as possible, particularly the wall coating, taking into account high partial pressure of oxygen.

**2.1.3** Where selecting materials, particularly plastics, the toxicity and the quantity of noxious gases likely to escape during combustion of the chosen materials is to be taken into account.

**2.1.4** Requirements regarding materials for oxygen installations are given in Sec 3.

**2.1.5** Lubricants are to be approved for use in over-oxygenated environment.

**2.1.6** The choice of materials is to be justified and submitted to the Society for approval; the Society reserves the right to call for tests.

#### 2.2 Electrical equipment

**2.2.1** Requirements regarding the electrical equipment are given in Sec 4.

**2.2.2** Electrical equipment are to be selected so as to prevent static electricity to build up and the risk of spark.

### 3 Fire detection

#### 3.1 Outer area

**3.1.1** In outer spaces where no regular human supervision is ensured, a fire detection system allowing to signalize automatically any incipient fire and its location is to be provided for.

#### 3.2 Inner area

**3.2.1** In each compartment of the deck chambers, a fire detection and alarm system is to be provided.

**3.2.2** The alarm is to be audio and visual both locally and at the life support control station.

### 4 Fire-fighting

#### 4.1 General

**4.1.1** *Each compartment in a deck decompression chamber should have suitable means of extinguishing a fire in the interior which would provide rapid and efficient distribution of the extinguishing agent to any part of the chamber.*

**4.1.2** The fire-fighting equipment is to be permanently available.

**4.1.3** The fire extinguishers provided for are to be suitable for operation at the pressure prevailing within the enclosure.

#### 4.2 Saturation diving system

**4.2.1** Each compartment of the deck chambers in a saturation diving system is to be provided with a fixed fire-extinguishing system.

**4.2.2** The fixed fire-fighting system is to be operable from both inside and outside of the deck chambers.

**4.2.3** The fire extinguishing agent is to be atomized water. The use of other product is to be submitted to the Society for approval.

**4.2.4** Reference is made to NFPA 99 - Health care facilities code - for the fire-fighting system inside hyperbaric chambers. Other standard may be accepted subject to approval of the Society.

**4.2.5** In addition to the fixed fire-fighting system, portable fire extinguishers are to be provided.

### **4.3 Surface supplied diving system**

**4.3.1** Portable extinguishers may be sufficient in deck decompression chambers of surface supplied diving systems.

## **5 Control stations**

### **5.1 General**

**5.1.1** Fire safety installations to be provided in the control stations are specified in NR609 Diving support units.

**5.1.2** Emergency breathing apparatus are to be available at diving and life support control stations.



## **INSPECTION AND TESTING**

---

<b>SECTION 1</b>	<b>INITIAL INSPECTION AND TESTING</b>
<b>SECTION 2</b>	<b>IN-SERVICE SURVEY</b>
<b>APPENDIX 1</b>	<b>SURVEY AND TESTING CHECK-LIST</b>



# SECTION 1

# INITIAL INSPECTION AND TESTING

## 1 General

### 1.1 Application

**1.1.1** The present Section provides requirements for the initial inspection and testing of diving systems.

### 1.2 Rules reference

**1.2.1** Reference is made to the following documents for inspection and testing:

- IMCA D 004 - The initial and periodic examination, testing and certification of hyperbaric evacuation launch systems
- IMCA D 018 - Code of practice on the initial and periodic examination, testing and certification of diving plant and equipment
- IMCA D 023 - Diving Equipment Systems Inspection Guidance Note for Surface Oriented (Air) Diving Systems
- IMCA D024 - Diving Equipment Systems Inspection Guidance Note for Saturation (Bell) Diving Systems
- IMCA D037 - Diving Equipment Systems Inspection Guidance Note for Surface supplied Mixed Gas Diving Systems
- IMCA D040 - Diving Equipment Systems Inspection Guidance Note for Mobile / Portable Surface supplied Systems

**1.2.2** Other applicable standards may be accepted subject to Society approval.

## 2 Factory Acceptance Test

### 2.1 General

**2.1.1** The components and sub-systems of the diving plant for which the Factory Acceptance Tests (FAT) are to be conducted in the presence of the Society, are listed in Ch 1, Sec 2, Tab 2.

### 2.2 Electrical pressure vessel penetrators

**2.2.1** The penetrators are to be tested under design pressure. The testing protocol is to be submitted to the Society.  
Note 1: Testing protocol as per ASME PVHO is recommended.

### 2.3 Compressors

**2.3.1** Any part of the compressor under pressure is to be pressure tested in accordance with the Part C, Chapter 1 of the ship rules, unless otherwise specified.

**2.3.2** Functional test for delivery rate and pressure are to be performed.

### 2.3.3 Pollutant content

The outlet gas from the compressor is to be tested for pollution content according to EN 12021.

### 2.4 Gas cylinders

**2.4.1** Gas cylinders are to be tested in accordance with the standard applied for their design and construction.

### 2.5 Flexible hoses

**2.5.1** Flexible hoses are to be tested in accordance with the technical standard applied for their design and construction.

**2.5.2** The tests generally include:

- internal pressure strength test (proof test) at a minimum testing pressure equal to 1,5 times the design pressure
- bursting pressure test
- tensile test
- resistance to low and high temperature
- low temperature flexibility test
- ambient temperature flexibility test
- resistance to ozone
- resistance to external pressure
- chemical inertia
- dimensional tolerances.

When the applied standard requires an internal oil resistance test, this may be omitted when the flexible hoses carry only gas or water.

**2.5.3** In addition, flexible hoses intended to carry gas containing more than 25% of oxygen are to be shock tested in accordance with a recognized standard.

### 2.6 Umbilical

**2.6.1** Umbilicals are to be tested in accordance with the technical standard applied for their design and construction and the manufacturer's testing program.

**2.6.2** The Society may require to witness the manufacture of the umbilical.

**2.6.3** Flexible hoses are to be tested in accordance with the technical standard applied for their design and construction.

**2.6.4** The qualification tests generally include:

- bending test on a sample of umbilical, with the bending radius encountered in the normal service. No permanent strain is to be observed
- cycling load test on a sample of umbilical. To be conducted from zero to the design load. The number of cycle should be related to the category of the LARS. No permanent strain is to be observed
- tensile breaking test on a sample of umbilical.

**2.6.5** Flexible hoses used in umbilicals are to be tested in accordance with [2.5] before to be assembled in the umbilical.

**2.6.6** After assembly in the umbilical, the following tests are to be performed:

- Overpressure test at 1,5 times the maximum working pressure taking into account that:
  - All flexible hoses are to be pressure tested simultaneously
  - The electrical cables are to be checked for damage after testing.
- Leak test at the maximum working pressure

The internal cleanliness is to be verified as appropriate to the intended duty.

### 3 Commissioning program on-board

#### 3.1 General

**3.1.1** The initial testing of the complete diving system and of each sub-system are to be carried out in accordance with a commissioning and testing program agreed by the Society.

#### 3.2 List of examination and testing

**3.2.1** The commissioning is to include at the minimum:

- verification of the conformity of the installation with regard to the layout drawings and specification
- verification of the certificates of the diving system components and the marking plates
- verification of the cleanliness of the breathing gas piping in accordance with [7.5]
- verification of the marking of the breathing gas piping in accordance with the colour code in Ch 3, Sec 5
- verification of the oxygen gas storage area, piping, valves and alarms
- examination and testing of each sub-systems as specified in App 1 in the column "new built" and in Articles [6] to [16]
- final diving test as described in [3.4].

#### 3.3 Testing procedures

**3.3.1** The following testing procedures are to be submitted:

- a) PVHO pressure testing and gas leak testing (chamber complex, diving bell, HRU)
- b) Breathing gas system testing (piping, fittings and gas cylinders):
  - pressure testing
  - gas leak testing
  - purity and cleanliness testing
  - BIBS testing.

- c) Diving control panel and life support control panel testing:
  - gas distribution arrangement
  - pressure rate
  - pressure testing
  - leak testing
  - functional tests
  - gas analyzers
  - electrical, communication and video equipment.

d) Depth gauges calibration and testing

e) Sanitary system: toilets, sewage and fresh water

f) CO<sub>2</sub> removal testing (chambers and diving bell)

g) Environmental control unit (temperature and humidity)

h) gas reclaim system, if fitted

i) Gas transfer system

j) Chamber bilge drain system

k) Fire-fighting system

l) Diver heating system

m) Launch and recovery system

n) Diving bell

o) Diving test procedure as per [3.4].

#### 3.4 Diving test

**3.4.1** The final commissioning is to include a non-manned diving test with the diving bell/basket lowered to the rated depth.

**3.4.2** The bell/basket is to be weighted to its maximum rated weight.

**3.4.3** During the diving test, the bell is to be tested for:

- gas leakage
- function test of electrical and communication system
- function test of breathing gas supply.

### 4 Diving bell

#### 4.1 General

**4.1.1** The following inspection and tests are to be conducted on the diving bell/basket as a minimum:

- weighing in air and in water
- testing of the PVHO in accordance with [6]
- testing of the breathing gas system in accordance with [7]
- testing of the ballast release system in water, when relevant
- testing of the emergency systems
- testing of the location and communication systems
- testing of the diving bell heating system
- testing of the CO<sub>2</sub> removal system
- testing of the BIBS in accordance with [11].



## 5 Deck decompression chambers

### 5.1 General

**5.1.1** The following inspection and tests are to be conducted on the DDC, as a minimum:

- testing of the PVHO in accordance with [6]
- testing of the breathing gas system in accordance with [7]
- testing of the sanitary systems
- testing of the fire safety systems
- testing of the CO<sub>2</sub> removal system
- testing of the breathing gas reclaim system, if fitted
- testing of the environmental control unit in accordance with [8]
- testing of the instrumentation
- testing of the communication system
- testing of the BIBS in accordance with [11].

## 6 Pressure Vessel for Human Occupancy

### 6.1 General

**6.1.1** The inspection and testing of the PVHO is to include:

- pressure testing in accordance with [6.2]
- gas leak testing in accordance with [6.3]
- testing of the viewports in accordance with [6.4]
- testing of the doors, hatches and medical locks in accordance with [6.5]
- visual examination of the signs of corrosion on the shell of the PVHO and particularly the bottom part inside and outside
- visual examination of the shell penetrators
- visual examination of the supporting structure
- visual examination of the windows
- visual examination of the markings
- visual examination of the insulation, if any
- visual examination of the doors, hatches and their locking mechanisms
- visual examination of the medical lock
- visual examination of the associated piping and fittings
- visual examination of the valves and flow fuses
- visual examination of the connecting flanges between chambers
- visual examination of the bilge drain
- visual examination of the protectors on the outlet lines.

### 6.2 Pressure testing

**6.2.1** Hydraulic pressure test at 1,3 times the Maximum Allowable Working Pressure (MAWP) is to be conducted and witnessed by the Society.

### 6.3 Gas leak test

**6.3.1** Gas leak test are to be conducted at maximum working pressure for medical/equipment locks and all doors, hatches, valves, pipe work, fittings and penetrations on each compartment of the PVHO.

**6.3.2** The maximum allowable gas leak rate is 0.5% of the PVHO volume over a period of 12 hours, calculated at constant temperature.

Note 1: The pressure is to be corrected with the temperature change using the gas law:  $P_1/T_1 = P_2/T_2$ , where  $T_i$  is the absolute temperature in Kelvin and  $P_i$  is the pressure.

**6.3.3** Gas leak tests are to be conducted in accordance with an agreed procedure.

**6.3.4** All part of pressure vessel, door, window, piping, valve and fittings are to be sprayed with a snoopier leak detection liquid.

**6.3.5** When helium is intended to be used in the breathing gas, the gas leak test is to be conducted with a gas mixture containing 10% Helium as a minimum.

**6.3.6** The PVHO is to be pressurized for a minimum of 6 hours. The pressure and the temperature are to be noted on a record chart every hour or less.

### 6.4 Viewport

**6.4.1** Viewports are to be tested at a pressure equal to 1,25 times Maximum Allowable Working Pressure.

Note 1: Other testing in accordance with ASME PVHO standard may be accepted as an alternative.

### 6.5 Doors, hatches and medical locks

**6.5.1** The doors, hatches and locks are to be function tested under a pressure of less than 0,1 bar.

## 7 Breathing gas system

### 7.1 General

**7.1.1** Testing of piping systems carrying breathing gas is to comply with the Ship rules as applicable for piping Class 1.

### 7.2 Piping and pressure vessel

**7.2.1** An overpressure test at 1,5 times the design pressure is to be conducted on all piping systems carrying breathing gas.

**7.2.2** A gas leak test in accordance with [6.3] be conducted on all pressure vessels and piping carrying breathing gas.

### 7.3 Breathing gas distribution panel

**7.3.1** Each supply source of breathing gas is to be tested separately.

## 7.4 Pollutant contamination

**7.4.1** The breathing gas supply system is to be tested during commissioning on-board for pollutant content according to EN 12021.

**7.4.2** Breathing gas samples are to be taken at the gas cylinders, in relevant parts of the breathing gas piping, inside the chambers, at the BIBS supply line and at the gas reclaim unit.

## 7.5 Cleanliness

**7.5.1** The cleanliness of the breathing gas piping system is to comply with a recognized standard such as ASTM G93 - Oxygen cleaning method - or an equivalent standard.

## 8 Environmental control unit

### 8.1 General

**8.1.1** Testing of the ECU is to be conducted in accordance with an approved testing program.

### 8.2 Thermal test

**8.2.1** The accuracy of heating/chilling system in the DDC is to be tested. A maximum difference of +/- 1°C between the setting value and the measured value is allowed.

**8.2.2** The DDC and diving bell under testing are to be pressurized to the maximum allowable working pressure.

The simulation is to include metabolic heat production, injection of water vapor and of CO<sub>2</sub>.

**8.2.3** The 100% redundancy of the heating/chilling and humidity system is to be tested.

## 9 Carbon dioxide removal system

### 9.1 General

**9.1.1** The carbon dioxide scrubber systems of the DDC and the diving bell are to be tested for performance and endurance according to an agreed program.

**9.1.2** The carbon dioxide level in the DDC is to be maintained under a partial pressure of 0,005 bar taking into account a production rate of 0,05 kg per occupant per hour.

## 10 Breathing gas reclaim system

### 10.1 General

**10.1.1** The breathing gas reclaim system is to be tested for performance and endurance according to an agreed program.

**10.1.2** The alarms and pressure relief valve on the gas bag are to be tested.

## 11 Built-in Breathing System (BIBS)

### 11.1 General

**11.1.1** The BIBS in the DDC and diving bell are to be tested in accordance with an approved procedure.

## 12 Divers hot water unit

### 12.1 General

**12.1.1** The divers' heating units are to be tested in accordance with an approved procedure.

## 13 Control stations

### 13.1 General

**13.1.1** The following inspection and tests are to be conducted on the control stations, as a minimum:

- functional testing of the fire safety systems
- switching from main to emergency power source
- functional testing of the communication and CCTV systems
- functional testing of the gas distribution panel
- functional testing of the gas analyzers
- functional testing of the alarms
- verification of the markings and diagrams.

## 14 Electrical installations

### 14.1 General

**14.1.1** All electrical installations are to be tested in accordance with the Ship rules Part C, Chapter 2, Section 15.

**14.1.2** The following inspection and tests are to be conducted on the electrical installations, as a minimum:

- functional test of each sub-system
- testing of main and emergency power supply
- insulation resistance test on every electrical circuit.

## 15 Launch and recovery system

### 15.1 General

**15.1.1** In addition to the inspection and testing list in App 1, Launch and recovery systems are to be surveyed in compliance with NR526 or NR595, as applicable.

### 15.2 Heave compensation

**15.2.1** If fitted, heave compensation systems are to be function tested.

### 15.3 Umbilical winch

**15.3.1** Functional testing of the winch umbilical is to be witnessed by the Society.

**15.3.2** Pressure testing of the swivel is to be witnessed by the Society.

## 16 Hyperbaric Rescue Unit

### 16.1 General

**16.1.1** The Hyperbaric Rescue Unit is to be inspected and tested in accordance with an agreed testing program.

**16.1.2** The following inspection and tests are to be conducted:

- weighing in air and in water
- testing of the evacuation procedure
- testing of the launching system in accordance with [16.2]
- testing of the sanitary systems
- testing of the fire safety systems

- testing of the CO<sub>2</sub> removal system
- testing of the environmental control unit (heating / chilling)
- testing of the instrumentation
- testing of the communication system
- sea trials including propulsion, steering and towing tests, as relevant
- examination of the towing line
- examination of the markings as defined in Ch 2, Sec 5
- inspection and testing applicable to lifeboats as per SOLAS / LSA requirements.

### 16.2 Launching system

**16.2.1** The launching system of the HRU is to be inspected and tested in accordance with IMCA D004.

Note 1: When not certified by the Society, a valid 3rd party certificate is to be produced.

#### 16.2.2 Overload test

An overload test in accordance with IMCA D004 at full out-board position is to be conducted.

## SECTION 2

## SCOPE OF IN-SERVICE SURVEYS

### 1 General

#### 1.1 Application

**1.1.1** The present Section provides requirements for the in-service surveys of diving systems.

**1.1.2** The requirements of the present Section cover integrated and portable diving systems.

**1.1.3** When a portable diving system is not used for a long period, the Owner may apply for a lay-up procedure as defined in [3.2].

#### 1.2 Rules reference

##### 1.2.1 IMCA publications

Reference is made to the following documents for survey and testing:

- IMCA D004 - The initial and periodic examination, testing and certification of hyperbaric evacuation launch systems
- IMCA D011 - Annual auditing of diving systems
- IMCA D018 - Code of practice on the initial and periodic examination, testing and certification of diving plant and equipment
- IMCA D023 - Diving Equipment Systems Inspection Guidance Note for Surface Oriented (Air) Diving Systems
- IMCA D024 - Diving Equipment Systems Inspection Guidance Note for Saturation (Bell) Diving Systems
- IMCA D037 - Diving Equipment Systems Inspection Guidance Note for Surface supplied Mixed Gas Diving Systems
- IMCA D040 - Diving Equipment Systems Inspection Guidance Note for Mobile /Portable Surface supplied Systems.

#### 1.3 Modifications and repair

**1.3.1** The Owner is to inform the Society about any modifications or repair on the diving system.

**1.3.2** As a rule, the equipment modified or repaired is to be tested before putting it back into service.

**1.3.3** *An inspection either general or partial according to the circumstances should be made every time a defect is discovered or an accident occurs which affects the safety and certification of the diving system or whenever a significant repair or alteration is made. The inspection should be such as to ensure that the repairs or alterations carried out have been done effectively and are in all respects in full compliance with the applicable provisions of this Note.*

**1.3.4** *After any survey or inspection under this section has been completed no significant change should be made in the diving system without the agreement of the Society, except the replacement of equipment and fittings for the purpose of repair or maintenance.*

### 2 Survey program

#### 2.1 General

**2.1.1** The items of in-service surveys are provided in Appendix 1 and in Articles [3] to [10].

#### 2.2 Service and maintenance records

**2.2.1** The service record book and the Planned Maintenance System are to be presented to the attending Surveyor.

#### 2.3 Survey periodicity

**2.3.1** The survey periodicity is specified in Ch 1, Sec 1, [2.3.2].

#### 2.4 Owner surveys

**2.4.1** In addition to the in-service surveys witnessed by the Society, the Owner is to perform semi-annual surveys as recommended by the IMCA publications listed in [1.2.1].

These surveys are to be recorded in the Planned Maintenance System.

### 3 Portable diving systems

#### 3.1 General

**3.1.1** The Owner is to inform the Society about any installation and decommissioning operations of a portable diving system.

**3.1.2** As a rule, the diving system is to be inspected and tested in accordance to the commissioning procedure before it is put back into service.

#### 3.2 Lay-up

**3.2.1** When the equipment is not used for a long period, the Owner may apply for a lay-up procedure.

An equipment put out of commission may be subject to specific requirements for maintenance of class, as specified below, provided that the Owner notifies the Society of the fact.

**3.2.2** The lay-up maintenance program provides for a “laying-up survey” to be performed at the beginning of lay-up and subsequent “annual lay-up condition surveys” to be performed in lieu of the normal annual surveys which are no longer required to be carried out as long as the equipment remains laid-up.

The other periodical surveys which become overdue during the lay-up period may be postponed until the re-commissioning of the equipment.

**3.2.3** Where the equipment has an approved lay-up maintenance program and the period of class expires, the equipment lay-up period is extended until it is re-commissioned.

**3.2.4** The minimum content of the lay-up maintenance program as well as the scope of the decommissioning, annual lay-up condition and recommissioning surveys are to be submitted to the Society for approval.

The annual lay-up condition survey shall contain, through a lay-up log-book, the survey items of the annual survey as deemed necessary.

The re-commissioning procedure shall contain, through a lay-up log-book, the survey items of the Class renewal survey, as deemed necessary.

**3.2.5** During the lay-up period, the exposed part of the equipment are to be adequately protected and regularly inspected.

## 4 Diving bell

### 4.1 General

**4.1.1** Each component of the diving bell is to be surveyed in accordance with the relevant items listed in App 1.

**4.1.2** The following inspection and tests are to be conducted on the diving bell/basket as a minimum:

- testing of the PVHO in accordance with Sec 1, [6] and [6]
- testing of the gas cylinders
- testing of the piping system
- testing of the ballast release system, if any
- testing of the emergency systems
- testing of the location and communication systems
- testing of the diving bell heating system
- testing of the electrical installations.
- visual examination of the batteries packs and their watertight seals
- visual examination of the means for partially filling the bell in order to recover an unconscious diver
- visual examination of the connectors of the piping lines
- visual examination of the BIBS
- visual examination of the anodes, if any
- visual examination of the bell framework.

## 5 Deck decompression chambers

### 5.1 General

**5.1.1** Each component of the deck decompression chambers is to be surveyed in accordance with the relevant items listed in App 1.

**5.1.2** The following inspection and tests are to be conducted on the DDC, as a minimum:

- testing of the PVHO in accordance with Sec 1, [6] and [6]
- testing of the piping system
- testing of the sanitary systems
- testing of the fire safety systems
- testing of the CO<sub>2</sub> removal system
- testing of the environmental control unit
- testing of the breathing gas reclaim system, if any
- testing of the instrumentation
- testing of the communication system
- testing of the electrical installations.

## 6 Pressure Vessel for Human Occupancy

### 6.1 General

**6.1.1** The PVHO and their components are to be surveyed in accordance with the relevant items listed in App 1.

**6.1.2** The inspection and testing of the PVHO is to include:

- pressure testing in accordance with [6.2]
- gas leak testing in accordance with Sec 1, [6.3]
- testing of the viewports in accordance with [6.4]
- visual examination of the signs of corrosion on the shell of the PVHO and particularly the bottom part inside and outside
- visual examination of the shell penetrators
- visual examination of the supporting structure
- visual examination of the windows
- visual examination of the markings
- visual examination of the insulation, if any
- visual examination of the doors, hatches and their locking mechanisms
- visual examination of the medical lock
- visual examination of the associated piping and fittings
- visual examination of the valves and flow fuses
- visual examination of the connecting flanges between chambers
- visual examination of the bilge drain
- visual examination of the protectors on the outlet lines.

### 6.2 Pressure testing

**6.2.1** In-service pressure test at 1.25 times the Maximum Allowable Working Pressure (MAWP) is to be conducted and witnessed by the Society.

## 6.3 Gas leak test

**6.3.1** Gas leak test are to be conducted at maximum working pressure for medical/equipment locks and all doors, hatches, valves, pipe work, fittings and penetrations on each compartment of the PVHO. See Sec 1, [6.3].

**6.3.2** The pressure inside each compartment is to be recorded on a pressure chart and submitted to the attending Surveyor.

## 6.4 Viewport

**6.4.1** PVHO acrylic viewports are to be tested in-service according to ASME PVHO-2.

**6.4.2** The acrylic viewports are to be replaced after a service period of no more than 10 years.

## 7 Gas cylinders and pressure vessels

### 7.1 Seamless gas cylinders and pressure vessels not taken under water - dry internal service

**7.1.1** As an alternative to App 1 and in certain very special circumstances the five-yearly internal examination of seamless gas cylinders and pressure vessels, as defined in App 1, Tab 1, ref. 9.1, can be substituted by ultrasonic testing only with a validity of 10 years. The circumstances are:

- The cylinder must be within its 3 yearly test validity
- The cylinder must not have been used for compressed air storage, due to inherent moisture
- The cylinder must be connected to a residual pressure valve (RPV) while in service. In the event that the RPV fails to retain pressure or has visible signs of tampering, an internal visual examination in line with the five-yearly examination will be required
- Moisture readings taken upon filling and return of the cylinder demonstrate that levels within the cylinder have not exceeded 25ppm (-46°C at 1013 mbar) whilst in service. If the moisture level is found to have exceeded 25ppm, an internal visual examination in line with the five-yearly examination will be required.

Examination/Test to be provided:

- Ultrasonic testing of the gas cylinder as an alternative to the 5-yearly internal survey.

Note 1: The ultrasonic testing system used must conform to the requirements of ISO 6406:2005, section 11.4

### 7.2 Other gas cylinders

**7.2.1** The inspection and testing requirements are described in App 1.

## 8 Electrical installations

### 8.1 General

**8.1.1** All electrical installations are to be inspected and tested in-service in accordance with the Ship rules.

## 9 Launch and recovery system

### 9.1 General

**9.1.1** In addition to the inspection and testing listed in App 1, Launch and recovery systems are to be surveyed in compliance with NR526 or NR595 as applicable.

### 9.2 Wires

#### 9.2.1 Annual testing

There is to be an annual removal of a length of wire rope from just beyond the first sheave from the bell termination with the bell below the surface, allowing for swell, to be discarded. A length sufficient to provide test samples for two tensile tests should be cut from the bell end adjacent to the termination. In certain circumstances the competent person may waive the recommendation to cut all the way back to the first sheave. In systems where there is a single vertical fall directly from the winch to the bell it will be necessary to cut right back to the winch.

A sample is to be tested to destruction to verify that the required factor of safety is maintained. Should the test prove unsatisfactory due to problems with test procedures or where the wire rope fails within a length equal to six wire rope diameters (6d) from the base of the socket or cone, a second test may be carried out. This alternative test should not be used as a way of avoiding discard where a valid test is performed which indicates low strength.

The ultimate strength test to be carried out on a sample from the part subject to the most severe dynamic loading will be used to verify that a factor of safety of 8:1 is still being maintained and if not the wire rope is to be discarded. Even if the factor of safety is being maintained but the result falls 10% below the base value adopted following the test carried out when the rope was first put into service, it is to be discarded.

One of the tensile test samples is to be dismantled and the internals examined.

The certification documents and testing reports (original manufacturer's certificate, initial test certificate and each annual test certificates) are to be recorded in the Planned Maintenance System.

The destruction test of the wire rope does not need to be witnessed by the attending surveyor. In that case, the inspection may be limited to document review.

### **9.2.2 Wires lubrication**

The cable is to be pressure lubricated every 6 months unless it is renewed every 2 years. Lubrication operation are to be recorded in the PMS.

Wires should be lubricated before lay-up period.

### **9.3 Heave compensation**

**9.3.1** If fitted, heave compensation system is to be function tested.

## **10 Hyperbaric Rescue Unit**

### **10.1 General**

**10.1.1** In accordance with IMO Res 692(17), each Hyperbaric Rescue Unit is subject to an annual inspection.

**10.1.2** The HRU and its launching system are to be inspected and tested in accordance with an agreed program. Reference is made to IMCA D004 for the inspection and testing of the launching system of the HRU.

## APPENDIX 1

## INSPECTION AND TESTING CHECK-LIST

### 1 General

#### 1.1 Application

**1.1.1** This Appendix provides the check-list of inspection and testing to be conducted for diving systems at the time of commissioning and during their service life.

**1.1.2** The inspection and testing requirements are based on the document IMCA D018 - Code of practice on the initial and periodic examination, testing and certification of diving plant and equipment.

**1.1.3** The list of survey and testing is provided in Tab 1.



Table 1 : Inspection and testing

Ref. (1)	Items	New built (2)	Survey periodicity (years)							Note	
			1	2	2,5	3	4	5	10		
1	Disposable Tube Type Gas Analyzers (including hand operated pumps) • Examination and function test of pump plus check expiry date of tubes	(2)	●	●		●	●	●			
2	Gas analyzers • Visual examination and functional test • Calibration test to agreed specification (in situ)	(2)	●	●		●	●	●			The examination of analyzers includes the piping connected to it and providing the gas sample.
3	Man-Riding Basket/Bell (structure and lift point(s) only) • Visual examination of lifting points and main structure for damage/corrosion • Load test of lifting points (this also applies to secondary lift points) at 1.5 times SWL with NDT of lifting points or pad eyes before and after test where appropriate	(2)	●	●		●	●	●			This can be a diving basket, a wet bell or a close diving bell. If damage/corrosion is identified other testing may be required. It is not a requirement that the basket/bell be connected to the LARS during the test and the testing may be carried out in a number of ways (a pad eye puller is one)
5.2	Personal Breathing Apparatus (BIBS) • Visual examination and function test (including communications if fitted)	(2)	●	●		●	●	●			This does not include the supply system pipework pressure testing.
5.3	Personal Breathing Apparatus (used under water) • Visual examination and function test at atmospheric pressure (including communications) Carry out survey and testing in line with manufacturer's recommendation <sup>90</sup>	(2)	●	●		●	●	●			This does not include the supply system pipework pressure testing or the cylinder.
6	Video and Communication Equipment • Examination and function test. Check condition of batteries (if applicable)	(2)	●	●		●	●	●			This includes through water emergency, hard wire primary and sound powered secondary communications equipment, diver mounted video equipment and audio/video recording equipment. The individual items tested should be listed on any certificate.
7	Compressors, Boosters and Filtration Units used for Gas Transfer at both High and Low Pressures • Visual examination and function test (including any safety devices other than PRV) • Check delivery rate and pressure • Check gas purity as appropriate	(2)	●	●		●	●	●			This excludes receivers, volume tanks, storage bottles or cylinders, supply system pipework and ancillary systems. The amount of water vapour allowed in an air or gas sample in many international standards is related to air or gas which is to be stored at high pressure. This is done to reduce the problems of condensation and freezing of regulators. Such restrictions do not need to apply when samples of low pressure air or gas are analyzed and a higher water vapor content may be allowed.
(1)	The reference numbers from 1 to 99 correspond to the detail sheet number in IMCA D018.										
(2)	In accordance with manufacturer's specification and fit for the purpose it will be used for.										
(3)	In accordance with a recognized international code or standard and fit for the purpose it will be used for.										

Ref. (1)	Items	New built (3)	Survey periodicity (years)							Note
			1	2	2,5	3	4	5	10	
9.1	Gas Cylinders and Pressure Vessels not taken under water - Dry Internal Service <ul style="list-style-type: none"> <li>External visual examination</li> <li>Thorough external visual examination and gas leak test to maximum working pressure</li> <li>Thorough internal visual examination. If the Surveyor deems it necessary, an overpressure test at 1.25 MAWP, followed by NDT may be required. See Sec 2, [7].</li> </ul>	(3)								This includes both fixed and transportable gas storage cylinders and tubes and filter housings. It does not include welded pressure vessels or pressure vessels for human occupancy. If the cylinders are in composite material see Ref. 10.2. Hydraulic testing of large storage tubes subject to dry internal service is not recommended as it introduces moisture in to the system which may prove difficult to remove. In such cases pneumatic or gas overpressure testing may be substituted. If testing is not hydraulic, other testing such as wall thickness measurement or acoustic emission testing may also be required.
			●	●	●	●	●	●		
9.2	Gas Cylinders and Pressure Vessels not taken under water - Wet Internal Service <ul style="list-style-type: none"> <li>External visual examination</li> <li>Thorough internal and external visual examination and gas leak test to maximum working pressure</li> <li>Overpressure test to 1.5 times the maximum working pressure (or the factor required by the design code or standard if different)</li> </ul>	(3)								This includes driers, filter housings, gas recovery volume tanks, sanitary and shower tanks, cylinders used for hyperbaric fire extinguishers. If the cylinders are in composite material see Ref. 10.2. Hydraulic testing in situ may be impractical or undesirable. In such cases pneumatic or gas overpressure testing may be substituted. If testing is not hydraulic, other testing such as wall thickness measurement or acoustic emission testing may also be required.
			●	●	●	●	●	●		
10.1	Gas Cylinders taken under water <ul style="list-style-type: none"> <li>External visual examination</li> <li>Thorough internal and external visual examination</li> <li>Gas leak test to maximum working pressure. If the Surveyor deems it necessary, a hydraulic overpressure test may be required</li> <li>Hydraulic overpressure test to 1.5 times maximum working pressure (or the factor required by the design code or standard if different)</li> </ul>	(3)		●						If a hydraulic test has been carried out, it is important that confirmation is received that all moisture has been removed prior to the unit being put back into service. This category includes cylinders fitted to baskets/wet bells/externally on closed bells plus filter housings and any other small pressure vessels taken under water to any appreciable depth. If the cylinders are in composite material see Ref. 10.2
			●	●	●	●	●			
(1)	The reference numbers from 1 to 99 correspond to the detail sheet number in IMCA D018.									
(2)	In accordance with manufacturer's specification and fit for the purpose it will be used for.									
(3)	In accordance with a recognized international code or standard and fit for the purpose it will be used for.									

Ref. (1)	Items	New built	Survey periodicity (years)										Note
			1	2	2,5	3	4	5	10				
10.2	<p>Composite Gas Cylinders</p> <ul style="list-style-type: none"> <li>External visual examination, particularly for abrasion and impact damage, delamination and any other damage</li> <li>internal visual examination of composite cylinders taken under water</li> <li>Thorough internal visual examination and gas leak test to maximum working pressure. A hydraulic overpressure test may be required</li> <li>Hydraulic proof pressure test to the pressure marked on the cylinder OR volumetric expansion test as appropriate to the design of the cylinder</li> </ul>	(3)	●	●		●	●	●	●			<p>Note: This category applies to cylinders, filter housings and any other small pressure vessels which are subject to extreme exposure or normally very damp conditions although they may not be taken underwater to any appreciable depth. Examples would be cylinders or pressure vessels mounted externally on a hyperbaric evacuation system, mounted inside the hull of an SPHL or used in a small boat as part of a portable surface supplied system.</p> <p>If the cylinders are composite material use detail sheet 10.2</p>	
10.3	<p>Gas Cylinders Subject to Extreme Exposure or Normally in very Damp Conditions</p> <ul style="list-style-type: none"> <li>External visual examination</li> <li>Thorough external visual examination and gas leak test to maximum working pressure. If the Surveyor deems it necessary, a hydraulic overpressure test may be required</li> <li>Thorough internal visual examination plus hydraulic overpressure test to 1.5 times maximum working pressure (or the factor required by the design code or standard if different)</li> </ul>	(3)	●	●		●	●				<p>Particular care is to be taken in inspecting the areas under clamps or where the cylinder rests on a support.</p>		
11	<p>Electrical Equipment</p> <ul style="list-style-type: none"> <li>Visual examination</li> <li>function test of unit (including protective devices) plus continuity and resistance testing of cables</li> </ul>	(2)	●	●		●	●		●		<p>Sec. Sec 2, [8]</p> <p>This does not include equipment such as lighting or power sockets which form part of a vessel or platform electrical system.</p> <p>Any certificate issued should clearly identify the various sub-systems and items included in the test.</p>		
12	<p>Diving Bell Emergency Location System</p> <ul style="list-style-type: none"> <li>Physical examination for damage or deterioration</li> <li>function test including check of battery condition</li> </ul>	(2)	●	●		●	●		●				
13	<p>Environmental Control Unit (integral test only)</p> <ul style="list-style-type: none"> <li>Visual examination and function test.</li> </ul>	(2)	●	●		●	●		●		<p>Testing may require recalibration of the control system.</p>		
(1)	The reference numbers from 1 to 99 correspond to the detail sheet number in IMCA D018.												
(2)	In accordance with manufacturer's specification and fit for the purpose it will be used for.												
(3)	In accordance with a recognized international code or standard and fit for the purpose it will be used for.												

Ref. (1)	Items	New built	Survey periodicity (years)							Note	
			1	2	2,5	3	4	5	10		
14	External Regeneration Unit (integral test only) <ul style="list-style-type: none"> <li>• Visual examination and function test.</li> <li>• Function test of satisfactory operation of flow fuses</li> </ul>	(2)	●	●		●	●	●			This excludes the pressure testing of the housing and piping. Testing may require recalibration of the control system.
15	Fixed Firefighting Systems - Internal or External (integral test only) <ul style="list-style-type: none"> <li>• Function test</li> <li>• Visual examination of nozzles, valves, pipework and fittings</li> <li>• Function test to demonstrate operation of the system, or simulated test using air or gas as the test medium</li> <li>• If an automatic detection/activation system is fitted then a function test to demonstrate correct operation</li> </ul>	(2)	●								This excludes the supply system piping and any ancillary equipment.
16	Portable Firefighting Systems and Extinguishers <ul style="list-style-type: none"> <li>• External visual examination plus check that any indicating device is reading within the acceptable range</li> </ul>	(2)	●	●		●	●	●			This does not include pressure testing the cylinder. Part of the visual examination is to confirm that any security tag or similar is unbroken. When on board a ship or installation the normal hand held portable extinguishers are the responsibility of the vessel owner and will have to meet different requirements to those listed here. These will normally be the requirements of the marine legislation of the flag state. When specialised hyperbaric portable extinguishers are used inside deck chambers then the pressure cylinders will need to meet the requirements for wet internal service (see detail sheet 9.2).
17	Gas Reclaim System, Gas Mixer and Gas Blenders <ul style="list-style-type: none"> <li>• Visual examination and function test (including any safety devices other than PRV)</li> <li>• Gas bag bacteriological control (swap test)</li> </ul>	(2)	●	●		●	●	●			This covers the integral test only and does not include any cylinders, the supply system pipework testing or the divers' breathing apparatus.
18	Depth Gauges (including Caisson Gauges if used to control decompression) <ul style="list-style-type: none"> <li>• Checked for accuracy against a certified test instrument to an accuracy of <math>\pm 0.25\%</math> of maximum scale value at a minimum of 5 points within the scale</li> <li>• Visual examination and function test in situ</li> </ul>	(2)	●	●		●	●	●			This refers to gauges used to measure divers' depth accurately in order to provide information essential for decompression, saturation, storage and transfer within a diving system. The test report submitted to the Society shall list the actual readings taken at each point, the gauge under test and details of the test instrument. Gauges which do not meet the required accuracy are to be adjusted or replaced as necessary.
(1)	The reference numbers from 1 to 99 correspond to the detail sheet number in IMCA D018.										
(2)	In accordance with manufacturer's specification and fit for the purpose it will be used for.										
(3)	In accordance with a recognized international code or standard and fit for the purpose it will be used for.										

Ref. (1)	Items	New built (2)	Survey periodicity (years)							Note
			1	2	2,5	3	4	5	10	
19	Life Support Gauges (including Caisson Gauges if used only to indicate depth to the divers) <ul style="list-style-type: none"> <li>Visual examination and check by comparison only against a certified test instrument to an accuracy of <math>\pm 2.5\%</math> of maximum scale value at a minimum of 4 points within the scale</li> </ul>	(2)	●	●		●	●	●		This refers to gauges which read pressures critical to the life support function. Such gauges are bell and bail out charging panel and the last gauge monitoring pressure to the divers' breathing apparatus (including BIBS). The test report submitted to the Society shall list the actual readings taken at each point, the gauge under test and details of the test instrument. Gauges which do not meet the required accuracy are to be adjusted or replaced as necessary.
20	Pressure indicating Gauges <ul style="list-style-type: none"> <li>Visual examination for physical condition and function test throughout normal operating range</li> </ul>	(2)	●	●		●	●	●		This refers to gauges whose purpose is to show if pressure is present in a supply system and, if so, the approximate magnitude of the pressure. They are neither depth gauges nor life support gauges (as in Ref. 18 and 19). The checks and the results are to be recorded in the planned maintenance system. Gauges which are inaccessible (such as inside the diving bell) may be checked by a diver and witnessed by the Surveyor.
21	Diver Heating Systems (integral test only) <ul style="list-style-type: none"> <li>Visual examination and function test</li> <li>Overpressure test</li> </ul>	(2)	●	●		●	●	●		If the unit is electrically powered then continuity and resistance testing should be carried out.
22.1	Launch and recovery system <ul style="list-style-type: none"> <li>Visual examination for damage/corrosion.</li> <li>Independent static load test on each brake system at 1.5 times maximum SWL</li> <li>Function test of the heave compensation system, if any</li> <li>Dynamic test of system at 1.25 times maximum SWL (NDT to be carried out afterwards on critical areas)</li> </ul>	(2)	●	●		●	●	●	●	See Sec 1, [15] for initial inspection and Sec 2, [9] for in-service surveys. This includes bell or basket launch and recovery systems, winches, structures and heave compensators. Testing of lifting appliances and equipment is normally carried out as part of the integral system. If individual components have to be replaced such as strops or shackles then this does not require retesting provided the change is done on a like-for-like basis and the new component is supplied with its own relevant examination and proof load test certificate. If the equipment is moved as a complete unit within the validity of the test certificate, then retesting may be limited to seatfastenings or similar.
(1)	The reference numbers from 1 to 99 correspond to the detail sheet number in IMCA D018.									
(2)	In accordance with manufacturer's specification and fit for the purpose it will be used for.									
(3)	In accordance with a recognized international code or standard and fit for the purpose it will be used for.									

Ref. (1)	Items	New built (2)	Survey periodicity (years)							Note		
			1	2	2,5	3	4	5	10			
22.2	Hydraulic Power Unit - for Lifting Appliances used for Man-Riding (integral test only) <ul style="list-style-type: none"> <li>• Visual examination and function test as an integral part of the over-all lifting system</li> <li>• Intercooler/heater (if fitted) checked for function and flow</li> <li>• Hydraulic fluid/oil analysis carried out or replacement of fluid/oil</li> </ul>	(2)		●		●		●		●		Significant water ingress into non-water-based hydraulic fluid systems will increase the likelihood of internal corrosion and increased wear. If there is evidence of such water ingress then steps should be taken to eradicate the water and any pressurised components within the hydraulic circuit such as rams, accumulators, tanks etc. should be tested as if subjected to wet internal service.  The analysis of hydraulic fluid/oil is carried out partly to identify any metallic particles which could indicate excessive wear in some components. If the fluid/oil is replaced then it must be remembered that this check will not be available.
24.1	Pipework Systems, Valves, Regulators and Relevant Fittings <ul style="list-style-type: none"> <li>• Internal pressure test to 1.5 times maximum working pressure of the system plus gas leak test at maximum working pressure of the system</li> <li>• Verify internal cleanliness appropriate to intended duty</li> <li>• Visual examination</li> <li>• Gas leak test at maximum working pressure of the system</li> </ul>	(2)		●							See Sec 1, [7]  It may not be appropriate in some cases to conduct the initial testing of a complete panel or assembly at 1.5 times maximum system working pressure. In such circumstances a suitable test protocol should be agreed with the Surveyor to verify the integrity of the components making up the panel or assembly.  If a valve, regulator, fitting or similar is changed out on a like-for-like basis then no overpressure test is required and a gas leak test at maximum working pressure is sufficient.  If a piece of pipework is replaced or the system is modified then an overpressure test to 1.5 times maximum working pressure of the relevant part(s) of the system is required. This may be a bench test or may be carried out in situ. In all cases this will be followed by a gas leak test in situ at maximum working pressure of the system. Consideration will need to be given to whether internal cleanliness appropriate to the intended duty has been maintained.	
(1)	The reference numbers from 1 to 99 correspond to the detail sheet number in IMCA D018.											
(2)	In accordance with manufacturer's specification and fit for the purpose it will be used for.											
(3)	In accordance with a recognized international code or standard and fit for the purpose it will be used for.											

Ref. (1)	Items	New built	Survey periodicity (years)										Note
			1	2	2,5	3	4	5	10				
24.2	Oxygen System Pipework, Valves and Relevant Fittings <ul style="list-style-type: none"> <li>Internal pressure test to 1.5 times maximum working pressure of the system plus gas leak test at maximum working pressure of the system</li> <li>Verify internal cleanliness to oxygen standards</li> <li>Visual examination</li> <li>Gas leak test at maximum working pressure of the system</li> </ul>	(2)											See. Sec 1, [7] It may not be appropriate in some cases to conduct the initial testing of a complete panel or assembly at 1.5 times maximum system working pressure. In such circumstances a suitable test protocol should be submitted to the Society. If a valve, regulator, fitting or similar is changed out on a like-for-like basis then no overpressure test is required and a gas leak test at maximum working pressure is sufficient. If a piece of pipework is replaced or the system is modified then an overpressure test to 1.5 times maximum working pressure of the relevant part(s) of the system is required. This may be a bench test or may be carried out in situ. In all cases this will be followed by a gas leak test in situ at maximum working pressure of the system. Internal cleanliness to oxygen standards will need to be verified.
24.3	Relief Valves <ul style="list-style-type: none"> <li>Visual examination</li> <li>Function test at required relief setting followed by leak test to maximum working pressure (normally integral with equipment to which valve is fitted)</li> </ul>	(2)											See. Sec 1, [7]
24.4	Bursting Discs <ul style="list-style-type: none"> <li>Visual examination</li> <li>Gas leak test to maximum working pressure (normally integral with equipment to which disc is fitted)</li> <li>Complete renewal</li> </ul>	(2)											
25.1	Pressure Vessels for Human Occupancy <ul style="list-style-type: none"> <li>Visual examination</li> <li>Thorough internal and external visual survey plus a gas leak test at full working pressure</li> <li>Internal overpressure test</li> </ul>	(2)											See Sec 1, [6] for initial inspection and Sec 2, [6] for in-service surveys. This includes any spool pieces, medical or equipment locks, trunkings and clamps connected to such vessels. Some national regulations or pressure vessel standards may give no option but to apply hydraulic overpressure testing.
(1)	The reference numbers from 1 to 99 correspond to the detail sheet number in IMCA D018.												
(2)	In accordance with manufacturer's specification and fit for the purpose it will be used for.												
(3)	In accordance with a recognized international code or standard and fit for the purpose it will be used for.												

Ref. (1)	Items	New built	Survey periodicity (years)							Note	
			1	2	2,5	3	4	5	10		
25.2	Viewports used in Pressure Vessels for Human Occupancy <ul style="list-style-type: none"> <li>Overpressure tested to 1.25 times maximum rated working pressure or other testing to establish structural integrity as required by the ASME PVHO standard</li> <li>Visual examination in situ</li> <li>Gas leak test as an integral part of the PVHO to which it is fitted</li> <li>Internal overpressure test</li> <li>Complete renewal (from the date of fabrication)</li> </ul>	(3)								See Sec 1, [6] for initial inspection and Sec 2, [6] for in-service surveys.	
		●									
			●		●		●				
				●				●			
									●		
26	Welded Pressure Vessels (not for Human Occupancy) <ul style="list-style-type: none"> <li>Visual external examination</li> <li>Thorough internal and external visual survey plus a gas leak test at full working pressure</li> <li>Internal overpressure test</li> </ul>	(3)								This includes air receivers, filter housings, gas storage containers (but not gas cylinders), sanitary and shower tanks, volume tanks and submerged pressure housings. Vessels which form an integral part of a chamber complex may be tested integrally with it. If the pressure housing is exposed to external pressure (such as a bell battery pack) and is not pressure compensated then an external pressure test may be required. Hydraulic testing of large storage tubes subject to dry internal service is not recommended as it introduces moisture into the system which may prove difficult to remove. In such cases pneumatic or gas overpressure testing may be substituted. If testing is not hydraulic then other testing such as wall thickness measurement or acoustic emission testing may also be required.	
			●		●		●				
								●			
27	Sanitary Systems (integral test only) <ul style="list-style-type: none"> <li>Visual examination and function test</li> </ul>	(2)								Excludes pressure vessels and any supply system pipework. Part of the function test is to confirm that the interlock operates correctly.	
			●		●		●				
28	Umbilicals - Hose Components only - including End Terminations and Fittings but excluding Electrical Components <ul style="list-style-type: none"> <li>Hydraulic overpressure test at 1.5 times maximum rated working pressure or as recommended in manufacturing code or standard</li> <li>Gas leak test then verify internal cleanliness as appropriate to the intended duty</li> <li>Visual examination and function test</li> <li>Gas leak test to maximum rated working pressure</li> </ul>	(2)								See Sec 1, [2.6] This includes excursion, main bell, wet bell and surface dive umbilicals plus deck hoses and flexible whips. If an umbilical hose has an end fitting changed or replaced then that hose requires retesting under the "new" category. In the case of hoses which are likely to be subjected to external pressure (for example gas recovery hoses) then the above internal pressure tests are adequate to test the integrity of end fittings provided the hose was originally designed and type tested to withstand external pressure.	
		●									
		●									
			●		●		●		●		
				●				●			●
(1)	The reference numbers from 1 to 99 correspond to the detail sheet number in IMCA D018.										
(2)	In accordance with manufacturer's specification and fit for the purpose it will be used for.										
(3)	In accordance with a recognized international code or standard and fit for the purpose it will be used for.										



Ref. (1)	Items	New built	Survey periodicity (years)							Note			
			1	2	2,5	3	4	5	10				
29.1	<p>Wire Rope and Terminations (man-riding)</p> <ul style="list-style-type: none"> <li>Sample tested to destruction to provide a baseline for future monitoring. The sample tested to destruction should prove an adequate safety factor exists. This is normally 8 times safe working load</li> <li>Visual examination of visible section</li> <li>Cut back a length of wire rope and test to destruction to prove an adequate safety factor (see notes below)</li> <li>Reterminate and apply static load test at 1.5 times SWL</li> </ul>	(2) ●									Davit launching systems for hyperbaric lifeboats have different requirements (see Ref. 32). See Sec 2, [9.2]. If the test to destruction when the wire is first put in to service does indicate an MBL below that of the manufacturer, then the manufacturer's MBL should always be adopted as the base value against which to monitor future deterioration in breaking force. However if the result falls 10% below the MBL then the rope should be discarded.		
29.2	<p>Wire Rope and Terminations (Non-Man-Riding)</p> <ul style="list-style-type: none"> <li>Function test at SWL as an integral part of the lifting system</li> <li>Visual examination of visible section</li> <li>Apply static load test at 1.5 times SWL</li> </ul>	(2)				●	●	●	●				
30	<p>Bell Ballast Release Systems</p> <ul style="list-style-type: none"> <li>Release systems to be function tested in air</li> <li>Visual examination and function test of all mechanisms</li> <li>Overload test to 1.5 times the static load of the ballast weight in air. NDT carried out on all critical items</li> <li>Dry function test of all components and release mechanisms</li> <li>Test bell positive buoyancy and confirm this is in line with original requirement</li> </ul>	(2) ●				●	●	●	●			This also includes lift wire, guide wire and umbilical release systems. Reference is made to AODC 061 – Bell ballast release systems and buoyant ascent in offshore diving operations - for further explanations on tests to be performed.	
32.1	<p>Hyperbaric Evacuation Launch Systems</p> <ul style="list-style-type: none"> <li>Overload test in installation in accordance with IMO guidance at full onboard position</li> <li>Thorough visual examination for deterioration</li> <li>Function test including emergency launching means</li> <li>Falls to be replaced (except stainless steel falls)</li> </ul>	(2) ●											This refers to SOLAS-type or specially designed and dedicated launch systems. For non-dedicated launch system, refer to IMCA D004. When carrying out practice deployments, the HRU chamber should be pressurised and unmanned. As far as possible any practice should simulate operational conditions. Where a secondary means of launch is provided (such as stored energy) then practical deployment of the HRU using the secondary system must be carried out under the same conditions and frequency as the primary system. Reference is made to IMCA D 004 for further guidance.
(1)	The reference numbers from 1 to 99 correspond to the detail sheet number in IMCA D018.												
(2)	In accordance with manufacturer's specification and fit for the purpose it will be used for.												
(3)	In accordance with a recognized international code or standard and fit for the purpose it will be used for.												

Ref. (1)	Items	New built	Survey periodicity (years)							Note
			1	2	2,5	3	4	5	10	
100	Hyperbaric Rescue unit <ul style="list-style-type: none"> <li>As per SOLAS requirements applicable to lifeboats or with specified deviations</li> <li>Overload test</li> <li>Thorough visual examination and function test</li> <li>Visual examination of the towing line</li> </ul>	(2) ● ● ● ●	●	●	●	●	●	●	●	Elements part of the HRU are to be surveyed in accordance with the relevant items above. Eg: PVHO, gas cylinders, fire fighting system, etc. See Sec 1, [16] for initial inspection and Sec 2, [10] for in-service surveys.
101	Umbilical winch <ul style="list-style-type: none"> <li>Function testing</li> <li>Overpressure testing of swivel at 1.25 MAWP</li> </ul>	(2) ● ●	●	●	●	●	●	●	●	
102	Diving bell <ul style="list-style-type: none"> <li>visual examination and testing</li> </ul>	(2) ●	●	●	●	●	●	●	●	See Sec 1, [4] for initial inspection and Sec 2, [4] for in-service surveys. Elements part of the closed diving bell are to be surveyed in accordance with the relevant items above. Eg: PVHO, gas cylinders, fire fighting system, etc.
103	Unmanned diving test at the maximum rated depth	●							●	See Sec 1, [3.4]

(1) The reference numbers from 1 to 99 correspond to the detail sheet number in IMCA D018.  
 (2) In accordance with manufacturer's specification and fit for the purpose it will be used for.  
 (3) In accordance with a recognized international code or standard and fit for the purpose it will be used for.