Amendments to the "Rules for the Classification of Underwater Units"

Effective from 1/7/2023

List of the amendments:

Part/Chapter/Section/Paragraph amended	Reason
Pt A, Ch 1, Sec 1, [5.1.2](new), Pt A, Ch 1, Sec 2, [1.1.1], [1.1.4](new), [1.2.1], [1.2.6](new), [2.1.1], [2.1.3](new), [6.7.1], [6.7.4](new) Pt A, Ch 2, Sec 1, [2.3](new), [3.1.5](new), [3.2.3](new), [4.3](new) Pt A, Ch 2, Sec 3, [3](new)	• to introduce the possibility of issuing a specific class certificate to Modular Diving Systems made up of different underwater units or systems, operated by the same owner, each provided with its own Certificate of Classification (e.g. hyperbaric chambers, bells, ROVs, etc.) or Certificate of Compliance with other applicable regulations (e.g. launch portals, containerized plants, etc.), that can be employed together as a Diving System. • to introduce the category "Diving support systems" and relevant notation DSU; • to introduce the service notation "special service" that may be assigned to units or modular diving systems that are intended for services that are not listed in Sec 1, [6.1] (Prop. 219)
Pt B, Ch 2, Sec 1, [1.3.2], Tab 1(deleted) Pt C, Ch 1, Sec 3, [2.1.7] Pt C, Ch 1, Sec 4, Tab 1, [3.1.1] Pt C, Ch 2, Sec 1, [4.1.3] Pt E, Ch 2, Sec 2, [2.1](title), [2.1.1] Pt E, Ch 3, Sec 3, [2.1.1], Fig 1(deleted), Fig 2(deleted)	to improve - based on the experience gained in the application of the Rules during some ongoing projects - requirements for: • stability criteria (in Pt B) • piping passing through the pressure hull and calculation of carbon dioxide breathed out by each person in working conditions (in Pt C) • decompression chambers and umbilicals (in Pt E) and to correct an editorial error in and correction in Pt C, Ch 1, Sec 4, Tab 1 (Prop. 219)

SECTION 1 GENERAL PRINCIPLES

1 Application

1.1 Premise

1.1.1 Where not otherwise specified, both "underwater vehicles" and "apparatuses used for underwater activity" or "systems for underwater activity" will, for the sake of simplicity, be referred to hereafter as "underwater units".

1.2 Units included and excluded

1.2.1 These Rules apply to vehicles, apparatuses and systems suitable for underwater operation or related to underwater activity, manned or unmanned, mobile or fixed, self-propelled or non-propelled, of any size.

These Rules do not apply to mobile or fixed marine platforms, for drilling or similar activity, for which reference is to be made to the specific rules.

2 Rules

2.1 Equivalence

2.1.1 Tasneef may consider the acceptance of alternatives to the requirements of these Rules, provided that they are deemed, in its sole opinion, to be equivalent to the Rules.

2.2 Novel features

2.2.1 Tasneef may consider the classification of units based on or applying novel design principles or features, to which the Rules are not directly applicable, on the basis of experi-ments, calculations or other supporting information pro-vided.

The specific limitations may then be indicated on the Certificate of Classification.

2.3 Amendments to the Rules

2.3.1 The Rules may be amended at any time and the amendments do not apply to already existing units, unless otherwise stated by Tasneef on a case-by-case basis.

3 Duties of the Interested Party

3.1 Statutory regulations

3.1.1 The classification of a unit does not absolve the Interested Party from compliance with any requirements issued by Administrations and any other applicable international and national regulations for the safety of life at sea and protection of the marine environment.

3.2 Compliance with other rules

3.2.1 Although not specifically indicated in these Rules, the relevant requirements contained in the "Rules for the Classification of Ships" (hereafter referred to as "the Rules") apply.

3.3 Assumptions

3.3.1 These Rules are based on the assumption that the design of the vehicle, apparatus or system for the underwater activity is performed by qualified technicians (with whom the responsibility for the design remains), that those units are operated in a proper manner and that the operating personnel are recognised fit for such operation by the relevant Authority or, where no legal regulations exist, are properly trained.

It is also assumed that, prior to commencing any underwater operation especially if immersion of persons is involved, the Interested Party will inform the competent Authorities, as necessary, in order to be able to plan any rescue operations with timely measures and appropriate means, already prearranged.

4 Definitions

4.1 Pilot

4.1.1 The pilot is the captain of a self-propelled underwater unit usually of small size and required to operate with the continued assistance of a supply vessel.

If the unit is not dependent on the assistance of a supply vessel, the pilot takes the usual role of the Master with regard to these Rules.

4.2 Operating Person Responsible

4.2.1 The Operating Person Responsible is the member of the crew of a non-self-propelled underwater unit (e.g. a bell) who is responsible for the operation of the unit during the mission.

4.3 Diving Superintendent

4.3.1 The Diving Superintendent is the person responsible for the maintenance and operational efficiency of the underwater units, whether self-propelled or non-propelled, manned or unmanned, as well as of the systems relevant to the underwater activity fitted on the supply vessel. He follows the activity of all units under his supervision directly from the supply vessel throughout the mission.

4.4 Duration of the underwater mission

4.4.1 The mission starts when the operating personnel enter the unit and ends when they exit from the unit into the external atmosphere.

4.5 Vehicles of major or large size

4.5.1 Vehicles of major or large size are vehicles having maximum length L of the pressure hull greater than 20 m.

4.6 Vehicles of minor or small size

4.6.1 Vehicles of minor or small size are vehicles having maximum length L of the pressure hull equal to or less than 20 m.

4.7 Isobaric or normobaric or neutrobaric pressure

4.7.1 Isobaric or normobaric or neutrobaric pressure is an absolute pressure not greater than 0,2 MPa. An isobaric operation means one carried out at isobaric pressure.

4.8 Hyperbaric pressure

4.8.1 Hyperbaric pressure is an absolute pressure greater than isobaric pressure. A hyperbaric operation means one carried out at hyperbaric pressure.

4.9 Operating time

4.9.1 Operating time is the time the unit takes, in normal conditions, to submerge, reach the working site, perform the planned underwater operations and emerge again. The operating time is calculated from when the last porthole is closed until the same porthole is reopened. See [4.4].

4.10 Decompression

4.10.1 Decompression is the slow return from hyperbaric pressure to isobaric pressure.

This treatment is to be adopted for divers after they have performed activity in hyperbaric conditions.

5 Certification that can be issued to underwater units

5.1 General

5.1.1 Underwater units may be issued with a Certificate of Classification according to the indications given in Sec 2 or with other statements of conformity specifically requested by the Interested Party. It is understood that, whatever the certification issued, the necessary checks are to be carried out on the basis of the requirements contained in these Rules.

5.1.2 *(1/7/2023)*

For modular diving systems, the following criteria applies:

- the modular system is to be assigned with a Certificate of Classification, encompassing all the modules that are part of the system;
- each module that can be operated independently from other parts of the system is to be assigned with its own Certificate of Classification;
- modules that are intended to be operated only together with other parts of the modular diving system are to be provided Certificate of Compliance to the applicable Tasneef Rules, with the same validity and anniversary dates of the Certificate of Classification of the modular system.

6 Use of underwater units

6.1 Main underwater activities

6.1.1 The most common services to which underwater units may be assigned are listed below; any services not included in the list will be given particular consideration:

a) **observation**: exploration, inspection of submerged works, construction survey of submerged arrangements, research, hydrographical surveys, oceanographic studies, spotting;

b) **work**: fishing, digging, drilling, extraction, drawing of samples from the seabed, carriage, maintenance and repair of submerged parts, building of underwater structures and plants, various installations, rescue, demolition, salvage;

c) **supply**: assistance to underwater works;

d) **tourism**: carriage of passengers (see Part E).

6.2 Weather conditions with regard to launching and hauling

6.2.1 If the diving systems are linked to a surface unit, their operation is subject to the limitations concerning weather conditions specified in the certification of the surface unit.

Launching and hauling are linked to the features of the supply unit (and, in any event, are decided by the Operating Person Responsible).

6.3 Use with continued assistance from the supply unit

6.3.1 In this case, the supply unit-underwater unit combo is considered a single operational set with regard to equipment, spare parts and living arrangements.

SECTION 2 CLASSIFICATION NOTATIONS

1 Categories and types of underwater units

1.1 Categories

1.1.1 Premise

For classification purposes, units for carrying out underwater activities are assigned to the categories indicated in [1.1.2] ~~and~~, [1.1.3] and [1.1.4].

1.1.2 Propelled underwater units

Units (vehicles, apparatuses or systems) fit to operate below the water surface or which can be used, both on the sea surface and submerged, to carry out specific underwater activities and fitted with means for their propulsion.
Notation (self-propelled underwater units): **MLS p**

1.1.3 Non-propelled underwater units

Units defined as in [1.1.2] not fitted with means for their propulsion.
Notation (underwater units): **MLS**

1.1.4 Diving support systems *(1/7/2023)*

Systems or modules operating above the water surface to support diving activities (e.g. decompression chambers, ventilation systems, etc.)
Notation (diving support): **DSU**

1.2 Types

1.2.1 Premise *(1/7/2023)*

The most common types of underwater units are listed in item [1.2].

For the purposes and within the limits of the provisions of the Tasneef Rules, underwater units may be of particular types, if considered so constructed and/or arranged as to be able to perform ~~special~~ services such as those listed in Sec1, [6.1].

Units that can perform more than one ~~special~~ service are to comply with the requirements related to each service and to provide the operational performance necessary to shift from one service to another.

Units or Modular Diving Systems that are intended for services that are not listed in Sec 1, [6.1] may be assigned with the service notation **special service**. The classification requirements of such units are considered by the Society on a case by case basis.

An additional service feature may be specified after the notation (e.g. special service - submarine rescue system) to identify the particular service in which the unit is intended to operate. The scope and criteria of classification of such units are indicated in an annex to the Certificate of Classification.

Where units operate in manned conditions, the relevant type notation will be indicated with the letter (m) as a suffix, e.g. **Submarine (m).**

1.2.2 Vehicles and other apparatuses performing underwater activities

a) **Submersibles**

1) Underwater units fit to sail in fresh or salt water, manned or unmanned, mainly afloat, but which are also capable of submerging, proceeding and operating underwater and re-emerging to the surface, without impairing the safety of persons on board.

They may be required to operate in the vicinity of a supply vessel at sea or a base located ashore. Usually they are self-propelled units which, if of small size, may be towed on the sea surface during transfer voyages, if any.

Notation: **Submersible**

2) A particular type of submersible consists of **submersible pontoons**, which are units capable of being partially submerged so as to embark cargoes on deck and then re-emerge after the cargo has been embarked.
Notation: **Submersible pontoon**

3) Submersible pontoons indicated in 2) provided with arrangements and systems fit for the launching of heavy cargoes lashed on the deck, such as offshore structures, are given the additional notation "launching".
Notation: **Submersible pontoon launching**

b) **Submarines**

Underwater units fit to sail in fresh or salt water, manned or unmanned, mainly underwater, but which are also capable of proceeding afloat, without impairing the safety of persons on board (see also Pt B, Ch 2, Sec 1, [1.2.1] b)).

They may be required to operate in the vicinity of a supply vessel at sea or a base located ashore or underwater.

Usually, they are manned self-propelled units which, if of small size, may be towed on the sea surface during transfer voyages, if any.

Notation: **Submarine**

c) **Bathyscaphes**

Submarines capable of operating at a depth greater than 1000 m.

Notation: **Batiscaph**

d) Mesoscaphes

Submarines capable of operating at a depth not greater than 1000 m

Notation: **Mesoscaph**

e) **Bathyspheres**

Bathyscaphes whose pressure structure is spherical.

Notation: **Bathisphere**

f) **Mesospheres**

Mesoscaphes whose pressure structure is spherical.

Notation: Mesosphere

g) **Digging units to bury underwater pipelines and cables**

Usually they are units that can be used unmanned, towed to the operation site, or embarked on a supply vessel.

Notation: **MSS**

h) **Hyperbaric Diving Bells**

Apparatuses that are usually intended to accommodate persons in a hyperbaric atmosphere.

Notation: **Hyperbaric Diving Bell**

i) **Isobaric Diving Bells**

Apparatuses similar to those defined in (h) intended to accommodate persons in an isobaric atmosphere.

Notation: **Isobaric Diving Bell**

j) **Remotely operated submarine**

They are particular types of submarines, unmanned, free moving or connected to an umbilical cable, used for surveys or for varying underwater activities, such as hull cleaning of floating units, cleaning of underwater structures, inspection of underwater structures, underwater photographs.

Notation: **ROV**

k) **High depth diving suit**

They are rigid shells having hinges at legs and arms, fitted with appliances for carrying out underwater works, which accommodate an operator.

They are permanently connected to a supply vessel.

They allow underwater work at a maximum depth of 500 m, in isobaric conditions, with underwater currents having a maximum speed of 2 knots.

Notation: **Diving suit**

1.2.3 Submerged installations

a) **Habitats**

They are submerged installations, anchored on the seabed, designed to provide a comfortable environment for underwater operators who have completed their underwater work shifts or are waiting to be moved elsewhere.

Use of these habitats is foreseen at depths not greater than 200 m.

Notation: **Habitat**

b) **Submerged laboratories**

They are arrangements provided with telescopic legs that enable the structure to rest on an uneven seabed. The lower parts of the legs are provided with long vertical blades which improve their penetration in the seabed. They may contain accommodation spaces and openings which allow the underwater operators to get out and in. In this case, if the laboratory operates in an isobaric atmosphere, it is to be provided with a decompression chamber.

Notation: **SEALAB**

c) **Submersible igloos**

They are arrangements usually anchored on the seabed, having a hemispheric shape and a diameter of about 2 m, provided with complete and efficient outfitting for at least one underwater operator.

In these igloos at least one operator can stay and survive; they are used as a refuge not far away from the working site.

In some cases they can be connected by means of a steel cable to a laboratory or a habitat and can be recovered by winding up the cable on a drum.

Other types are self-propelled (with very limited range) and are operated as true submarines, where the crew can go in or out of a suitable door.

Notation: **Submersible Igloo**

d) **Stowage reservoirs**

Reservoirs, usually spherical in shape, anchored on the seabed, also at great depths, intended to contain liquids or gases extracted from the seabed.

Notation: **Stowage Reservoir**

1.2.4 Decompression chambers

Apparatuses that can be fitted on board a supply vessel or at a base ashore and that are used for assistance to underwater operators.

Notation: **Decompression Chamber**

1.2.5 Systems for carrying out underwater activities (diving systems)

They are systems usually consisting of:

a) diving bells or other units and arrangements for carrying out underwater activities

b) decompression chamber

c) equipment and appliances for launching and hauling diving bells or other underwater units

d) systems for the production, checking and distribution of mixtures of oxygen and other gases for the supply of the breathing systems used for carrying out underwater activities, including umbilical cables.

General notation: **Diving System**

1.2.6 Modular systems for carrying out underwater activities (modular diving systems) *(1/7/2023)*

Modular systems are consisting of different underwater units or systems, operated by the same owner, each provided with its own Certificate of Classification or Certificate of Compliance, that can be employed together as a Diving System.

General notation: **Modular Diving System**

2 Certificate of Classification

2.1 General

2.1.1 *(1/7/2023)*

The units indicated in [~~2~~1.~~1~~2] above can be issued a Certificate of Classification in accordance with the requirements stipulated hereafter.

2.1.2 As far as the issue, filling in, validity and endorsements of the Certificate of Classification are concerned, the relevant requirements of Part A of the Rules apply, unless otherwise specified in these Rules. In particular, as far as the filling in is concerned, the following applies.

Where the main moulded dimensions are requested, the maximum dimensions of the pressure hull and those of the light hull are indicated; for the pressure hull, overall length, out-of-plating breadth and maximum depth (including turret); for light hull, the Rule dimensions of surface ships.

In the section dedicated to hull equipment, if the unit is required to always operate in the vicinity of a supply vessel, it will be indicated that it is located on the supply vessel.

The following will be specified on the Certificate of Classification:

- whether continued assistance, and at what distance, from a supply vessel is foreseen;
- if necessary, the worst weather and sea conditions in which the unit may be fit to sail, both on the sea surface and in immersion or emersion (as for the wave height to be indicated on the Certificate, see Pt B, Ch 2, Sec 1, [1.3]);
- the maximum operating depth, indicated in letters and not in numbers;
- that the operation of the unit is subject to compliance with the requirements indicated in the user manual (see [6.7]);
- that the weather and sea conditions during operations are to be such that the unit can in fact be operated;
- whether the transfer voyages are to be carried out under tow or not;
- whether the unit is self-propelled or not. In the case of self-propelled units, the main characteristics of the propulsion systems are to be indicated; in the case of non-self-propelled units, it will be indicated that "the unit is without propulsion systems";
- whether the unit is operated "manned" or "unmanned";
- whether or not the unit is operated with an umbilical cable or with another restraint from the supply vessel;
- whether the unit is provided with traction systems on the seabed (e.g. caterpillar tractor) or other similar systems enabling it to move on the seabed;
- if deemed necessary, the mechanical and chemical characteristics of the steel used for the construction of the hull (both pressure and light hull);
- the statement, if applicable, indicated in Pt B, Ch 1, Sec 1, [2.2].

2.1.3 *(1/7/2023)*

For **modular diving systems**, as defined in [1.2.6], the following information will be specified on the Certificate of Classification of the system:

- list of the underwater units or systems that are part of the modular system with the indication of the number of the Certificate of Classification or Certificate of Compliance of each unit or system, as applicable;
- list of possible configurations of the system, if more than one exists;
- indication that the operation of the system is subject to compliance with the requirements provided in the user manual (see [6.7]).

3 Conditions for classification and characteristics of class

3.1 Symbols, characteristics of class and navigation

3.1.1 The provisions indicated in Chapter 1 of the Rules apply. No navigation notation is assigned to the units indicated in [1.2.2] k), [1.2.3] and [1.2.5] c) and d).

As a rule, in most cases (especially for small size units) the navigation notation may be completed by:

- the wording "in weather and sea conditions such that the unit can operate and with continued assistance from the supply vessel";
- the indication of the operational area, if any, as well as of the navigation limitations imposed by Tasneef on the basis of the average weather and sea conditions in the geographical area where the unit is intended to operate, also taking account of the dimensions and characteristics of the unit itself.

On the Certificate of Classification, if the materials are not suitable for low temperatures (e.g. if the unit cannot operate in polar areas), the geographical operational limits are to be specified, considering the ambient conditions in which the unit operates and is manoeuvred (e.g. a diving bell that can be lowered to sea directly through a moon-pool from a warmed-up hangar may not be considered operational at low temperatures).

If the shape and dimensions of the unit are such that it is not fit to sail in any sea state, navigation for transfer under tow is not to be extensive so that favourable weather and sea conditions can be relied on. On the other hand, these conditions are also necessary for the immersion and emersion manoeuvres associated with the underwater service for which the unit is intended.

If the unit is intended to operate in fresh water, the operational area will be indicated on the Certificate of Classification.

4 Classification of systems and apparatuses for underwater work, if any, fitted on board a supply vessel

4.1 General

4.1.1 The supply vessel may be classified in accordance with the provisions of the Rules for the Classification of Ships; for the classification of systems and apparatuses relevant to the particular operation of the supply vessel, the specific requirements of the same Rules are to be applied.

At the request of the Interested Party, the systems and/or apparatuses fitted on the supply vessel, as complementary services to diving systems, may not be covered by the Certificate of Classification of the vessel; in that case, an appropriate statement will be endorsed on the certificate.

Also at the request of the Interested Party, the systems and/or apparatuses may be classified separately or together with the underwater unit to which they are fitted.

If the supply vessel is provided with a dynamic positioning system, the latter is to be tested during sea trials; otherwise it will be put out of service.

4.2 Additional class notation: DIVING SUPPORT

4.2.1 Tasneef assigns the additional class notation **DIVING SUPPORT** to supply vessels provided with diving systems complying with the provisions of these Rules and with the requirements of Part F, Ch 13, Sec 14 of the Rules for the Classification of Ships.

5 Register of ships

5.1

5.1.1 The Register of ships contains the vehicles, apparatuses and systems for underwater work provided with a Certificate of Classification.

6 Technical documentation

6.1 Premise

6.1.1 For each unit for which the issue of the Certificate of Classification is requested, the technical documentation required in the following paragraphs is to be submitted to Tasneef may also call for additional documentation, at its sole discretion, on a case-by-case basis.

The calculations and data contained in the technical documentation are to provide sufficient technical, theoretical and bibliographical references, where necessary.

6.2 General information

6.2.1 The following information is to be supplied with the request for classification:

- the building yard, the building place and, in the case of existing units, also the year of build;
- the assigned name and the former names (given in chronological order);
- any Classification Society, in addition to Tasneef, requested to issue a Certificate of Classification or, for an existing unit, which issued the Certificate of Classification (or the Authority which issued documents of fitness for the service formerly performed);
- the last period of class with the former Classification Society;
- the service for which the unit is intended;
- the requested navigation, with indication of the maximum number of persons on board, the extent of the voyages and the most severe weather and sea conditions the unit can cope with;
- whether or not the unit will be operated with the assistance of a supply vessel.

6.3 Documentation requested for units surveyed by Tasneef during construction

6.3.1 In addition to the documents requested in the specific parts of these Rules, the following documentation is to be submitted to Tasneef for examination and approval, where applicable:

a) detailed construction plans of all the structure, with indication of the scantlings, connection types and characteristics of the materials used;

b) diagrams of the apparatuses and systems installed for the on board services, including the sanitary discharge systems;

c) sufficient documentation for the checks deemed necessary;

d) detailed hypothesis and assumptions on which the design is based;

e) the calculations performed on the basis of the above-mentioned assumptions, with a view to proving the adequate strength of the structures, as well as the efficiency and functionality of the propulsion system, steering gear and various systems;

f) testing data and tests performed on prototypes or samples, if any, with pressure measures corresponding to the collapse depth and stress levels during operation;

g) calculations relevant to the stability of the unit in the various operating, navigational and manoeuvring conditions;

h) structural strength calculations showing the stress level attained with the allowable geometric variations;

Note 1: Also after checks during building and assembly, both in the pre-constructed parts and in those built, variations to the geometry of the pressure hull (see Ch 2, Sec 2, [2.7]) may be found; those defects (deviations from the circular shape or not

p) diagrams and functional schemes of the:
   1) piping for fuel oil, lubricating oil and cooling water for engines,
   2) compressed air piping,
   3) piping for high and low pressure water ballast,
   4) piping for hydrodynamic control systems, where the capacity and head of the pumps and compressors are indicated, as well as the dimensions and materials of the pipes and the material in which tanks and receptacles for fluids are built,
q) construction drawings relevant to the shafting, with indication of the materials used and sealing appliances,
r) construction drawings relevant to the propellers or other propulsion devices, with indication of the materials used,
s) general diagram of the electrical system,
t) detailed diagram of the main electrical switchboard,
u) diagram of the electrical system using accumulator batteries and relevant safety arrangements, indicating the number, type and characteristics of the accumulator batteries;
v) characteristics and type of the sonar system;
w) characteristics and type of the telephone system to communicate with the surface supply vessel (underwater ultrasound telephone);
x) list of the safety means and equipment;
y) diagram and characteristics of the (main and emergency) breathing system;
z) construction drawing of the bottles containing oxygen for the breathing system, with indication of their capacity, maximum working pressure, materials used and their characteristics and relevant testing certificates;
aa) description of the systems to eliminate carbon dioxide, with indication of materials used and relevant testing certificates;
ab) diagram of the system to control contamination of the breathing atmosphere inside the unit, with relevant testing certificate;
ac) diagram of the system to control air temperature and humidity;
ad) description and type of the instrumentation relevant to all the safety arrangements (hydrogen detectors in the battery spaces, various sensors, leakage detectors, and so on);
ae) plan of the arrangements for food and potable water;
af) description of the arrangement for the system for garbage elimination;
ag) description of the system for remote control of the main and auxiliary engines;
ah) description of the systems and appliances to be used in the case of an emergency;
ai) stability calculations with the unit in the following conditions (in quadruplicate): floating, fully immerged, during immersion, during emersion and, in the case of an emergency, with one or more ballast tanks unusable due to damage (see Pt B, Ch 2, Sec 1, [1.3]);
aj) user manual (see item [6.7] below).

Tasneef reserves the right to request additional documentation, checks, surveys and tests as a consequence of the examination of the foregoing documentation and of the outcome of the required surveys.

6.5 Documentation requested for units not classed by an IACS Society

6.5.1 A copy of the same documentation is requested as for new buildings indicated in [6.3.1].

6.6 Other documentation requested

6.6.1 For each unit, whether a new or existing building, the following lists are to be filled in and supplied to Tasneef:

a) a complete list of each piece of machinery and system fitted on the unit, with indication of its main characteristics (for all the services on board);
b) a list of the special tanks on board (see Pt B, Ch 1, Sec 1, [3]), with indication of their capacity and coordinates of their centre of gravity;
c) a list of the service tanks on board (fuel oil, water, lubricating oil, etc.), with indication of their capacity;
d) a list of all the pressure receptacles, with indication of their capacity, and working and design pressure, as well as the coordinates of relevant centres of gravity.

6.7 User manual

6.7.1 *(1/7/2023)*

The user manual (or operation manual or instruction and maintenance manual) is to be kept on board the unit and/or the relevant diving support vessel, as applicable, and is to serve as information and guidance for the personnel on board in situations that may occur during the operating phases of the unit and/or the systems and for the checks that are to be carried out.

6.7.2 At each survey it is to be verified that the user manual is available on board. The manual is to include:

a) the front page, with indication of the total number of pages it consists of;
b) the contents;
c) the instructions relevant to use and maintenance of all the systems and appliances fitted on board, supplemented with particular and general diagrams. Special attention is to be given to the procedure to pump down the ballast double bottom tanks, specifying the depth at which they can be emptied by means of compressed air (see Pt B, Ch 1, Sec 8, [4.1.1]);
d) general plan with all openings and hull penetrations;
e) schematic plan of the items of machinery and systems fitted on board for the various services;
f) list of all the apparatuses and instruments fitted on board, divided according to the various services.

6.7.3 In the user manual, all the typical most significant data are to be listed as follows:

a) dimensions of the unit;

b) mechanical and chemical characteristics of the material the pressure hull is built of;

c) operative range;

d) displacement (weight in air, for small size units);

e) maximum and normal operational speed (navigating on the sea surface and in immersion);

f) maximum number of persons on board;

g) maximum operational depth (for units operating in hyperbaric conditions, such as diving bells, maximum difference between external and internal pressure);

h) data relevant to the stability cases considered in the Stability Booklet for the Master (or Pilot, for self-propelled units of small size);

i) characteristics of the propulsion system;

j) periodical checks.

6.7.4 *(1/7/2023)*

For modular diving systems, the manual is to include the following information:

a) list of all the modules that are part of the system with the indication of the main technical characteristics;

b) details of all the interfaces and connections of the underwater units that are part of the modular system;

c) list of any possible configuration of the modular system with the indication of the relevant operative instructions and limitations;

d) detailed instructions for the change of configuration of the system or replacement of a module;

e) information regarding the checks before use of the modular system.

6.7.5 In the manual, annotations are to be endorsed and pointed out stating that:

a) for any repair or modification, even if of minor scope, affecting the pressure hull or parts connected to it, prior approval from Tasneef is to be obtained. Otherwise, the unit's class will be automatically suspended;

b) for modifications causing a substantive variation to the stability characteristics of the unit, new stability calculations are to be submitted to Tasneef for examination and then a new inclining experiment is to be carried out in the presence of a Tasneef Surveyor. The necessary variations will need to be included in the Stability Booklet. Otherwise, the unit's class will be automatically suspended.

6.7.6 In addition to the requirements listed in the foregoing paragraphs, the manual is to contain information, indications and annotations for the following items:

a) information on safety (with a detailed description of the safety systems) and relevant operations, including the recovery systems also with the unit at full load, as well as the preliminary operations to be carried out prior to every mission. All the manoeuvres necessary for the manual functioning of the essential services are also to be illustrated in detail, as well as the operations to be carried out in the case of an emergency. Particular attention is to be given to the safety measures, which prevail over all the other services; therefore a lot of space is to be dedicated to explaining how the valves are to be checked, the breakers are to be closed, etc. in order to verify the correct position of levers and buttons so as to be absolutely sure of the manoeuvres necessary when manual intervention is needed;

b) indications relevant to all the service cases of the unit, including mooring in port and use in polar areas, where icing can, for instance, lock the valves;

c) information on the operations foreseen for the maintenance and overhaul intervals of the various parts; for the propulsion engines the running hours foreseen and effected between two consecutive overhauls are to be indicated. The personnel on board are to carry out the above-mentioned checks at the required intervals and record the results in the log-book;

d) indications relevant to:

- limitations, if any, on use owing to stability,
- speed of the sea current that can be overcome by the propulsion system,
- maximum sea and wind force the unit can withstand on the sea surface;
- maximum descent and/or ascent speed (it is assumed 0,3 m/s, if not otherwise specified);

e) annotations to be recorded which refer to:

- the various operations such as launching, recovery, dry-docking,
- in the case of large size units, filling up the trim tanks, balance tanks and the fuel reserve in the tanks.

  All filling-up relevant to the last immersion is to be reported in the immersion table, available to the Master.

  For each unit, a record of the weight movements is to be kept with indication of their horizontal distance from the vertical line passing through the centre of gravity or centre of buoyancy of the unit, so as to be able, at any time, to return to an equilibrium situation starting from an equilibrium status;

f) in the case of units having little reserve buoyancy and thus with small freeboard, the warning that the personnel shall embark or disembark only when the unit is lashed to the supply vessel and carry out the checks prior to every immersion when on board the same vessel;

g) instructions regarding first aid to injured persons (in accordance with the types of accidents that operators can have);

h) annotations regarding the drills, periodically performed by the crew, relevant to the use of safety devices and first aid appliances, as well as the instruction courses given to the personnel;

i) information on the nutritional methods, stowage and processing of food and water, as well as on the

SECTION 1 SURVEY REQUIREMENTS

1 Application

1.1 Premise

1.1.1 As far as survey requirements are concerned, those given in Sections 1, 2 and 3 apply in addition to those given in Part A of the Rules, as applicable.

1.1.2 The surveys provided in this Section can be expanded to the extent deemed necessary and, in the case of particular units, modified.

Any parts found not complying with the applicable requirements or in unsatisfactory condition are to be properly modified or, preferably, replaced, unless otherwise determined by Tasneef.

2 Survey for the assignment of class

2.1 Units surveyed by Tasneef during construction

2.1.1 For units surveyed by Tasneef during construction, class will be assigned according to the provisions of the Rules, as far as applicable and taking account of the particular requirements indicated in Sec 2. At the end of construction, the unit will be submitted to the tests indicated in Sec 3.

2.2 Units classified after construction

2.2.1 Units classed with an IACS Society

The procedure for the assignment of class is the following:

- examination by Tasneef of the required documentation (see Ch 1, Sec 2, [6.4]);
- execution of the required surveys, listed below, which may be supplemented by checks deemed necessary, considering the particular type of the unit, also taking account of the examination of the documentation referred to in the foregoing item;
- dry-docking survey, sea chests and relevant valves, propellers, tailshafts; inspection and hydrostatic test of reservoirs and/or bottles for compressed air may generally be postponed to their regular expiry date, if they are not required with regard to the work carried out during the survey for the assignment of class, provided that a copy of the reports relevant to the last survey of those parts is supplied;
- execution of the immersion test to the maximum operational depth. If the unit is used at an operational depth less than 500 m, the immersion test may not be required, if its execution is confirmed by an appropriate annotation or statement by the Society with which the unit is duly classified.

  An immersion test to a depth greater than the operational depth is not covered by the regular insurance of the pilot and crew of the unit.

Upon satisfactory outcome of the above-mentioned surveys, an Interim Certificate of Classification is issued for use as a Certificate of Classification .

The Interim Certificate of Classification can only be issued if a sufficient number of survey items, relevant to hull and machinery, have been surveyed to allow an evaluation of whether the unit is eligible to be classed for the foreseen period.

The survey for the assignment of class for a period of 5 years is to include all the survey items required; it may be carried out in more than one session and is to be completed within 12 months of commencement; any recommendations are also to be dealt with within that period, unless an earlier deadline has been given.

The survey items for the assignment of class until the expiry date of the renewal survey assigned by the former Society are:

- annual hull survey;
- survey of cofferdams;
- survey of engine room, under and above flooring;
- survey and test of bilge suctions;
- annual machinery and systems survey;
- survey of the fire protection (for units intended for the carriage of passengers) (see Ch 1, Sec 1, [7.1.2]);
- survey and test of the fire-fighting appliances with the scope of a class renewal survey (see Ch 1, Sec 1, [7.1.2]);
- survey with the scope of a class renewal survey of some parts, disassembled to the Surveyor's satisfaction, of the main engines and auxiliary machinery for the essential services of hull and machinery;
- running test of the propulsion system and essential machinery.

As far as thickness measurements are concerned, the previous thickness measurement results should be submitted, if possible. However, Tasneef reserves the right not to accept those results, either partially or totally, and to stipulate the relevant conditions.

If the unit was under the Continuous Survey System of Hull and/or Machinery for renewal survey with the former Classification Society and if that system is not kept with Tasneef as well, in addition to the previous surveys all the Continuous Survey items surveyed more than one year

before the commencement date of the class period with the former Society are also to be surveyed.

The survey for the assignment of class is to be carried out in one session and is to be completed before the Interim Certificate of Classification is issued. Any recommendations are to be dealt with not later than 12 months from the commencement of the survey for the assignment of class, unless a shorter period has been given.

2.2.2 Units not classed with an IACS Society

For existing units that have never been classed by other IACS Societies, the survey for admission to class is to be a complete survey with any additional checks deemed necessary by Tasneef; the various survey items are, in terms of scope, to be not less than that indicated in the foregoing requirement [2.2.1].

As regards materials, main and auxiliary machinery, apparatuses and systems for which, as a rule, Tasneef testing is required, their acceptance is subject to submission of alternative supporting documentation issued by bodies recognised as qualified by Tasneef or, if such documentation is not available, to the execution of adequate checks and tests (including non-destructive examinations), provided that permission is granted by Tasneef.

The above requirement is a condition for classification of the unit and can give rise to recommendations which impose work to be carried out.

In any case, exhaustive running tests of machinery, systems and their components are to be performed, as requested by Tasneef Surveyors.

The Interim Certificate of Classification can be issued only after the survey has been completed in full, except for recommendations and work, if any, to be dealt with in the above-mentioned period of 12 months from the commencement of the survey, subject to the judgement and discretion of Tasneef.

2.2.3 Issue of the Certificate of Classification

The full term Certificate of Classification will be issued after the relevant survey reports have been examined.

2.2.4 Application of different rules

For the classification of existing units, national and international rules of recognised bodies may be applied. In such case, the certificate issued will specify the basis and assumptions on which the unit concerned has been classified.

2.3 Modular Diving Systems

2.3.1 *(1/7/2023)*

Modular diving systems can be assigned with a Certificate of Classification only when:

- all the underwater units that are part of the system are provided with their own Certificate of Classification issued by Tasneef, in due course of validity;
- all the underwater units that are part of the system are managed by the same owner;
- any other component, required for the operation of the modular system, which is not provided with its own Certificate of Classification is to be approved and tested by Tasneef, as applicable, and provided with a Certificate of Compliance issued in accordance with Ch 1, Sec 1,[5.1.2].

Before the assignment of the Certificate of Classification, the system will be submitted to the tests indicated in Sec 3.

2.3.2 *(1/7/2023)*

In case of automatic class suspension for overdue surveys of one or more of the modular diving system modules, the certificate of classification of the modular system maintains its validity only for the modular system configurations which do not include the module/s for which the classification is suspended.

3 Hull and machinery periodical surveys

3.1 Class renewal surveys

3.1.1 Periodicity, surveys in advance and postponements

a) For all types of units, class renewal surveys are to be carried out not later than 5 years from the previous one.

The first class renewal survey is to be carried out not later than 5 years after the date of entry into operation.

b) The Interested Party has the right to have class renewal surveys carried out in advance or delayed with regard to the regular expiry date; in any event, the expiry date of the next survey is not modified. However, advance periods and delays greater than 3 months are not allowed.

In particular cases where, at the request of the Interested Party, the scope of an annual survey is so expanded as to reach the scope of a class renewal survey, the expiry date of the subsequent class renewal survey is modified and is calculated from the date of completion of that survey.

c) The periodicity indicated in a) may be reduced, if deemed necessary by Tasneef, considering the type of unit and the service in which it is used.

d) The Continuous Survey System for class renewal survey is not allowed, for either hull or machinery.

3.1.2 Survey items to be carried out during the class renewal survey

At the first class renewal survey, the survey items listed under the following points and the pneumatic tests indicated in [3.1.3] are to be performed:

a) check of roundness of the pressure hull (at all frames and all plates in the area between frames) by measuring the local deformations (out-of-roundness);

b) all the survey items required at annual surveys (see [3.2.2]);

c) running test of all apparatuses and machinery with the unit both out of the water (if possible for small size units) and floating in the water;

d) check of the log-book, as well as inspection of all hull equipment (if fitted) and test of the relevant machinery;

3.1.5 Class renewal surveys for modular diving systems *(1/7/2023)*

At all class renewal surveys, including the first, the survey items listed under the following points are to be performed:

- verification that the Certificates of Classification of the underwater units that are included in the system are in regular course of validity;
- survey in accordance with [3.1.2], or other applicable Tasneef Rules for modules not covered by the present Rules, of modules provided with a Certificate of Compliance;
- a functional test of the modular system in one representative configuration; when the possible configurations of the system may significantly differ, the Surveyor may ask to perform additional functional tests.

  The functional test of the modular system does not require the execution of an immersion test to the maximum operational depth.

In case the class certificate of one or more of the modules are not in course of validity, a condition of class will be imposed to limit the modular system configurations to those assembled with modules provided with class certificate in course of validity.

3.2 Annual surveys

3.2.1 Periodicity, surveys in advance and postponements

The relevant requirements given in Part A, Ch 2, Sec 2, [5.2.1] of the Rules apply.

3.2.2 Survey items to be carried out during annual surveys

At all annual surveys, including the first, the survey items listed under the following points are also to be performed:

a) examination of the user manual to verify that the due surveys, checks and overhauls have been carried out at the intervals provided by the Manufacturer and accepted by Tasneef. These actions are to be recorded in the log-book;

b) surveys and checks of:

- breathing apparatuses, means of escape and life-saving appliances,
- navigation, search and communication apparatuses,
- batteries (with their recharge devices) and other sources of energy,
- corrosion control systems (if fitted),
- controls for ballast system, trim system and solid ballast release system,
- propulsion systems,
- hull equipment (if fitted),

c) during the above surveys, disassembly or disconnection of the various systems and circuits is not required, unless that is due as a regular procedure for checking and maintenance or the attending Surveyor has doubts about the condition of those parts. The timers recording the immersion time and the depth meters are to be re-calibrated;

d) the portholes and other similar items for external sight (see also item [6.1]) are to be examined; portholes or similar items which have scratches, both on the side subject to high pressure and on the side subject to low pressure, deeper than 0,05 mm, are to be replaced. The frames accommodating the portholes which have scratches deeper than 0,15 mm are to be replaced;

e) the local deformations (out-of-roundness) are to be checked for one frame out of three on large size units and for alternate frames on those of small size, as well as for either of the plates adjacent to the frame checked (this latter check is only to be made in those positions where no dismantling is needed);

f) in units having pressure hull of spherical shape, the sphericity is to be checked (this latter check is only to be made in those positions where no dismantling is needed);

g) a running test of the machinery items, steering system, electrical system, alarms and instruments is to be performed;

h) Tasneef reserves the right to amend the Rules relevant to the procedure of these surveys with regard to the running periods foreseen between two successive overhauls and based on the outcome of endurance and duration tests of the most stressed components;

i) an immersion test to an agreed depth is to be performed after every annual survey and a detailed report is to be given to the Tasneef Surveyor, unless he has attended the test personally;

j) all the safety arrangements are to be surveyed, i.e.

- the system for elimination of carbon dioxide, as per [3.1.2] m),
- the system for checking the pollution of the breathing mixture,
- the system for checking the internal humidity and temperature,
- the instrumentation relevant to the safety systems,
- the system for regeneration of the breathing mixtures,
- the system for ventilation and air conditioning,
- the individual technical equipment for underwater operators, as required by the regulations in force,
- the fire-fighting appliances, (see Ch 1, Sec 1, [7.1.2]).

After the satisfactory outcome of the above survey items, a running test of the various arrangements is to be performed.

3.2.3 Annual surveys for modular diving systems *(1/7/2023)*

At all annual surveys, including the first, the survey items listed under the following points are to be performed:

- verification that the Certificates of Classification of the underwater units that are included in the system are in regular course of validity;
- survey in accordance with [3.2.2], or other applicable Tasneef Rules for modules not covered by the present Rules, of modules provided with a Certificate of Compliance, as applicable.

In case the class certificate of one or more of the modules are not in course of validity, a condition of class will be imposed to limit the modular system configurations to those assembled with modules provided with class certificate in course of validity.

3.3 Intermediate surveys

3.3.1 The relevant requirements given in Part A, Ch 2, Sec 2, [5.3] and Ch 3, Sec 4 of the Rules apply.

3.4 Dry-docking survey

3.4.1 Periodicity, surveys in advance and postponements

The first dry-docking survey is to be carried out not later than one year after the unit entered into operation.

The successive dry-docking surveys are to be carried out one year after the previous survey.

The Interested Party has the right to have any dry-docking survey carried out up to 2 months in advance and up to 4 months after the regular expiry date; in any event, the expiry date of the successive survey is not modified.

For small size units, the dry-docking survey is considered an item of the annual survey.

Tasneef has the right to require the dry-docking survey to be carried out at shorter intervals than those indicated above, where experience or particular operating conditions so recommend.

3.4.2 Survey items to be carried out at the dry-docking survey

On this occasion, all hull penetrations are also to be examined, with any dismantling deemed necessary, for instance all penetrators, i.e. hull watertight penetrations with a small diameter for the passage of electrical cables, pipes, etc.

The tightness of these penetrations may be checked by a pneumatic test with soap solution (bubble test).

In units (usually large size) used for activities where they need to be soundproof (for instance, to operate in the vicinity of acoustic-primed mines, or to closely watch sea fauna, etc.), where the hull is externally coated with ceramic material (usually tiles) attached by means of glue, the good condition of this ceramic coating is to be verified and, if some areas are missing, damaged or loose, those areas are to be replaced or, if feasible, repaired.

3.5 Tailshaft survey

3.5.1 Periodicity, surveys in advance and postponements

The first tailshaft survey is to be carried out not later than two years after the unit entered into operation.

The successive surveys are to be carried out three years after the previous survey.

The Interested Party has the right to have any tailshaft survey, after the first, up to 2 months in advance and up to 4 months after the regular expiry date; in any event, the expiry date of the successive survey is not modified.

The periodicity of tailshaft surveys may be reduced or increased with regard to that indicated above, at Tasneef's discretion, considering the operating conditions of the unit. For small size units, the tailshaft survey is considered an item of the class renewal survey.

3.5.2 Survey items to be carried out at the tailshaft survey

As a rule, the relevant requirements given in Part A, Ch 3, Sec 7 of the Rules apply.

In particular, all the sealing devices are also to be examined, if possible.

Thrusters are excluded from the scope of the tailshaft survey and are included in the scope of the class renewal survey.

For units that need to be soundproofed due to their specific operation (see [3.4.2]), which are provided with particular propellers (5 or even 7 bladed and skewed), special attention is to be paid to keeping the shape of the blades, as the characteristic of the required noiselessness may be impaired, if any repair should, even slightly, alter the original design profile.

3.6 Automation system survey

3.6.1 If machinery spaces are left periodically unattended by personnel on duty, or machinery is permanently controlled from a main centralised station, automation systems for the propulsion machinery and the machinery for essential services are to be so installed as not to reduce the global safety of the unit and to allow the machinery to properly function and manoeuvre using the traditional method in any case.

As far as automation systems not intended for essential services are concerned, it is to be checked that they are so installed as not to reduce the global safety of the unit and not to dangerously interfere with the functioning of the propulsion machinery and that of systems intended for essential services.

4 Occasional surveys

4.1 General

4.1.1 After the unit has undergone revision, repair or alteration work, it is to be verified that the efficiency, strength and safety conditions, based on which the unit was classified, have been restored.

The attending Surveyor may require a short navigation test and an immersion test to the maximum design depth; the latter test is always to be carried out if the unit has undergone structural work affecting the pressure hull. In any event, the immersion test indicated in Sec 3, [2.5.4] is to be carried out.

All the repairs, alterations and modifications approved by Tasneef, as well as all the renewals performed, are to be recorded in the user manual, so that they are known to the Surveyors attending subsequent surveys.

All the foregoing work is to be surveyed by Tasneef.

4.2 Underwater units carrying passengers

4.2.1 Underwater units carrying passengers are to undergo an occasional survey with the scope of an annual survey 3 months after they entered into operation. The first annual survey is to be performed 9 months after the aforementioned occasional survey.

4.3 Modular Diving Systems

4.3.1 *(1/7/2023)*

Modular diving systems are to undergo an occasional survey:

- in case of repairs, alterations and modifications of any component constituting part of the system;
- when the system is installed on a new diving support vessel;
- when one of the modules which are part of the system is replaced or undergo major repairs or alteration works.

5 Lay-up and re-commissioning

5.1 General

5.1.1 The relevant requirements given in Part A, Ch 2, Sec 2, [8] of the Rules apply.

6 Periodical inspections and tests carried out by the crew or technicians entrusted by the Interested Party

6.1 General

6.1.1 The main parts of the underwater units are to be inspected and tested by the personnel entrusted for that purpose at monthly intervals or according to the periodicity established by the Manufacturer.

Manned units are to be inspected and tested before every immersion, unless they perform more than one immersion in 24 hours without the need for refueling for propulsion and/or recharging the breathing mixture; in that case, the required checks and tests need only be carried out before they are put to sea at the beginning of the mission.

All unmanned units are to be inspected and tested before every launch or more often, if deemed necessary.

The above-mentioned inspections and tests are to be recorded in the user manual, with the date when they were performed and the legible signature(s) of the person(s) responsible.

The results of the inspections and tests are also to be recorded in the log-book.

Portholes are to be replaced, tested to 1,5 times the maximum working pressure and to the temperature of + 20°C, on the following due dates:

a) if there is no Manufacturer's recommendation, 3 years after they were fitted in place;

b) if there is a Manufacturer's recommendation stating that they are fit to be kept in place more than the period indicated in (a), after the lesser of the following periods corresponding to:
   - 10,000 pressurisation cycles;
   - 40,000 hours under pressure.

Each window is to be pressurised at least once after its construction, for instance during testing, before it is fitted in place. The test is to be performed with the window located in its supporting frame and may be carried out either hydrostatically or pneumatically. During the test, the window is to be kept subjected to pressure for at least 1 hour and not more than 4 hours; the depressurisation is to be made by drops not greater than 4,5 MPa/min.

During the test, the temperature is to be as close as possible to the design pressure and in any case not inferior to it by more than 2,5°C; where the test temperature should by chance exceed the design temperature, but in any case by not more than 3°C, this is not to last for more than 1 minute.

Deformations or cracks which develop after the above-mentioned test cause the window to be rejected.

As a rule, evidence is to be given that the personnel in charge have performed at least the following surveys, checks and tests:

a) monthly:
   - internal inspection of battery-pods, if external to pressure hull;

b) every 6 months:
   - check of windows with a curved surface and/or transparent domes with their parts connecting to the pressure hull (o-ring, frames, etc.);
   - checks of portholes;
   - check of hatches for internal access;
   - check of tightness of sliding telescopic devices, if any, penetrating the pressure hull [various antennas (radar, etc.), snorkel, periscopes, etc.];

c) every 12 months:
   - hydrostatic test of the double bottom and other ballast tanks;
   - check, maintenance and inspection of the vertical and horizontal rudders;
   - check, without dismantling unless repairs are needed, of all the hull penetrations (penetrators);
   - checks of the sacrificial anodes.

SECTION 3 TESTS AT THE END OF CONSTRUCTION

1 General checks prior to sea trials

1.1 Premise

1.1.1 All the tests and checks required below are to be performed in the presence of the Surveyor entrusted with the construction survey.

1.2 Apparatuses

1.2.1 All the apparatuses are to be tested in order to verify their proper efficiency.

If fitted on board, the gyrocompass is to have performed not less than 3 hours of continuous service.

It is to be checked that all the foreseen spare parts are on board, especially those regarding the control apparatuses of the breathing system and various safety systems.

1.3 Arrangements and systems on board

1.3.1

a) All the systems are to be checked and are to be found in proper efficient condition.

b) All the valves opening and closing the various ballast tanks, as well as the remote control valves for the various circuits, are to be checked. The valves connected to shell plating are to be perfectly watertight.

c) The seating surface of the hatch giving access to the inside of the pressure hull is to be examined; it is to be clean, not corroded and its sealing gasket is to be undamaged.

d) If feasible, where they are fitted on board, all the quick release devices of the external parts of the pressure hull, such as, for instance, arms for underwater work, external net to collect samples, and external solid ballast, are to be checked.

1.4 General preliminary tests

1.4.1 The program of tests deemed necessary to carry out in order to confirm the full efficiency, functionality, strength and safety of the unit is to be agreed with Tasneef.

In any case, the following checks are required:

- check of the insulation condition of the electrical system;
- visual examination of the pressure hull.

In the case of small size units, it may be found that the pressure hull was subjected during construction in the pressure tank tower to a test pressure as indicated in Pt B, Ch 1, Sec 1, [4.1.6]. In the case of large size units, the "air pressure test" indicated in the following [1.5] is to be performed.

Before and after the above-mentioned pressure test, a check of the out-of-roundness of the pressure hull is to be carried out in a number of positions decided by the Surveyor entrusted with the construction survey.

1.5 Dock trials

1.5.1 Dock trials are to be performed for a duration deemed sufficient by the attending Surveyor. During these trials, all the systems and apparatuses of the unit are to be running.

Any damage found on this occasion will cause the tests to be discontinued. They are to be resumed from the beginning after repairs have been carried out.

The "air pressure test" is to be carried out by slightly decreasing the pressure inside the unit (a decrease of 4 hPa with respect to the external pressure is considered sufficient). If the barometric pressure inside the unit does not change for at least 2 minutes, the test is considered valid. If the internal pressure decreases, where leaks from the hull are not found, every access hatch is to be checked together with its sealing rubber gasket.

The test is to be repeated until the internal pressure shows no variation for a period of not less than 2 minutes.

Moreover, the efficiency of the mooring and warping arrangements of the unit, if fitted, is to be checked, taking account of the use, characteristics and size of the unit.

For the breathing systems and all spaces which are pressurised during service, a gas tightness test is to be performed.

These spaces are to be pressurised by means of dry air or dry nitrogen to a pressure 1,1 times the maximum working pressure and the pressure is not to decrease more than 0,5% per hour, taking account of any temperature variations.

For independent emergency breathing systems, the above pressure is not to decrease more than 0,3% per hour.

2 Sea trials

2.1 Preliminary checks

2.1.1 Sea trials are to be carried out with the assistance of the supply vessel.

Sea conditions and wind force are not to exceed those stated at the design stage; in any case, wind force is not to exceed force 4 on the Beaufort scale.

Visibility conditions are to be considered sufficient by the Master of the supply vessel.

- by emptying the central balance tanks, the emersion tank or the "negative" tank by means of high pressure pumps;
- with one or more ballast tanks full and the corresponding tanks on the other side empty. In this case, the heeling and trim of the unit are to be verified and the residual freeboard checked.

The emersion test in emergency conditions is also to be performed from the maximum depth indicated in [2.5.5], after calibrating the appropriate automatic emersion device, if fitted. When this device is activated, the foreseen signalling buoy is also to be released.

2.5.7 Hauling down and recovery

In the case of small size units, a hauling test and a recovery test of the unit from the supply vessel are also to be performed.

3 Test of Modular Diving Systems

3.1 General

3.1.1 *(1/7/2023)*

Modular diving systems are to be tested both at dock and sea trials in all the possible configurations which are included in the Certificate of Classification and relevant user manual (see Ch 1, Sec 2 [6.7.4]).

In case of similar configurations are foreseen, Tasneef may waive the repetition of tests; in this respect, the test plan for the modular diving system is to be approved by Tasneef.

Immersion test to the maximum operational depth is not required when the same test has been already carried out on each underwater unit included in the modular system, as applicable.

SECTION 1 GENERAL REQUIREMENTS

1 Introduction

1.1 Foreword

1.1.1 For what is not specified in this Section, the requirements of Part B, Chapter 3 of the Rules, as far as applicable, are valid.

1.2 Definitions

1.2.1

a) A fully submerged body is in stable equilibrium condition when the buoyancy equals the displacement and also when the centre of mass is located underneath the centre of buoyancy and aligned on the same vertical.

b) Δ_{surf} and Δ_{sub} being, respectively, the displacement of the unit on the surface and underwater, the reserve buoyancy can be defined as follows:

as a percentage:

$$\frac{\Delta_{sub} - \Delta_{surf}}{\Delta_{sub}} \cdot 100 \quad (\%)$$

or in tons:

Δ_{sub} - Δ_{surf}

Submersibles have reserve buoyancy equal to or greater than 20%, submarines lower than 20%.

c) Equilibrium trim: a unit on the surface or underwater is said to be in such a condition when, with standard loading and engines stopped (propellers at rest), it is in equilibrium between buoyancy and weight and also when the centre of buoyancy C and mass G are aligned on the same vertical, with the unit in horizontal trim.

To obtain such a condition, trim tanks (aft and fore) and central compensating tanks are used and, since the reserve buoyancy has to be eliminated, the negative tank, if any, is to be filled (see Ch 1, Sec 1, [3.3]).

d) Equilibrium water: this is the amount of water shared between the compensating tanks and the trim tanks, corresponding to the difference between the reserve buoyancy and the standard ballast water (contained in double bottoms and in the buoyancy tank - see Ch 1, Sec 1, [3.2]).

e) Blowing trim or breaking surface (rigged to diving): this condition applies when, opening the kingston valves and the air vents of ballast tanks, the kingston valves of the buoyancy tank are also opened but its air vents are not; a small amount of water flows into this tank compressing the air up to a pressure equal to the value of hydrostatic pressure at corresponding depth. When air vents are opened, the unit submerges.

1.3 General design conditions and stability criteria

1.3.1 Adequate stability is to be provided, both underwater and on the surface, as well as in all intermediate and emergency conditions.

While on the surface, the transverse metacentric height is to be similar to that required in surface ships.

Lower values can be accepted in small size units, provided that the centre of mass is always located under the centre of buoyancy. However, actual metacentric height (ρ - a) is to be equal to or greater than 0,04 D, D being the outer diameter of the pressure hull, in m.

In any case, (ρ - a) > 0 is always to result up to a transverse trim of 75°.

If manned navigation on the surface is required, a freeboard deemed acceptable by Tasneef is to be granted and adequate protection of gangways is to be provided.

1.3.2 *(1/7/2023)*

In small size units, adequate negative buoyancy is to be provided (to be obtained only by means of thrusters, because positive buoyancy must always exist in any working condition) for any unit involved in work on the seabed, in such a way that it is transversely stable even when lying on ground having an inclination of 25° with respect to the horizontal.

Furthermore, the centre of mass is to be in such a position that sufficient stability is granted when:

a) the unit is on the surface in waves of height equal to the intended navigation and operative conditions, when surfaced with open hatches, as stated in the class certificate in accordance with Pt A, Ch 1, Sec 2, [3.1.1]; if not otherwise specified, the significant wave height is to be assumed not less than 2,5 times the height of the hull (from keel to weather deck). ~~The wave height limiting the possibility of personnel boarding when the unit is floating is determined by assuming that the lowermost point of the sill of the openings from the waterline, assumed in still water, is to be not less than 1,5 times the height of such a wave.~~

Unprotected openings when the unit is operating in surface are to be at a height of not less than ~~twice~~ one meter above ~~such~~ the reference wave height in all the foreseeable loading conditions when surfaced.

~~With respect to the wind intensity (F), the maximum wave heights (H, in m) reported in Tab 1 are to be assumed.~~

~~If the unit is to be launched already manned from the supply ship, the sea state which inhibits launch is to be related to the possibility that such operation must be performed in complete safety.~~

Table 1-

F	0	1	2	3	4	5	6	7	8	9
H (m)	0	0,1	0,5	1,25	2,5	4	6	9	14	20

b) roll angle is $\leq$ 45°, port and starboard.

It is also to be ensured that:

- in static condition for the unit, longitudinal shifting of weights or equipment within the unit does not produce a trim variation greater than 5°;
- in any self-propelled unit, a zero buoyancy condition is achievable in immersion, at any speed of the unit and in any possible working condition;
- if ballast items or any other part dismountable from the hull exist, their attachment to the hull is adequately designed and their abandonment possible with a longitudinal and/or transverse trim of at least 10°;
- habitats (with at least 3 legs) are stable on ground with an inclination of at least 25° with respect to the horizontal;
- fully equipped ballasted bells have a negative buoyancy equal to at least 3000 N, with a diver on board and without water in the gangway trunk;
- fully equipped non-ballasted bells have a positive buoyancy equal to at least 2000 N, with the maximum allowable number of divers on board and with the gangway trunk filled with water;
- the weight of a diver fully equipped and with fully charged breathing cylinders is assumed equal to 1000 N;
- the centre of mass of bells is located underneath the centre of buoyancy, both in normal and in emergency conditions.

1.3.3 In large size units, the percentages of the equilibrium trim displacement on the surface to be achieved from the equilibrium water and from the permanent ballast are to be specified.

Load and position (frames) of permanent ballast are to be specified together with the indication of the partial centroidal coordinates (for every zone where such ballast is fitted) as well as of the coordinates of the total centre of mass of the ballast.

1.3.4 When a unit not in motion and without dynamic actions (at rest) submerges, its Δ_{sub} is not equal to its "in air" weight P, but lower; Δ_{sub} becomes equal to P by means of the "equilibrium system".

If $P < \Delta_{sub}$, the buoyancy S is positive and in such case the unit always tends to emerge. In units where $S > P$ is always verified (in this case immersion can be achieved only dynamically), the value of:

$S = V_{c\ sub} \cdot \gamma$

$V_{c\ sub}$ being the volume of displaced water of the unit completely submerged, can be calculated assuming:

γ = 1 t/m^3 (fresh water).

1.4 Stability calculations

1.4.1 Four copies of the trim and stability booklet with Instructions to the Master containing data related to the stability test, carried out with the unit on the surface and completely submerged, attended by a Tasneef Surveyor and including the necessary information on the following conditions for the unit, where applicable, including the equilibrium polygon (see [1.6]) and the calculations under Ch 2, App 1, [3.3], are to be submitted, together with the required diagrams and capacity plan:

- dry lightweight condition, corresponding to the unit on the surface, with the complete hull, outfitting, arrangements and plants for the specific service for which it is intended to operate. The following are not to be considered: movable weights of any type and, in particular, fluid circulating in the hull and engine room; high pressure air in cylinders and/or pressure vessels, as well as any equilibrium water; crew with their personal effects;
- surface navigation at full load, in towed condition;
- surface navigation at full load, in departure condition;
- surface navigation at full load, in arrival condition;
- blowing trim (rigged to diving);
- in immersion, at an intermediate depth between surface and maximum operating depth.

  Due to the fact that in this condition the stability index "a" is valid both for transverse and longitudinal inclinations, the critical condition generated by longitudinal shifting of even small loads, due to the relevant values of righting levers, is to be assessed;
- at maximum operating depth;
- lying on the seabed, both flat and on a plane transversely inclined at an angle of 25° (see Part B, Ch 2, Sec 2, [1.2] and [1.3]);
- in working condition on the seabed;
- during loading of weights (rock samples, etc.) on the seabed;
- during immersion and emersion phases, with particular consideration of free surfaces, to assess whether, as far as practicable, when the centre of gravity and the centre of buoyancy of the unit coincide, there is still shape stability (see [1.5]).

  In large size units, stability during fast ascension is to be checked with the unit subjected to a heeling moment (generated by an existing transverse trim due, for instance, to shifting of a weight or to unsymmetrical water charging).
- in zero stability condition;
- in equilibrium trim, on the surface;
- in equilibrium trim, underwater;
- during emergency emersion, including the condition with lateral ballast tanks unsymmetrically loaded, by

SECTION 3 PUMPS, PIPING AND FITTINGS FOR HULL AND MACHINERY

1 Introduction

1.1 General

1.1.1 Pt C, Ch 1, Sec 10 of the Rules is to be applied, in addition to the requirements of these provisions, as far as possible and reasonable.

2 Systems and their arrangement

2.1 General

2.1.1 All piping is to be considered class I.

2.1.2 The Manufacturer is to communicate the list of essential systems for manoeuvre and safety by sending, for approval, the relevant diagram, with indication of all the necessary elements for review and in particular the maximum working and design temperatures and pressures, as well as the type and mechanical and chemical characteristics of the materials used.

2.1.3 The drawings of all passages of piping through the resistant hull are to be sent for approval. However, these passages are to be limited and the use of stuffing box type devices is to be avoided as far as possible.

2.1.4 Essential services are to have dual controls, one of them manual if possible.

2.1.5 The parts of the piping exposed to salt water are to be protected by special paint and/or linings.

2.1.6 Piping and its fittings which may be directly or indirectly connected to the sea are to be dimensioned with the same safety coefficient requested for the resistant hull.

2.1.7 *(1/7/2023)*
All piping passing through the resistantpressure hull is to be equipped with 2 consecutive and easily accessible valves, one which is fail closedset type (based on a FMEA analysis agreed with Tasneef) and the other which is manually operated; both valves are to be located within the resistantpressure hull and the first one secured directly to the shell plating. If this is not possible, the part between the passage through the hull and the first valve is to be designed for an inner pressure equal to the collapse pressure of the resistant hull.

Pumps, valves, cocks and other fittings are to be located in an easily accessible position. They are to be distinguished by marks indicating their function and the circuit they serve; all valves and cocks are to be equipped with an "open/closed" indicator and they are to be protected from impacts.

2.1.8 Circuits installed outside are to be conveniently protected from impacts. Where possible, pumps and vessels are to be installed inside the resistant hull.

2.1.9 All piping and associated fittings are to be distinguished by a colour code; the relative code is to be displayed on board where it is visible to the crew. Persons concerned may colour either the entire piping or limited stripes. In particular, piping is to be coloured next to valves, connections, intersections, joints, equipment, bulkheads and in any other positions where this is deemed necessary.

Generally, the colours used are indicated in Tab 1 for piping relative to different on-board services, except for breathing service (see Sec 4, [1.1.1] c)).

An arrow indicating the direction of the flux may be required to be added. If so, it is added on the piping next to the distinctive colour and it is painted in black or white in order to contrast with the colour of the piping.

Table 1

COLOUR	PIPING AND FITTINGS
Green	Water
Silver-grey	Steam and overheated water
Brown with pink stripe	Mineral oils, vegetable oils, liquid fuels
Yellow ochre	Different gases (in gaseous or liquid state, provided that they differ from those in Sec 4, [1.1.1] c)
Violet	Acids and alcohols
Light blue	Air
Black with yellow stripe	Other liquids

2.1.10 Flexible hoses will be considered case-by-case; however, they are to be reduced to a minimum.

The use of metallic or other material for high pressure flexible hoses will be specially considered by Tasneef.

2.1.11 Fittings are not to be arranged on piping unless they are suitably fixed to the hull, especially if vibrations are appreciable.

2.1.12 See also Sec 4 concerning piping and valves relative to systems and arrangements for underwater work.

2.1.13 See Pt A, Ch 2, Sec 2, [3.6] for tests on piping.

SECTION 4 BREATHING SYSTEM

1 General

1.1

1.1.1

a) It is assumed that the air breathed in an isobaric environment is composed of the following elements:

- N_2 = 79% ± 0,5% (in volume),
- O_2 = 21% ± 0,5% (in volume) (23% in weight),
- CO_2 (max) = 300 ÷ 450 ppm,
- CO(max) = 10 ppm,
- vapours of non-toxic oil (max) = 1 mg/m^3,
- vapours of toxic oil (max) = 1 ppm,
- steam = 0,5 g/m^3,
- NO_2 + NO (max) = 0,5 g/m^3,
- solid particles, dust etc. = residual whose dimensions are less than 5 µm verified by filtering 5 dm^3 of air through a filter which passes solid particles whose dimensions are not greater than 5µm

b) Pipes and associated accessories for different gases of the breathing systems are generally to be distinguished by the colours indicated in Tab 1.

Table 1

Gas	Valves and piping	Bottles
N_2	Grey with black stripes or completely black	Grey with white stripes or completely black
O_2	White	Black with white stripes or completely white
NO	Light blue	Light blue
He	Brown	Brown
H_2	Red	Red
CO_2	Grey	Grey
O_2 + He	White and brown	Brown with white stripes
~~aria~~Air	White and black	~~Grey~~White and black

When a bottle contains 2 or more gases mixed with each other, the head is to indicate the colours of the gases divided into alternate segments. Each bottle is to be marked with the name and chemical formula of the content or the percentage of components in the mixture. The code of the above-mentioned colours is to be displayed on board in a suitable position where it can be easily consulted.

Flexible hoses with quick couplings can be used on board the support ship in order to permit substantial flexibility in distribution operations.

c) the type of lubrication oil of breathing mixture compressors is not to make the mixture unsuitable for breathing.

Vegetable oil is to be used for breathing air compressors; the use of mineral oil is not allowed.

2 Oxygen system - Consumption and characteristics of the gas

2.1 General

2.1.1 The oxygen consumption per person is assumed to be 1,14 l/min at 20°C and 0,1 MPa in working conditions; air consumption is 20 times greater than this, under the same conditions.

However, the quantity provided, including the amount for emergencies, is to be enough for the duration of the entire mission, plus 72 hours. Tasneef may waive this requirement, partially or totally, taking into account the type of unit as well as the brevity and low hazard level of the mission. The following oxygen consumption can be considered to estimate particular design conditions:

- person who is sleeping 0,25 l/min
- person who is sitting 0,30 l/min
- person who is standing 0,40 l/min
- person who is walking slowly 0,60 l/min
- person who is walking slowly on the (muddy) seabed -1,1 l/min
- person who is swimming at 0,5 knots 0,80 l/min
- person who is swimming at 0,85 knots 1,4 l/min

For units equipped with diver-lock-out, at least 72 breathing hours are to be foreseen for each person who remains in transfer-lock.

In emergency conditions, oxygen consumption per person can be reduced to 26 l/h, but it is to be borne in mind that, when tense, a person consumes 1,5 l/min of oxygen.

Oxygen quantity which is already in the rooms at the beginning of the mission is not to be considered for supplying purposes.

The oxygen content in each room is not to be more than 22% in volume, at the pressure of 0,1 MPa, in order to reduce fire hazards.

As an indication, the main oxygen characteristics are given below:

- boiling temperature θ_e = -182,96 °C

b) Automatic control

When these systems are used, the system design is to include a careful evaluation of safety in respect of fire hazards of an electrical nature.

In the case of failure of the automatic control, manual control of the system must be possible. Any deficiency in the automatic control system is to generate a signal.

O_2 partial pressure is to be continuously monitored. Type approved portable O_2 analysers are to be used for continuous measurement of the oxygen concentration in the air or in other gases.

3 Carbon dioxide

3.1 General

3.1.1 *(1/7/2023)*

Carbon dioxide breathed out by each person in working conditions is to be calculated on the basis of the reference operative profile taking into account the percentage of time at work and time in rest; when the reference operative profile is not available, the Carbon dioxide can be assumed to be 25 l/h, at 20°C and 0,1 MPa; alternative calculation methods may be accepted when supported by appropriate technical backgroundif people stand still, this value is reduced to 22 l/h per person (actually, each person produces on average 17,5 l/h of carbon dioxide at 20°C and 0,1 N/mm^2).

The normal level of carbon dioxide in the inner atmosphere is assumed to be 0,3% in volume (the maximum admissible value is 1,5%); during design it is assumed that the average level of carbon dioxide is 0,5% (5000 ppm) (at atmospheric pressure, not in hyperbaric conditions). The value of admissible partial pressure of carbon dioxide, in isobaric atmosphere, is 5 hPa in normal operating conditions; in hyperbaricemergency conditions, the partial pressure of carbon dioxide is not to exceed 20 hPathreshold is 2,6 hPa and below 200m depth the value goes down to 2 hPa.

During the design of the breathing system, it is to be anticipated that the carbon dioxide quantity to be eliminated is at least 20% more than the amount which can be produced inside the unit. The length of the stay is to be considered equal to the planned duration of the mission increased by 72h.

The breathing system is to be made of materials which are non-combustible, non-toxic, non-corrosive and non-reactive with carbon dioxide. Nor are they to be reactive with substances used as absorbers (e.g. if the use of alkaline absorbers, such as LiOH and KO_2, is foreseen, Al is not to be used unless it is adequately covered).

Solid absorbers are to be in grain or without dust. Spare absorber materials are to be stowed in inert and hermetically closed spaces (Al vessels are not to be used for alkaline absorbers) in order to prevent any deterioration. Some absorbers have an expiry date stamped by the supplier.

Absorbers in capsules, located in suitable positions, may be utilised.

A gauge is to be fitted to continuously indicate the percentage of carbon dioxide in the rooms; alternatively, a visual alarm is also acceptable.

SECTION 1 GENERAL

1 General

1.1

1.1.1 Electrical installations and equipment are to be in accordance with Part C, Ch 2 of the Rules, except as modified in this Section.

2 Documents to be submitted

2.1

2.1.1 The documents listed in Tab 1 are to be submitted in addition to those (where relevant) listed in Pt C, Ch 2, Sec 1, Tab 1 of the Rules.

3 Definitions

3.1 Essential services

3.1.1 Essential services are those services that need to be in continuous operation for:

a) maintaining the unit functionality

b) assuring the safety and health in a hyperbaric environment

c) monitoring of the divers by the crew.

All services supporting divers in the water, in a bell, in a decompression chamber are essential.

3.2 Emergency services

3.2.1 Emergency services are those services that are essential for safety in an emergency condition.

Examples of these services include:

a) condition monitoring of emergency batteries

b) emergency lighting

c) communication systems

d) life support systems

e) heating systems

f) alarm systems for the above services.

4 Environmental conditions

4.1

4.1.1 All electrical equipment is to be designed and constructed for the environment in which it will operate.

4.1.2 Electrical equipment installed in hyperbaric environments is not to be damaged by pressurisation and depressurisation of the environment.

4.1.3 *(1/7/2023)*

Electrical equipment installed inside a compression chamber is to be designed for hyperbaric use, oxygen-enriched atmospheres (when applicable), high humidity levels and marine application.

5 Materials and components

5.1 Insulating materials

5.1.1 Insulating material used in the construction of panels and switchboards is to be of a type that does not give off toxic gases in the event of fire.

5.2 Batteries

5.2.1 Specifications and sufficient test data or details of operating experience are to be provided to ascertain that the batteries can reliably perform for their estimated life under their service conditions.

5.2.2 Gas emission data, as applicable, are also to be considered.

5.3 Plug and Sockets

5.3.1 Electric plugs, sockets and receptacles are to be of types which prevent improper interconnections of the various systems and are to be provided with a means of securing after connection is made.

Table 1 : Documents to be submitted

No	I/A	Document
1	I	Plans showing electrical equipment arrangement
2	A	Single line diagrams of communication systems
3	I	Complete list of components and documentation on any tests carried out on all electrical equipment to be permanently installed within chambers and bells

SECTION 2 DECOMPRESSION CHAMBERS

1 General

1.1

1.1.1

a) A galley is not to be fitted in a decompression chamber: pre-packaged provisions are to be supplied from outside.

b) Inside the decompression chamber, a quick control is to be fitted to open the safety valves if the inside pressure exceeds the expected values. It is to be operated if the safety valves do not automatically open at the set pressure.

c) The general scheme of a hyperbaric system related to a decompression chamber is shown in Fig 1, where the symbols mean:

AG : sampling system for gas analysis

CIS : hyperbaric chamber for the stay

RIF/O_2 : O_2 supply

QC : pressure monitoring and control consoles

D/CO_2 : O_2 purification

RU : humidity control

DO : odour purification

PC : circulating pump

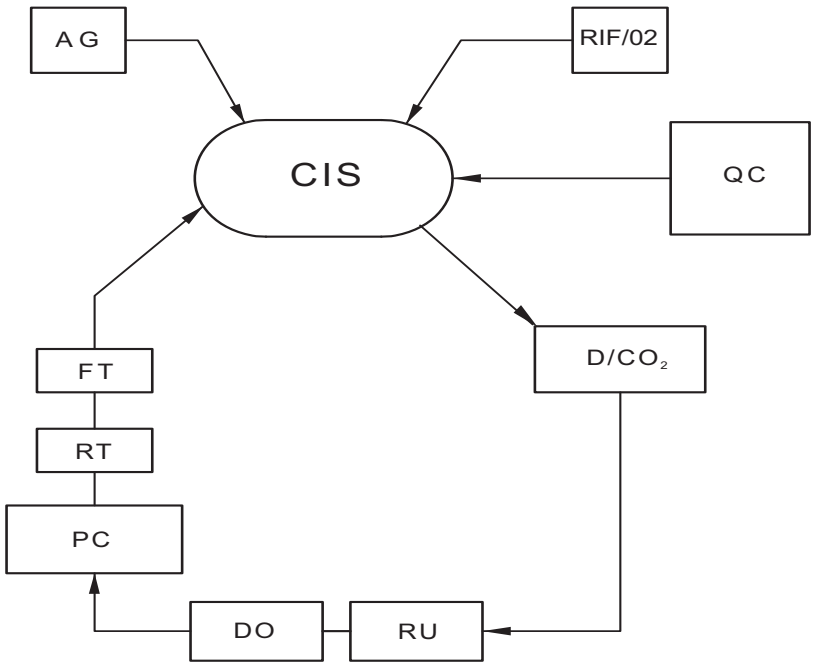
RT : temperature control

FT : filter of aluminium-potassium permanganate

d) At the end of the decompression cycle, or after therapeutic treatment, the diver is to remain near a decompression chamber for 12 hours and he is not to undertake a new cycle of underwater work for 24 hours.

Decompression chambers are to be soundproof and thermally insulated and they are to be equipped with a redundant heating plant, in order to guarantee divers a comfortable environment.

Figure 1



2 Details/features of decompression chambers

2.1 ~~Different arrangements~~General requirements

2.1.1 *(1/7/2023)*

a) The decompression chamber is to be operated by a pressure manual control. In addition, an automatic control system is to be fitted, which can be overridden at any time.

A valve which permits a maximum depressurisation equivalent to 10 m/min emersion speed is to be provided~~.~~; compartments that may be used for transfer of food and materials may be provided with an additional valve allowing the fast depressurization/pressurization at a maximum rate of 2 bar/min when the internal pressure exceeds 2 bar.

Depressurisation is to be controlled from outside the chamber.

In the chamber, partial O_2 pressure is not to be more than 0,1MPa and, for O_2 therapy treatment, O_2 release or adequate ventilation is to be provided in order to maintain the O_2 concentration below 30%, to reduce the fire hazard.

These chambers are not to be so small that the operator cannot stay in a fully upright position; openings are to let a fully equipped diver enter and exit without difficulty (even if carried on an hyperbaric stretcher).

The inner space is to permit at least one other person to enter.

If the decompression period is at least 24 hours, the inner space is to be such that two persons are able to stand up inside comfortably.

The minimum value of the inner height is to be:

- 1,50 m, for chambers where it is anticipated that divers will stay for no longer than 12 hours;
- 2 m, for chambers where it is anticipated that divers will stay for more than 12 hours, but not longer than 2 weeks;
- 2,10 m, for chambers where it is anticipated that divers will stay for more than 2 weeks.

The minimum diameter of the opening for transit from one chamber to another, under inner pressurisation condition, is to be 600 mm.

The length of the chamber is to be such that it allows divers to lie on the floor.

It is recommended that at least two decompression chambers should be available on the support ship; if only one chamber is fitted, it is to have two compartments, each with a separate door which can be opened from both sides.

The O_2 quantity is to be such that it permits four persons to simultaneously undergo the longest O_2 therapy in accordance with the treatment tables.

Decompression chambers are to be equipped with a breathing mixture purification system which is always able to maintain the CO_2 level below 5hPa.

Viewports are to be located on the chamber itself, in accordance with the requirements of Pt B, Ch 1, Sec 5, [2] and Pt D, Ch 1, Sec 2, [1].

Openings are to be provided, through which food or anything else can be introduced, leaving the operator inside under pressure.

Decompression chambers are to be built so that the installed equipment does not produce annoying noise when in operation.

If decompression chambers are connected together, they are to be well aligned, if necessary, with chocks: the maximum allowable gap between flanges of the connecting assembly is not to be more than that stipulated by the Manufacturer.

A safety valve is to be fitted suitable for discharging excess gas so that inside the pressure does not exceed 10% of the expected value.

This valve is to be suitably protected from impacts and it is to be set at a pressure value not greater than 3% of the maximum working pressure. A high pressure audible alarm is to be fitted; the alarm is to be given before the safety valve opens. The use of rupture discs is not allowed, even if they are associated with safety valves.

The discharge of safety valves is to be led to the open air, in a "safe" position.

In addition, a manual device is to be fitted to permit the quick closure of the safety valve. It is to be protected by a fragile screen, which can be broken easily if necessary. It is recommended that this screen should not be made of glass.

b) Decompression chambers can have smaller dimensions than those indicated in a), if they are not specifically designed to be permanently located on board the support ship, and they are exclusively used for emergency therapeutic recompression of an injured diver. Their inner volume is to be such that it does not create CO_2 build-up.

In addition, they are to be equipped with at least:

- a food lock,
- an equilibrium chamber,
- a direct entrance to the main chamber (without passing through the equilibrium chamber),
- a bed,
- a chair for a possible assistant.

c) An essential component of the hyperbaric system of the decompression chambers is the ECU (Environmental Control Unit), which is the automatic control system of the inner atmosphere.

This automatic system has to be designed to assure the maintenance of the stated temperature with ±1% °C of accuracy and the relative humidity with ±3% of accuracy. In addition, it has to remove the CO_2 produced by persons who are inside the chambers.

In general, it is external to the chamber, i.e. it supplies circulation, heating or cooling and dehumidification of the breathing mixture from outside the chamber: during decompression, divers do not have to carry out any manoeuvres inside the chamber.

SECTION 3 UMBILICAL

1 General

1.1 Arrangement and characteristics

1.1.1 The flexible hoses constituting the umbilical are to contain a steel strength rope which, in normal conditions, can support the weight.

In rest conditions, on board the support ship, umbilicals are to be reeled in on a drum of suitable diameter, or laid in overlapped coils, within an appropriate housing. Suitable holes are to be made on the bottom of the housing to avoid water stagnation.

1.1.2 The umbilical may contain:

- gas supply hoses (compressed air, N_2-O_2 mixture, O_2, He, He-O_2 mixture) or pipes to pressurise the inner part of the bell;
- a hose to convey the no longer suitable breathing mixtures and CO_2 to the surface;
- a cable for audio communications;
- a cable for video communications;
- a cable for the supply of electrical users, if any
- a hot water supply hose for the heating coils of the bell and for the umbilical connected to the wetsuits of divers (hookah, as described in point i) below).

The following requirements apply:

a) flexible hoses for breathing mixture are to be manufactured without joints and made of materials which are hydrocarbon and salt water resistant (synthetic rubber or similar materials suitably reinforced). The materials are also to be resistant to the conveyed gases at temperatures ranging from -40°C to 60°C. In addition, they are not to generate toxic vapours when heated at 60°C;

b) flexible hoses for hot water are to be manufactured without joints and made of synthetic rubber or similar materials which are chemically resistant to water up to 99°C;

c) in the event of failure or breakage of the pressurisation hose, automatic non-return valves are to isolate the hoses and the independent gas circuit is to be brought into operation from inside. The gas circuit is supplied by bottles fitted outside the bell;

d) the umbilical is to be manually coupled to the strength rope, on the surface, during the immersion phase, by suitable chains (a connection approximately every 30 m). The purpose of this is to reduce their separation due to currents;

e) all cables are to be certified by the Manufacturer as suitable to be used with external temperatures ranging from -40°C to 60°C;

f) the umbilical is not to be subject to bending stress in way of its connection to the pressure hull and penetrator;

g) an emergency release device for the umbilical is to be provided in the bells;

h) two groups of bottles are to be installed on the bell frame, mounted so that they can operate independently of each other. An O_2 bottle is also to be installed to supplement the consumed oxygen;

i) during their stay on the seabed, divers operating outside are to be connected to the bell by the umbilical called "hookah". It consists of:

   1) a flexible hose for breathing mixture supply (working pressure: 1MPa plus the value in MPa of hydrostatic pressure the diver is subjected to)

   2) a flexible hose for wetsuit heating and

   3) a cable for communication with the bell;

j) the mechanical characteristics of the strength ropes are to be specified by the Manufacturer and subjected to the approval of Tasneef (see Sec 4, [1]);

k) the umbilical is to be well protected from impacts or any other mechanical damage;

l) the length of the umbilical and lifting ropes is to be such as to permit an excursion of the bell 5% longer than the local depth of the sea;

m) the electrical cables inside the umbilical are not to have joints.

2 Constructional details

2.1

2.1.1 *(1/7/2023)*

The umbilical is to include a steel core whose ultimate tensile strength can withstand a load which is at least twice the weight in air of the bell itself, in the case of strength rope failure.

Umbilicals are to be designed, tested and certified in accordance with a recognised standard such as ISO 13628-5, or equivalent~~The umbilical is to have a steel core if its diameter is equal to or greater than 40 mm (see Fig 1). For smaller diameters, it is acceptable for its resistant part to be distributed on its perimeter (see Fig 2)~~.

Figure 1

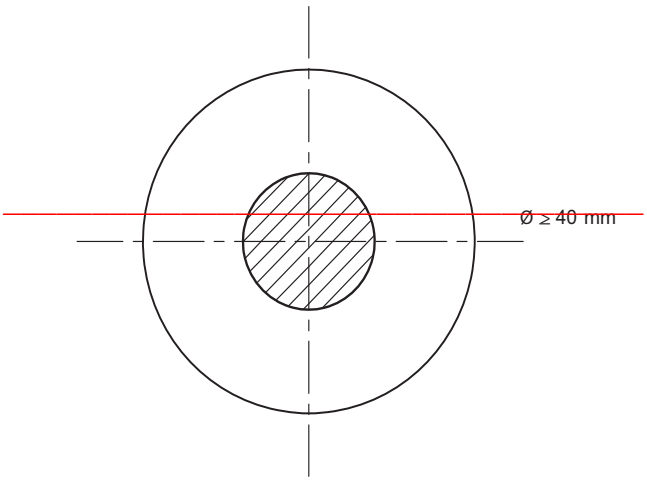
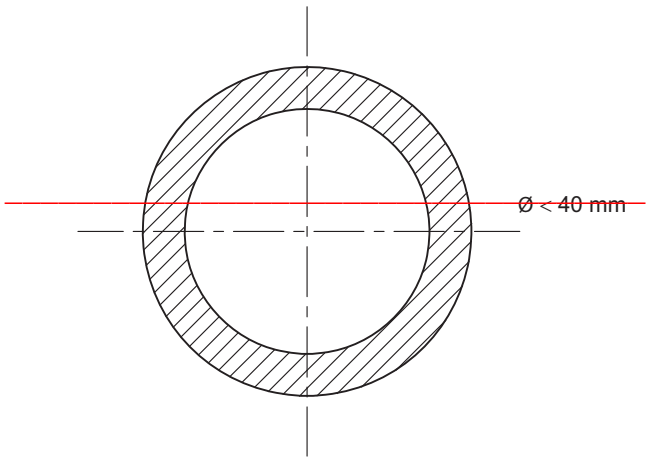


Figure 2



2.1.2 The bursting pressure of the flexible pipe constituting the external casing of the umbilical is to be at least four times greater than its working pressure. It is to be designed for an external pressure equal to the bell pressure increased by 300 m.

It is to be able to withstand accidental bending.

Its metallic joints are to be corrosion-resistant and protected against accidental unhooking and are to have the same strength characteristics as the flexible hose.