RULES FOR THE CLASSIFICATION OF STEEL SHIPS

(Development Review : External opinion inquiry)

Part 9 ADDITIONAL INSTALLATIONS

2019. 09.

Machinery Rule Development Team

-Main Amendments-

(1) Effective Date : 1 July 2019 (Date of which contracts for construction are signed)

◉ Ch 1 CARGO REFRIGERATING INSTALLATIONS
- Requirement for equivalency has been amended.

◉ Ch 9 CARGO VAPOUR EMISSION CONTROL SYSTEMS
- Application has been amended.
- Overfill control system and high level alarm system has been amended.

Present	Amendment	Reason
CHAPTER 1 CARGO REFRIGERATING INSTALLATIONS **Section 1 General** **101. General** **1. <omitted>** **2. Special installations** The surveys and constructions of refrigerating installations to which the requirements in this chapter can not be directly applied for a special reason are to be deemed appropriate at the discretion of the Society. **3. Equivalency** Refrigerating installations, which do not comply with requirements of the Rules may be accepted, provided that they are deemed by the Society to be equivalent to those specified in the Rules.	**CHAPTER 1 CARGO REFRIGERATING INSTALLATIONS** **Section 1 General** **101. General** **1. <omitted>** **2. Equivalency** The equivalence of alternative and novel features which deviate from or are not directly applicable to the Rules is to be in accordance with **Pt 1, Ch 1.** **3. <deleted>**	(amended) -align with other Rules.
CHAPTER 9 CARGO VAPOUR EMISSION CONTROL SYSTEMS **Section 1 General** **101. Application** **1. <omitted>** **2.** The requirements in this Chapter are based on the technical requirements of **IMO MSC/Circ. 585** and **USCG CFR 46 Part 39**, and the connection with each Section are as follows: (1) ~ (3) <omitted>	**CHAPTER 9 CARGO VAPOUR EMISSION CONTROL SYSTEMS** **Section 1 General** **101. Application** **1. <omitted>** **2.** The requirements in this Chapter are based on the technical requirements of **IMO MSC/Circ. 585** and **USCG CFR 46 Part 39**. The Rules apply to be registered the class notation in accordance with **Pt 1, Ch 1, Sec 2**. (1) ~ (3) <deleted>	- IMO MSC./Circ.585 & USCG CFR 46 Part 39

Present	Amendment	Reason
Section 2 Requirements for VEC1 Notation	**Section 2 Requirements for VEC1 Notation**	
203.	**203.**	
204. Cargo tank high level alarm	**204. Overfill control system**	(Amended) - IMO MSC./Circ.585 & USCG CFR 46 Part 39
1. Each cargo tank is to be equipped with an high level alarm. The high level alarm is to: (1) be independent of the cargo gauging system; (2) come into operation when the normal tank loading procedures fail to stop the tank liquid level exceeding the normal full condition; (3) give a visual and audible tank overflow alarm to the ship's operator; (4) ~ (7) <omitted> (8) <newly added>	**1.** Each cargo tank is to be equipped with an overfill control system. The overfill control system is to: (1) be independent of the cargo gauging system required by **203.**; (2) come into operation when the normal tank loading procedures fail to stop the tank liquid level exceeding the normal full condition. The overfill alarm is to be activated early enough to allow the person in charge of transfer operations to stop the cargo transfer before the tank overflow; (3) give a visual and audible tank overfill alarm to the ship's operator; (4) ~ (7) <same as the present> (8) The overfill alarms are to be identified with the labels "TANK OVERFILL ALARM" respectively, in black letters at least 50 mm high on a white background.	
Section 3 Requirements for VEC2 Notation	**Section 3 Requirements for VEC2 Notation**	
302. Overfill Alarm	**302. High level alarm system**	
1. Each cargo tank of a tanker is to be equipped with an overfill alarm system (High-high level) which complies with the followings: (1) The overfill alarm system is to be independent of the cargo gauging system and the high level alarm system; (2) At each cargo control station, the high level alarms required by **204.** and the overfill alarms are to be identified with the labels "HIGH LEVEL ALARM" and "TANK OVERFILL ALARM" respectively, in black letters at least 50 mm high on a white background; (3) The high level alarm required by **204.** is to be set at no less than that corresponding to 95 % of tank capacity. The overfill alarm is to come into operation after the high level alarm, but early enough to allow for action to prevent tank overflow;	**1.** Each cargo tank of a tanker is to be equipped with an High level alarm system which complies with the followings: (1) High level alarm system is to be independent of the high level alarm system; (2) The high level alarms is to be identified with the labels "HIGH LEVEL ALARM" in black letters at least 50 mm high on a white background; (3) The high level alarm ~~required by **204.**~~ is to be set at no less than that corresponding to 95 % of tank capacity. The high level alarm is to come into operation before overfill alarm .	

Present	Amendment	Reason
(4) The overfill alarm system is to give a visual and audible tank overfill alarm to the ship's operator; (5) Visible and audible alarms are to be fitted so that it can be seen and heard at the cargo control station and in the cargo deck area; **【See Guidance】** *(2018)* (6) The overfill alarm system is to alarm in the event of loss of power to the alarm system or failure of the electrical circuitry to the tank level sensor; and (7) The overfill alarm system is to be able to be checked at the tank for proper operation prior to each transfer or contain an electronic self-testing feature which monitors the condition of the alarm circuitry and sensor.	(4) The high level alarm system is to give a visual and audible tank high level alarm to the ship's operator; ~~(5) Visible and audible alarms are to be fitted so that it can be seen and heard at the cargo control station and in the cargo deck area; **【See Guidance】** *(2018)*~~ (6) The high level alarm system is to alarm in the event of loss of power to the alarm system or failure of the electrical circuitry to the tank level sensor; and (7) The high level alarm system is to be able to be checked at the tank for proper operation prior to each transfer or contain an electronic self-testing feature which monitors the condition of the alarm circuitry and sensor.	(Amended) - IMO MSC./Circ.585 & USCG CFR 46 Part 39

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-Main Amendments-

(1) Effective Date : 1 July 2019 (Date of which contracts for construction are signed)

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- Requirement for equivalency has been amended.

◉ Ch 9 CARGO VAPOUR EMISSION CONTROL SYSTEMS
- Application has been amended.
- Overfill control system and high level alarm system has been amended.

Present	Amendment	Reason
CHAPTER 1 CARGO REFRIGERATING INSTALLATIONS **Section 1 General** **101. General** **1. <omitted>** **2. Special installations** The surveys and constructions of refrigerating installations to which the requirements in this chapter can not be directly applied for a special reason are to be deemed appropriate at the discretion of the Society. **3. Equivalency** Refrigerating installations, which do not comply with requirements of the Rules may be accepted, provided that they are deemed by the Society to be equivalent to those specified in the Rules.	**CHAPTER 1 CARGO REFRIGERATING INSTALLATIONS** **Section 1 General** **101. General** **1. <omitted>** **2. Equivalency** The equivalence of alternative and novel features which deviate from or are not directly applicable to the Rules is to be in accordance with **Pt 1**, **Ch 1.** **3. <deleted>**	(amended) -align with other Rules.

Present	Amendment	Reason
CHAPTER 2 CARGO HANDLING APPLIANCES **Section 1 General** **101. General** **1. <same as the present Rules>** **2. Equivalency** (1) Cargo gear, cargo ramps and loose gear which do not comply with the requirements of the Rules may be accepted, provided that they are considered by the Society to have the effectiveness equivalent to those complying with the Rules. (2) Any existing cargo gear, cargo ramps and loose gear designed and manufactured not under the requirements of the Rules may be deemed by the Society to comply with the Rules, provided that they comply with any rules or standards recognized by the Society to be appropriate and have passed the tests and inspection required by the Society. **【See Guidance】** <hereafter, same as the present Rules> ***Section 2 Surveys*** ***<omit>***	**CHAPTER 2 CARGO HANDLING APPLIANCES** **Section 1 General** **101. General** **1. <same as the present Rules>** **2. Equivalency** The equivalence of alternative and novel features which deviate from or are not directly applicable to the Rules is to be in accordance with **Pt 1, Ch 1** of the Rules for the Classification of Steel Ships. *(2020)* **【See Guidance】** <hereafter, same as the present Rules> ***Section 2 Surveys*** ***201.~ 202. <same as current>*** **203. Registration Surveys** **1., 2. <same as current>** **3.** (1) (A) (B) Non-destructive test (When considered necessary by the Surveyor) **【See Guidance】** <hereafter, same as the present Rules>	* amendment due to reorganization of rules related to equivalency

Effective Date : 1 January 2020

(The contract date for ship construction or an application date for certification of an engine)

◉ reflected IACS UR M35(Rev.8 Jan 2019) and M36(Rev.6 Dec 2018)

- The requirements for alarm of high oil mist concentrations in the crankcase have been amended to alarm the operation of the oil mist detection device or the bearing lubricant outlet temperature or the operation of the bearing temperature monitoring device.

Present	Amendment	Remark
CHAPTER 3 AUTOMATIC AND REMOTE CONTROL SYSTEMS	**CHAPTER 3 AUTOMATIC AND REMOTE CONTROL SYSTEMS**	
Section 1 - 2 <same as the present Rules>	**Section 1 - 2 <same as the present Rules>**	
Section 3 Centralized Monitoring and Control Systems for Main Propulsion and Essential Auxiliary Machinery	**Section 3 Centralized Monitoring and Control Systems for Main Propulsion and Essential Auxiliary Machinery**	
301. - 304. <same as the present Rules>	**301. - 304. <same as the present Rules>**	
305. Automatic and remote control of main propulsion machinery or controllable pitch propellers [See Guidance]	**305. Automatic and remote control of main propulsion machinery or controllable pitch propellers [See Guidance]**	(Amended) - Reflecting the IACS UR M35(Rev.8), alarm for high oil mist concentrations in the crankcase have been amended to alarm the operation of the oil mist detection device or the bearing lubricant outlet temperature or the operation of the bearing temperature monitoring device.
1. - 4. <same as the present Rules>	**1. - 4. <same as the present Rules>**	
Table 9.3.1 Crosshead diesel engines (2017) **Table 9.3.2 Trunk piston diesel engines** (2017)	**Table 9.3.1 Crosshead diesel engines** (2017)(2020) **Table 9.3.2 Trunk piston diesel engines** (2017)(2020)	
306. <same as the present Rules>	**306. <same as the present Rules>**	

<Amendments>

Table 9.3.1 Crosshead diesel engines (2017)(2020)

Systems	Monitored parameters [H: High L: Low O: Abnormal status]		AA	RI	Auto slow down with alarm	Auto start of Stand by pump with alarm	Auto shut down with alarm	Notes [AA = Alarm Activation RI = Remote Indication* ●=apply]
Sensors	Common or separate		c	c	c	s	s	c = common; s = separate
Lubri-cating oil	~~Oil mist concentration in crankcase - H or Main, crank, crosshead bearing temp. (or bearing oil outlet temp).- H~~ Activation of oil mist detection arrange-ments (or activation of the temperature monitoring systems or equivalent devices of: - the engine main, crank and crosshead bearing oil outlet; or - the engine main, crank and crosshead bearing)	~~H~~ O	●		●			For engines having power ≧ 2250 kW or cylinder bore > 300 mm (1)

<Amendments>

Table 9.3.2 Trunk piston diesel engines (2017)(2020)

Systems	Monitored parameters [H: High L: Low O: Abnormal status]		AA	RI	Auto slow down with alarm	Auto start of Stand by pump with alarm	Auto shut down with alarm	Notes [AA = Alarm Activation RI = Remote Indication* ●=apply]
Sensors	Common or separate		c	c	c	s	s	c = common; s = separate
Lubricating oil (Diesel engine)	~~Oil mist in crankcase, mist concentration(H) or main & connecting rod bearing temp. (or oil outlet temp.) (H) or an equivalent device~~ Activation of oil mist detection arrangements (or activation of the temperature monitoring systems or equivalent devices of: - the engine main and crank bearing oil outlet; or - the engine main and crank bearing)	H O	●				●	Only for medium speed engines having power ≧ 2250 kW or cylinder bore > 300 mm. ~~Single sensor~~ : for each engine, one oil mist detector (or engine bearing temperature monitoring system or equivalent device) having two independent outputs for initiating alarm and for shutdown will satisfy independence of alarm and shut-down systems. (1) An equivalent device could be interpreted as measures applied to high speed engines where specific design features to preclude the risk of crankcase explosions are incorporated.

Present	Amendment	Remark
307. Automatic and remote control of electric generating sets **1. - 4. <same as the present Rules>** **Table 9.3.8 Auxiliary diesel engines and auxiliary turbines (2017)** **308. - 310. <same as the present Rules>** **Section 4 - 5 <same as the present Rules>**	**307. Automatic and remote control of electric generating sets** **1. - 4. <same as the present Rules>** **Table 9.3.8 Auxiliary diesel engines and auxiliary turbines (2017)(2020)** **308. - 310. <same as the present Rules>** **Section 4 - 5 <same as the present Rules>**	(Amended) - Reflecting the IACS UR M36(Rev.6), alarm for high oil mist concentrations in the crankcase have been amended to alarm the operation of the oil mist detection device or the bearing lubricant outlet temperature or the operation of the bearing temperature monitoring device.

<Amendments>

Table 9.3.8 Auxiliary diesel engines and auxiliary turbines (2017)(2020)

Engine	System	Monitored parameters [H: High L: Low O: Abnormal status]		AA	RI	Auto start of Stand by pump with alarm	Auto shut down with alarm	Notes [AA = Alarm Activation RI = Remote Indication* ●=apply]
Diesel Engine	Lubricating oil	~~Oil mist in crankcase, mist concentration(H) or main & connecting rod bearing temp. (or oil outlet temp.) (H) or an equivalent device.~~ Activation of oil mist detection arrangements (or activation of the temperature monitoring systems or equivalent devices of: - the engine main and crank bearing oil outlet; or - the engine main and crank bearing)	~~H~~ O	●			●	Only for medium speed engines having power ≧ 2250 kW or cylinder bore > 300 mm. ~~Single sensor~~ : for each engine, one oil mist detector (or engine bearing temperature monitoring system or equivalent device) having two independent outputs for initiating alarm and for shutdown will satisfy independence of alarm and shut-down systems.(1) An equivalent device could be interpreted as measures applied to high speed engines where specific design features to preclude the risk of crankcase explosions are incorporated.

Effective Date : 1 July 2020

(The contract date for ship construction)

- Chapter 4 Dynamic Positioning Systems : reflected MSC.1/Circ.1580

Present	Amendment	Remark
CHAPTER 4 DYNAMIC POSITIONING SYSTEMS **Section 1 General** **101. General** **1. Application** The requirements in this Chapter apply to the ships intended to be registered as ships provided with dynamic positioning systems. **2.** <same as the present Rules> **3. Classes of dynamic positioning systems** Dynamic positioning systems are classified and defined by their worst case failure modes as follows: (1) DPS(0), DPS(1) Loss of position may occur in the event of a single fault. (2) DPS(2) A loss of position is not to occur in the event of a single failure in any active component or system. Normally static components will not be considered to fail where adequate protection from damage is demonstrated. Single failure criteria include: (A) - (B) <same as the present Rules> (3) DPS(3) A loss of position is not to occur in the event of a single failure. A single failure includes: (A) - (C) <same as the present Rules>	**CHAPTER 4 DYNAMIC POSITIONING SYSTEMS(DP SYSTEMS)** **Section 1 General** **101. General** **1. Application** The requirements in this Chapter apply to the ships intended to be registered as ships provided with dynamic positioning systems(hereafter referred to as "DP system(s)"). **2.** <same as the present Rules> **3. Classes of dynamic positioning DP systems** ~~Dynamic positioning~~ DP systems are classified and defined by their worst case failure modes as follows: (1) DPS(0), DPS(1) Loss of position and/or heading may occur in the event of a single fault. (2) DPS(2) A loss of position and/or heading is not to occur in the event of a single failure in any active component or system. Normally static components will not be considered to fail where adequate protection from damage is demonstrated. Single failure criteria include: (A) - (B) <same as the present Rules> (3) DPS(3) A loss of position and/or heading is not to occur in the event of a single failure. A single failure includes: (A) - (C) <same as the present Rules>	(Amended) - Pt 9, Ch 4 of the Rules was based on MSC/Circ.645, but it has been fully amended to reflect MSC.1/Circ.1580 which was revised in MSC/Circ.645. (Changed terms) - dynamic positioning systems → DP system(s) - position → position and/or heading

Present	Amendment	Remark
102. Definitions Terms used in this Chapter are defined as follows: <Newly added>	**102. Definitions** Terms used in this Chapter are defined as follows: (1) **Dynamically positioned vessel (DP vessel)** means a unit or a vessel which automatically maintains its position and/or heading (fixed location, relative location or predetermined track) by means of thruster force.	- The definition of DP vessel has been newly added.
(1) **Dynamic positioning systems** comprise the following sub-systems, control panels, and back-up systems which are necessary to dynamically positioning the ship. (A) Thruster system (B) Power system (C) Control system	~~(1)~~(2) **Dynamic positioning systems (DP system)** ~~comprise the following sub-systems, control panels, and back-up systems which are necessary to dynamically positioning the ship.~~ means the complete installation necessary for dynamically positioning a vessel comprising, but not limited to, the following sub-systems: (A) ~~Thruster~~ Power system (B) ~~Power~~ Thruster system (C) ~~Control~~ DP control system	- The definition of DP system has been amended.
(2) **Thruster system** comprise the followings: (A) Thruster, power transmission gears driving thruster, thruster control hardware for control of thruster speed, pitch and heading (B) Main propellers and other propulsion units when these are included in dynamic positioning control mode.	~~(2) Thruster system comprise the followings:~~ ~~(A) Thruster, power transmission gears driving thruster, thruster control hardware for control of thruster speed, pitch and heading~~ ~~(B) Main propellers and other propulsion units when these are included in dynamic positioning control mode.~~	- The definition of thruster system has been moved to (4).
(3) **Power system** means all components and systems necessary to supply the dynamic positioning system with power and include the followings (A) Prime movers with necessary auxiliary systems including piping (B) Generators (C) Switchboards (D) Distributing system (cabling and cable routing) (E) Power management system	(3) **Power system** means all components and systems necessary to supply the ~~dynamic positioning~~ DP system with power and include the followings: (A) Prime movers with necessary auxiliary systems including piping, fuel, cooling, pre-lubrication and lubrication, hydraulic, pre-heating, and pneumatic systems; (B) Generators; (C) Switchboards; (D) Distributing system (cabling and cable routing); (E) Power supplies, including uninterruptible power supplies (UPS); and ~~(E)~~(F) Power management system(s) (as appropriate).	- The definition of power system has been amended.

Present	Amendment	Remark
<Newly added>	(4) **Thruster system** means all components and systems necessary to supply the DP system with thrust force and direction. The thruster system includes: (A) Thrusters with drive units and necessary auxiliary systems including piping, cooling, hydraulic, and lubrication systems, etc.; (B) Main propellers and rudders if these are under the control of the DP system; (C) thruster control system(s); (D) manual thruster controls; and (E) associated cabling and cable routing.	- The definition of thruster system has been moved from (2).
(4) **Control system** means all control components and systems, hardware and software necessary to dynamically position the vessel and include the followings. (A) Control systems (a) Remote control system(Joystick) (b) Automatic control system (B) Measuring system (C) Control panel (D) associated cabling and cable routing	~~(4)~~(5) **Control Dynamic Positioning control system (DP control system)** means all control components and systems, hardware and software necessary to dynamically position the vessel and include the followings.: (A) ~~Control systems~~ Computer system/joystick system; ~~(a) Remote control system(Joystick)~~ ~~(b) Automatic control system~~ (B) ~~Measuring system~~ Sensor system(s); (C) ~~Control panel~~ Control stations and display system (operator panels); (D) Position reference system(s); ~~(D)~~(E) ~~associated~~ Associated cabling and cable routing; and (F) Networks.	- The terminology for control system has been changed to the DP definition of DP system has been amended.
<Newly added>	(6) **Dynamic Positioning control station (DP control station)** means a workstation designated for DP operations, where necessary information sources, such as indicators, displays, alarm panels, control panels and internal communication systems are installed (this includes: DP control and independent joystick control operator stations, required position reference systems' Human Machine Interface (HMI), manual thruster levers, mode change systems, thruster emergency stops, internal communications).	- The definition of DP control station has been newly added.

Present	Amendment	Remark
(5) **Remote control system(Joystick)** is a semi-automatic control system, which enables the operator to give a defined thrust (force and direction) and a turning moment to the vessel.	~~(5) **Remote control system(Joystick)** is a semi-automatic control system, which enables the operator to give a defined thrust (force and direction) and a turning moment to the vessel.~~ (7) **Joystick system** means a system with centralized manual position control and manual or automatic heading control.	- The definition of joystick system has been amended.
(6) **Measuring system** comprise all hardware and software for the following position reference system and environmental sensor to supply information and corrections necessary to give position and heading reference. (A) - (B) <same as the present Rules>	~~(6)~~(8) **Measuring system** comprise all hardware and software for the following position reference system and environmental sensor to supply information and corrections necessary to give position and heading reference. (A) - (B) <same as the present Rules>	- Numbering (6)-(8) → (8)-(10)
(7) **Control panels** comprise centrally and locally situated panels for operating the dynamic positioning system.	~~(7)~~(9) **Control panels** comprise centrally and locally situated panels for operating the ~~dynamic positioning~~ DP system.	
(8) **Failure** is an occurrence in a component or system causing one or both of the following effects. (A) - (B) <same as the present Rules>	~~(8)~~(10) **Failure** is an occurrence in a component or system causing one or both of the following effects. (A) - (B) <same as the present Rules>	
<Newly added>	(11) **Failure Modes and Effects Analysis (FMEA)** means a systematic analysis of systems and sub-systems to a level of detail that identifies all potential failure modes down to the appropriate sub-system level and their consequences.	- The definitions of failure modes and effects analysis, FMEA proving trials, consequence analysis, hidden failure have been newly added.
<Newly added>	(12) **FMEA proving trials** means the test program for verifying the FMEA.	
<Newly added>	(13) **Consequence analysis** means a software function continuously verifying that the vessel will remain in position even if the worst-case failure occurs.	
<Newly added>	(14) **Hidden failure** means a failure that is not immediately evident to operations or maintenance personnel and has the potential for failure of equipment to perform an on-demand function, such as protective functions in power plants and switchboards, standby equipment, backup power supplies or lack of capacity or performance.	

Present	Amendment	Remark
<Newly added>	(15) **Loss of position and/or heading** means that the vessel's position and/or heading is outside the limits set for carrying out the DP activity in progress.	- The definition of loss of position and/or heading, position keeping have been newly added.
<Newly added>	(16) **Position keeping** means maintaining a desired position and/or heading or track within the normal excursions of the control system and the defined environmental conditions (e.g. wind, waves, current, etc.).	
(9) **Operational Mode** is the manner of control under which the dynamic positioning system may be operated and comprise the followings: (A) - (D) <same as the present Rules>	~~(9)~~(17) **Operational Mode** is the manner of control under which ~~the dynamic positioning~~ DP system may be operated and comprise the followings: (A) - (D) <same as the present Rules>	- Numbering (9)-(11) → (17)-(19)
(10) **Redundancy** is the ability of a component or system to maintain its function when a single failure has occurred. Redundancy can be achieved for instance by installation of multiple components, systems or alternative means of performing a function.	~~(10)~~(18) **Redundancy** is the ability of a component or system to maintain its function when a single failure has occurred. Redundancy can be achieved for instance by installation of multiple components, systems or alternative means of performing a function.	
(11) **Reliability** is the ability of a component or system to perform its required function without failure during a specified time interval.	~~(11)~~(19) **Reliability** is the ability of a component or system to perform its required function without failure during a specified time interval.	
<Newly added>	(20) **Worst-Case Failure Design Intent (WCFDI)** means the specified minimum DP system capabilities to be maintained following the worst-case failure. The worst-case failure design intent is used as the basis of the design. This usually relates to the number of thrusters and generators that can simultaneously fail.	- The definition of worst-case failure design intent has been newly added.
(12) **Worst case failure** is failure modes which, after a failure, results in the largest reduction of the position and/or heading keeping capacity. This means loss of the most significant redundancy group, given the prevailing operation.	~~(12) **Worst case failure** is failure modes which, after a failure, results in the largest reduction of the position and/or heading keeping capacity. This means loss of the most significant redundancy group, given the prevailing operation.~~	- The definition of worst-case failure has been amended.
<Newly added>	(21) **Worst-Case Failure (WCF)** means tthe identified single fault in the DP system resulting in maximum detrimental effect on DP capability as determined through the FMEA.	

Present	Amendment	Remark
103. Drawings and data **1. General** In the case of the ships intended to be registered as ships provided with dynamic positioning systems, the drawings and data to be submitted for approval before the commencement of work are generally as follows: (1) Drawings (A) Plans showing the construction and layout of the dynamic positioning system (B) <same as the present Rules> (C) Plans with respect to the automatic and remote control of the dynamic positioning system (a) - (e) <same as the present Rules> (D) <same as the present Rules> (2) Data (A) Equipment list of dynamic positioning systems (Name of equipment, model, type, Manufacturer) (B) <same as the present Rules> (C) Operation manuals (including details of the dynamic positioning system operation, installation of equipment, maintenance and fault finding procedures together with a section on the procedure to be adopted in emergency) (D) <same as the present Rules> **2. Reference data** For the ships intended to be registered as ships provided with dynamic positioning systems, in addition to the requirements in **Par 1** above, the following data is to be submitted : (1) - (2) <same as the present Rules>	**103. Drawings and data** **1. General** In the case of the ships intended to be registered as ships provided with ~~dynamic positioning~~ DP systems, the drawings and data to be submitted for approval before the commencement of work are generally as follows: (1) Drawings (A) Plans showing the construction and layout of the ~~dynamic positioning~~ DP system (B) <same as the present Rules> (C) Plans with respect to the automatic and remote control of the ~~dynamic positioning~~ DP system (a) - (e) <same as the present Rules> (D) <same as the present Rules> (2) Data (A) Equipment list of ~~dynamic positioning~~ DP systems (Name of equipment, model, type, Manufacturer) (B) <same as the present Rules> (C) Operation manuals (including details of the ~~dynamic positioning~~ DP system operation, installation of equipment, maintenance and fault finding procedures together with a section on the procedure to be adopted in emergency) (D) <same as the present Rules> **2. Reference data** For the ships intended to be registered as ships provided with ~~dynamic positioning~~ DP systems, in addition to the requirements in **Par 1** above, the following data is to be submitted : (1) - (2) <same as the present Rules>	

Present	Amendment	Remark
Section 2 Requirements of Dynamic Positioning Systems	**Section 2 Requirements of Dynamic Positioning Systems**	
201. General	**201. General**	
The ships intended to be registered as ships provided with dynamic positioning systems are to be provided dynamic positioning systems specified in **202.** and **203.**	**1.** The ships intended to be registered as ships provided with ~~dynamic positioning~~ DP systems are to be provided ~~dynamic positioning~~ DP systems specified in **202.** ~~and~~ **203.** this Section.	(Newly added) - The requirements for the design of DP system have been newly added to consider the external forces from mission-related systems.
<Newly added>	**2.** If external forces from mission-related systems (cable lay, pipe lay, mooring, etc.) have a direct impact on DP performance, the influence of these systems shall be considered and factored into the DP system design.	
<Newly added>	**3.** The ships In order to meet the single failure criteria given in **101. 3**, redundancy of components will normally be necessary as follows: (1) For DPS(2), redundancy of all active components; and (2) For DPS(3), redundancy of all components and A-60 physical separation of the components.	- The requirements for redundancy of DP systems have been newly added.
<Newly added>	**4.** For DPS(3), full redundancy of the control systems may not be possible. (i.e. there may be a need for a single changeover system from the main computer system to the backup computer system). Such connections between otherwise redundant and separated systems may be accepted when these are operated so that they do not represent a possible failure propagation path during DP operations.	
<Newly added>	**5.** For DPS(2) and DPS(3), connections between otherwise redundant and separated systems shall be kept to a minimum and made to fail to the safest condition. Failure in one system shall in no case be transferred to the other redundant system.	

Present	Amendment	Remark
<Newly added>	**6.** The DP control station shall be arranged where the operator has a good view of the vessel's exterior limits and the surrounding area. Equipment that shall be located at the DP control station includes, but is not limited to: (1) DP control and independent joystick control operator stations; (2) Manual thruster levers; (3) Mode change systems; (4) Thruster emergency stops; (5) Internal communications; and (6) Position reference systems' HMI, when considered necessary.	(Newly added) - The requirements for the arrangement of DP control station and for the equipment to be located at the DP control station have been newly added.

Present	Amendment	Remark
202. Requirements of dynamic positioning systems **1. Thruster system** (1) Design and location of thruster (A) Thrusters are to be designed to minimize potential interference with other thrusters, sensors, hull or other surfaces which could be encountered in the service for which the ship is intended. (B) Thruster intakes are to be located at sufficient depth to reduce the possibility of ingesting floating debris and vortex formation. (2) Performance of thruster (A) The response and repeatability of thrusters to changes in propeller pitch, speed or direction of rotation are to be suitable for maintaining the area of operation and the heading deviation specified. (B) Vessels with DPS(0) or DPS(1) are to have thrusters in number and of capacity sufficient to maintain position and heading under the specified maximum environmental conditions. (C) Vessels with DPS(2) or DPS(3) are to have thrusters in number and of capacity sufficient to maintain position and heading, in the event of any single fault, under the specified maximum environmental conditions. This includes the failure of any one thruster. (3) Alarm for thruster Each thruster unit is to be provided with a high power alarm. The setting of this alarm is to be adjustable and below the maximum thruster output.	**202. Requirements of ~~dynamic positioning~~ DP systems** **1. Thruster system** ~~(1) Design and location of thruster~~ ~~(A) Thrusters are to be designed to minimize potential interference with other thrusters, sensors, hull or other surfaces which could be encountered in the service for which the ship is intended.~~ ~~(B) Thruster intakes are to be located at sufficient depth to reduce the possibility of ingesting floating debris and vortex formation.~~ ~~(2) Performance of thruster~~ ~~(A) The response and repeatability of thrusters to changes in propeller pitch, speed or direction of rotation are to be suitable for maintaining the area of operation and the heading deviation specified.~~ ~~(B) Vessels with DPS(0) or DPS(1) are to have thrusters in number and of capacity sufficient to maintain position and heading under the specified maximum environmental conditions.~~ ~~(C) Vessels with DPS(2) or DPS(3) are to have thrusters in number and of capacity sufficient to maintain position and heading, in the event of any single fault, under the specified maximum environmental conditions. This includes the failure of any one thruster.~~ ~~(3) Alarm for thruster~~ ~~Each thruster unit is to be provided with a high power alarm. The setting of this alarm is to be adjustable and below the maximum thruster output.~~	(Moved) - The requirements for thruster system have been moved to 202. 2.

Present	Amendment	Remark
2. Power system (1) Electrical generating system (A) Capacity of electrical generating system For electrically driven thruster, the total capacity of electrical generating system is to be not less than the maximum dynamic positioning load together with the maximum auxiliary load. This may be achieved by parallel operation of two or more generating sets provided that the requirements of **Pt 6, Ch 1, 202.** are complied with. (B) <same as the present Rules> (2) - (3) <same as the present Rules> (4) Common source Where the electrical auxiliary services necessary for maintaining the ship normally in operational and habitable conditions, and the electrical service necessary for operating the dynamic positioning thrusters are supplied from a common source, the following requirements are to be complied with: (A) - (C) <same as the present Rules> (5) Number and rating of transformers The number and ratings of power transformers are to be sufficient to ensure full load operation of the dynamic positioning system even when one transformer is out of service. (6) Alarm for electrical generating system An alarm is to be initiated at the dynamic positioning control stations when the total electrical load of all operating thruster units exceeds a preset percentage of the running generators capacity. This alarm is to be adjustable between 50 and 100 percent of the full load capacity having regard to the number of electrical generators in service.	**~~2.~~1. Power system** (1) Electrical generating system (A) Capacity of electrical generating system For electrically driven thruster, the total capacity of electrical generating system is to be not less than the maximum ~~dynamic positioning~~ DP load together with the maximum auxiliary load. This may be achieved by parallel operation of two or more generating sets provided that the requirements of **Pt 6, Ch 1, 202.** are complied with. (B) <same as the present Rules> (2) - (3) <same as the present Rules> (4) Common source Where the electrical auxiliary services necessary for maintaining the ship normally in operational and habitable conditions, and the electrical service necessary for operating the ~~dynamic positioning~~ DP thrusters are supplied from a common source, the following requirements are to be complied with: (A) - (C) <same as the present Rules> (5) Number and rating of transformers The number and ratings of power transformers are to be sufficient to ensure full load operation of the ~~dynamic positioning~~ DP system even when one transformer is out of service. (6) Alarm for electrical generating system An alarm is to be initiated at the ~~dynamic positioning~~ DP control stations when the total electrical load of all operating thruster units exceeds a preset percentage of the running generators capacity. This alarm is to be adjustable between 50 and 100 percent of the full load capacity having regard to the number of electrical generators in service.	- Numbering 2. → 1. (Changed terms) - dynamic positioning → DP

Present	Amendment	Remark
<Moved>	**2. Thruster system** (1) Design and location of thruster (A) Thrusters are to be designed to minimize potential interference with other thrusters, sensors, hull or other surfaces which could be encountered in the service for which the ship is intended. (B) Thruster intakes are to be located at sufficient depth to reduce the possibility of ingesting floating debris and vortex formation. (2) Performance of thruster (A) The response and repeatability of thrusters to changes in propeller pitch, speed or direction of rotation are to be suitable for maintaining the area of operation and the heading deviation specified. (B) Vessels with DPS(0) or DPS(1) are to have thrusters in number and of capacity sufficient to maintain position and heading under the specified maximum environmental conditions. (C) Vessels with DPS(2) or DPS(3) are to have thrusters in number and of capacity sufficient to maintain position and heading, in the event of any single fault, under the specified maximum environmental conditions. This includes the failure of any one thruster. (3) Alarm for thruster Each thruster unit is to be provided with a high power alarm. The setting of this alarm is to be adjustable and below the maximum thruster output.	(Moved) - The requirements for thruster system have been moved from 202. 1.

Present	Amendment	Remark
3. Control system	**3. ~~Control~~ DP control system**	(Changed terms) - control system → DP control system
(1) General	(1) General	
(A) In general the DP-control system is to be arranged in a DP-control station where the operator has a good view of the vessel's exterior limits and the surrounding area.	(A) In general the ~~DP-control~~ DP control system is to be arranged in a ~~DP-control~~ DP control station where the operator has a good view of the vessel's exterior limits and the surrounding area.	
(B) The control station is to display information from the power system, thruster system and control system to ensure that these systems are functioning correctly. Information necessary to operate the DP system safely is to be visible at all times.	(B) The DP control station is to display information from the power system, thruster system and DP control system to ensure that these systems are functioning correctly. Information necessary to operate the DP system safely is to be visible at all times.	
(C) - (D) <same as the present Rules>	(C) - (D) <same as the present Rules>	(Newly added) - The requirements for alarm of DP control system have newly added. - The requirements for redundancy of DP control system have newly added.
<Newly added>	(E) Alarms and warnings for failures in all systems interfaced to and/or controlled by the DP control system shall be audible and visual. A record of their occurrence and of status changes shall be provided together with any necessary explanations.	
<Newly added>	(F) The DP control system shall prevent failures being transferred from one system to another. The redundant components shall be so arranged that any failed component or components may be easily isolated so that the other component(s) can take over smoothly with no loss of position and/or heading.	
(E) Minimum number of control system, position reference system and environmental sensor for dynamic positioning systems is to be in accordance with the **Table 9.4.1**:	~~(E)~~(G) Minimum number of control system, position reference system and environmental sensor for ~~dynamic positioning~~ DP systems is to be in accordance with the **Table 9.4.1**:	(Changed terms) Table 9.4.1 - remote control system → joystick system - automatic control system → DP control system - emergency automatic control system → backup DP control system

<Amendments>

Table 9.4.1 Minimum Number of Control System, Position reference System and Environmental Sensor

Class	Control system	Position reference system	Environmental sensor		
			Heading reference system	Vertical reference sensor	Means to ascertained the wind and direction
DPS(0)	~~Remote control~~ Joystick system(1) 1 set	1 set	1 set	1 set	each 1 set
DPS(1)	~~Automatic~~ DP control system(2) 1 set ~~Remote control~~ Joystick system(1)(2) 1 set	2 sets(3)	1 set	1 set	1 set
DPS(2)	~~Automatic~~ DP control system(2) 2 sets	3 sets(3)(4)	3 sets(3)	3 sets(3)	each 3 sets(3)
DPS(3)	~~Automatic~~ DP control system(2) 2 sets ~~Emergency automatic~~ Backup DP control system(2) 1 set	3 sets(3)(4)	3 sets(3)	3 sets(3)	each 3 sets(3)
(NOTES) (1) - (4) <same as the present Rules>					

Present	Amendment	Remark
(2) <same as the present Rules> <Newly added>	(2) <same as the present Rules> (3) Computer systems (A) For DPS(2), the DP control system shall consist of at least two computer systems so that, in case of any single failure, automatic position keeping ability will be maintained. Common facilities such as self-checking routines, alignment facilities, data transfer arrangements and plant interfaces shall not be capable of causing failure of more than one computer system. An alarm shall be initiated if any computer fails or is not ready to take control. (B) For DPS(3), the main DP control system shall consist of at least two computer systems arranged so that, in case of any single failure, automatic position keeping ability will be maintained. Common facilities such as self-checking routines, alignment facilities, data transfer arrangements and plant interfaces shall not be capable of causing failure of more than one computer system. The two or more computer systems mentioned above do not include the backup computer system; thus, in addition, one separate backup DP control system shall be arranged, see paragraph (D). An alarm shall be initiated if any computer fails or is not ready to take control. (C) For DPS(2) and DPS(3), the DP control system shall include a software function, normally known as "consequence analysis", which continuously verifies that the vessel will remain in position even if the worst-case failure occurs. This analysis shall verify that the thrusters, propellers and rudders (if included under DP control) that remain in operation after the worst-case failure can generate the same resultant thruster force and moment as required before the failure. The consequence analysis shall provide an alarm if the occurrence of a worst-case failure were to lead to a loss of position and/or heading due to insufficient thrust for the prevailing environmental conditions (e.g. wind, waves, current, etc.). For operations which will take a long time to safely terminate, the consequence analysis shall include a function which simulates the remaining thrust and power after the worst-case failure, based on input of the environmental conditions. (D) For DPS(3), the backup DP control system shall be in a room separated by an A-60 class division from the main DP control station. During DP operation, this backup control system shall be continuously updated by input from at least one of the required sets of sensors, position reference system, thruster feedback, etc. and be ready to take over control. The switchover of control to the backup system shall be manual, situated on the backup computer, and shall not be affected by a failure of the main DP control system. Main and backup DP control systems shall be so arranged that at least one system will be able to perform automatic position keeping after any single failure.	(Newly added) - The requirements for the computer system constituting the DP control system have been newly added.

Present	Amendment	Remark
	(D) Each DP computer system shall be isolated from other on-board computer systems and communications systems to ensure the integrity of the DP system and command interfaces. This isolation may be effected via hardware and/or software systems and physical separation of cabling and communication lines. Robustness of the isolation shall be verified by analysis and proven by testing.	
(3) Measuring system (A) - (B) <same as the present Rules> (C) Validation for measuring system Suitable processing and comparative techniques are to be provided to validate the. control system inputs from position reference systems and other environmental sensors, to ensure the optimum performance of the dynamic positioning system.	~~(3)~~(4) Measuring system (A) - (B) <same as the present Rules> (C) Validation for measuring system Suitable processing and comparative techniques are to be provided to validate the. control system inputs from position reference systems and other environmental sensors, to ensure the optimum performance of the ~~dynamic positioning~~ DP system.	
(4) Indicators Indications of the following are to be provided at each station from which it is possible to control the dynamic positioning system. (A) - (E) <same as the present Rules>	~~(4)~~(5) Indicators Indications of the following are to be provided at each station from which it is possible to control the ~~dynamic positioning~~ DP system. (A) - (E) <same as the present Rules>	
(5) <same as the present Rules>	~~(5)~~(6) <same as the present Rules>	
4. <same as the present Rules>	**4. <same as the present Rules>**	

Present	Amendment	Remark
203. Additional requirements for dynamic positioning systems	**203. Additional requirements for dynamic positioning systems**	
1. DPS(1)	**1. DPS(1)**	
(1) - (2) <same as the present Rules> (3) A manually initiated emergency alarm, clearly distinguishable from all other alarms associated with the dynamic positioning system is to be provided at the dynamic positioning control station to warn all relevant personnel in the event of a total. loss of dynamic positioning capability. In this respect consideration is to be given to additional alarms being provided at locations such as the master's accommodation and operational control stations. (4) For electrically driven thruster units, the following requirements are to be complied with: *(2019)* (A) Indication of absorbed electrical power and available on-line generating capacity is to be provided at the main dynamic positioning control station. (B) <same as the present Rules>	(1) - (2) <same as the present Rules> (3) A manually initiated emergency alarm, clearly distinguishable from all other alarms associated with the ~~dynamic positioning~~ DP system is to be provided at the ~~dynamic positioning~~ DP control station to warn all relevant personnel in the event of a total. loss of ~~dynamic positioning~~ DP capability. In this respect consideration is to be given to additional alarms being provided at locations such as the master's accommodation and operational control stations. (4) For electrically driven thruster units, the following requirements are to be complied with: *(2019)* (A) Indication of absorbed electrical power and available on-line generating capacity is to be provided at the main ~~dynamic positioning~~ DP control station. (B) <same as the present Rules>	
2. DPS(2)	**2. DPS(2)**	
(1) - (3) <same as the present Rules> <Newly added> <Newly added>	(1) - (3) <same as the present Rules> (4) The power available for position keeping shall be sufficient to maintain the vessel in position after worst-case failure according to **101. 3**. (5) At least one automatic power management system (PMS) shall be provided and shall have redundancy according to the equipment class and a blackout prevention function.	(Newly added) - The requirements for power's capability and power management system of DPS(2) vessel have been newly added.

Present	Amendment	Remark
(4) For electrically driven thruster units, the following requirements are to be complied with: *(2019)* (A) With one generating set out of action, the capacity of the remaining generating sets is to be not less than the maximum dynamic positioning load with the most effective thruster inoperative together with all electrical auxiliary services necessary for maintaining the ship in normal operational and habitable conditions. (B) Where generating sets are arranged to operate in parallel, the supplies to, essential services are to be protected by the tripping of non-essential loads as required by **Pt 6, Ch 1, 205. 10** and additionally, on loss of a running generating set, a reduction in thrust demand may be accepted provided the, arrangements are such that a sufficient level of dynamic position capability is retained to permit the maneuverability of the ship. (C) In relation to (A) and (B), in order not to loss of position, provision is to be made for automatic starting synchronization and load sharing of a non-running generator before the load reaches the alarm level required by **202. 2** (6). If necessary, power management system may be added. (5) - (6) <same as the present Rules>	~~(4)~~(6) For electrically driven thruster units, the following requirements are to be complied with: *(2019)* (A) With one generating set out of action, the capacity of the remaining generating sets is to be not less than the maximum ~~dynamic positioning~~ DP load with the most effective thruster inoperative together with all electrical auxiliary services necessary for maintaining the ship in normal operational and habitable conditions. (B) Where generating sets are arranged to operate in parallel, the supplies to, essential services are to be protected by the tripping of non-essential loads as required by **Pt 6, Ch 1, 205. 10** and additionally, on loss of a running generating set, a reduction in thrust demand may be accepted provided the, arrangements are such that a sufficient level of ~~dynamic position~~ DP capability is retained to permit the maneuverability of the ship. (C) In relation to (A) and (B), in order not to loss of position, provision is to be made for automatic starting synchronization and load sharing of a non-running generator before the load reaches the alarm level required by **202. 2** (6). ~~If necessary, power management system may be added.~~ ~~(5) - (6)~~(7) - (8) <same as the present Rules>	(amended) - 203. 2 (3) has been newly added to require a power management system for DPS(2) vessel. And the requirement of (6) (C) has been amended.

Present	Amendment	Remark
3. DPS(3) (1) <same as the present Rules> (2) The power system arrangement is to comply with the following requirements : (A) The divided power system is to be located in different spaces separated by A-60 class division. (B) - (C) <same as the present Rules> (3) <same as the present Rules> (4) The switchboard supplying the dynamic positioning system is to be split into at least two equal sections each fitted in a separate compartment and capable of being connected by bus section switches. (5) An emergency automatic control system is to be provided at an emergency control station, in a compartment separated by A-60 class division from that for the main control station. During DP-operation this emergency automatic control system is to be continuously updated by input from the sensors, position reference system, thruster feedback, etc., and be ready to take over control. The switch-over of control to the emergency automatic control system is to be manual, situated on the back-up computer and is not to be affected by failure of the main control system. (6) Arrangements are to be provided such that in the event of a failure of the working and standby control systems a smooth transfer of control to the emergency control system may be effected from the emergency control station by manual means.	**3. DPS(3)** (1) <same as the present Rules> (2) The power system arrangement is to comply with the following requirements : (A) For DPS(3), the power system shall be divisible into two or more systems so that, in the event of failure of one system, at least one other system will remain in operation and provide sufficient power for station keeping. The divided power system is to be located in different spaces separated by A-60 class divisions. (B) - (C) <same as the present Rules> (3) <same as the present Rules> (4) The switchboard supplying the dynamic positioning system is to be split into at least two equal sections each fitted in a separate compartment and capable of being connected by bus section switches. ~~(5) An emergency automatic control system is to be provided at an emergency control station, in a compartment separated by A-60 class division from that for the main control station. During DP-operation this emergency automatic control system is to be continuously updated by input from the sensors, position reference system, thruster feedback, etc., and be ready to take over control. The switch-over of control to the emergency automatic control system is to be manual, situated on the back-up computer and is not to be affected by failure of the main control system.~~ ~~(6) Arrangements are to be provided such that in the event of a failure of the working and standby control systems a smooth transfer of control to the emergency control system may be effected from the emergency control station by manual means.~~	(Amended) - The requirements for power system arrangement has been amended to prepare for power system failure. (Deleted) - The requirements of (5) and (6) are the same as the requirements of 202. 3 (3) (D), therefore the requirements (5) and (6) have been deleted.

Present	Amendment	Remark
(7) - (8) <same as the present Rules> (9) Signals from the environmental sensors required by **Table 9.4.1** are to supply the emergency automatic control system. (10) The emergency automatic control system is to be supplied from its own independent uninterruptible power supplies. (11) <same as the present Rules>	~~(7) - (8)~~(5) - (6) <same as the present Rules> ~~(9)~~(7) Signals from the environmental sensors required by **Table 9.4.1** are to supply the ~~emergency automatic~~ backup DP control system. ~~(10)~~(8) The ~~emergency automatic~~ backup DP control system is to be supplied from its own independent uninterruptible power supplies. ~~(11)~~(9) <same as the present Rules>	

Present	Amendment	Remark
Section 3 Testing and Inspection	**Section 3 Testing and Inspection**	
301. <same as the present Rules>	**301. <same as the present Rules>**	
302. On-board tests After installation on board, the dynamic positioning system is to be tested under the condition as close to the actual operation as practicable and confirmed that each equipment functions appropriately. However, the tests may be carried out at the sea trial, when their testing items are considered impracticable to be conducted at occasions other than the sea trials.	**302. On-board tests** After installation on board, the ~~dynamic positioning~~ DP system is to be tested under the condition as close to the actual operation as practicable and confirmed that each equipment functions appropriately. However, the tests may be carried out at the sea trial, when their testing items are considered impracticable to be conducted at occasions other than the sea trials.	
303. Sea trials In the sea trials, performance tests of the dynamic positioning system are to be carried out in accordance with the sea trial schedule including the followings approved by the Society. (1) - (3) <same as the present Rules>	**303. Sea trials** In the sea trials, performance tests of the ~~dynamic positioning~~ DP system are to be carried out in accordance with the sea trial schedule including the followings approved by the Society. (1) - (3) <same as the present Rules>	
304. Maintaining records and data regarding the performance capability of the dynamic positioning system Records and data regarding the performance capability of the dynamic positioning system are to be maintained on board the ship and are to be made available at the time of the periodical survey.	**304. Maintaining records and data regarding the performance capability of the ~~dynamic positioning~~ DP system** Records and data regarding the performance capability of the ~~dynamic positioning~~ DP system are to be maintained on board the ship and are to be made available at the time of the periodical survey.	

Present	Amendment	Remark
305. Survey Assigned to Maintain Classification Periodical survey interval and survey items of dynamic positioning systems(DPS) are to be applied as follows. **1. Annual survey** (1) <same as the present Rules> (2) The electrical installations comprising the DPS, such as controllers and operating stations for DP and independent joystick, references systems, sensors and mode change system, are to be visually inspected. (3) The technical condition of the DPS is to be verified during the survey. (4) - (5) <same as the present Rules> (6) For class notation DPS(3), normal working condition of the back-up DP control system is to be verified. If the survey is carried out during regular operations, then control need not be transferred to the back-up DP control system. (7) Emergency stop of thrusters from the DP control centre is to be tested. If the survey is carried out when the vessel is undergoing regular operations, then testing is not to be performed if there is any possibility of introducing unacceptable risks.	**305. Survey Assigned to Maintain Classification** Periodical survey interval and survey items of ~~dynamic positioning~~ DP systems~~(DPS)~~ are to be applied as follows. **1. Annual survey** (1) <same as the present Rules> (2) The electrical installations comprising the ~~DPS~~ DP systems, such as controllers and ~~operating stations for~~ DP control station and independent joystick, references systems, sensors and mode change system, are to be visually inspected. (3) The technical condition of the ~~DPS~~ DP systems is to be verified during the survey. (4) - (5) <same as the present Rules> (6) For ~~class notation~~ DPS(3), normal working condition of the ~~back-up~~ backup DP control system is to be verified. If the survey is carried out during regular operations, then control need not be transferred to the ~~back-up~~ backup DP control system. (7) Emergency stop of thrusters from the DP control ~~centre~~ station is to be tested. If the survey is carried out when the vessel is undergoing regular operations, then testing is not to be performed if there is any possibility of introducing unacceptable risks.	

Present	Amendment	Remark
2. Special survey (1) - (2) <same as the present Rules> (3) The different modes of thruster control from the DP control centre are to be tested. (A) - (D) <same as the present Rules> (4) <same as the present Rules> (5) Emergency stop of DP thrusters from DP control centre is to be tested. (6) - (7) <same as the present Rules> (8) The electrical installations comprising the DPS, such as controllers and operating stations for DP and independent joystick, references systems, sensors and mode change system, are to be visually inspected. (9) - (11) <same as the present Rules> (12) For class notation DPS(2) & DPS(3), the required redundancy with respect to defined single failures modes is to be verified by redundancy testing. (13) For class notation DPS(2) & DPS(3), the FMEA report and FMEA test program are to be verified to ensure that they have been updated when alterations have been done. (14) For class notation DPS(2) & DPS(3), correct functioning of the Consequence Analysis facility is to be verified as far as possible. (15) For class notation DPS(3), testing is also to be performed on the back-up DP control system. Switchover to back-up is to be tested, and monitoring of back-up control system status on the main control system is to be verified.	**2. Special survey** (1) - (2) <same as the present Rules> (3) The different modes of thruster control from the DP control ~~centre~~ station are to be tested. (A) - (D) <same as the present Rules> (4) <same as the present Rules> (5) Emergency stop of DP thrusters from DP control ~~centre~~ station is to be tested. (6) - (7) <same as the present Rules> (8) The electrical installations comprising the ~~DPS~~ DP systems, such as controllers and ~~operating stations for~~ DP control stations and independent joystick, references systems, sensors and mode change system, are to be visually inspected. (9) - (11) <same as the present Rules> (12) For ~~class notation~~ DPS(2) & DPS(3), the required redundancy with respect to defined single failures modes is to be verified by redundancy testing. (13) For ~~class notation~~ DPS(2) & DPS(3), the FMEA report and FMEA test program are to be verified to ensure that they have been updated when alterations have been done. (14) For ~~class notation~~ DPS(2) & DPS(3), correct functioning of the Consequence Analysis facility is to be verified as far as possible. (15) For ~~class notation~~ DPS(3), testing is also to be performed on the ~~back-up~~ backup DP control system. Switchover to back-up is to be tested, and monitoring of ~~back-up~~ backup control system status on the main control system is to be verified.	

Present	Amendment	Reason
Section 2 Surveys	**Section 2 Surveys**	
201. ~ 202. <same as the present Rules>	**201. ~ 202. <same as the present Rules>**	
203. Registration Surveys	**203. Registration Surveys**	
1. Drawings and Other Documents to be Submitted 【See Guidance】	**1. Drawings and Other Documents to be Submitted 【See Guidance】**	
<same as the present Rules>	<same as the present Rules>	
2. Examinations for Workmanship 【See Guidance】	**2. Examinations for Workmanship 【See Guidance】**	
<same as the present Rules>	<same as the present Rules>	
	3. On board installation survey	* reflecting Request for eatablishment / revision of classification techical rules(SUR3000-1562-2019) amended to clarify the scope of registration survey
<newly added>	(1) survey for connection between the structural members and hull structure (A) survey for welded connection between the structural members and hull structure (B) non-destructive testing(where requested by the Surveyor) (2) On board operation tests and load tests (3) Other tests considered necessary by the Society	
	4. Registration Surveys for cargo handing appliances already installed on board a ship	
	(1) Identification of materials and equipment certificates for cargo handing appliances (2) On board operation tests and load tests (3) Other tests considered necessary by the Society	
<hereafter, same as the present Rules>	<hereafter, same as the present Rules>	

CHAPTER 7 DIVING SYSTEMS

Section 1 General

101. General

1. Application

(1) The requirements of this Chapter apply to the design, construction and testing of the main equipment which form diving systems such as diving bells, decompression chambers, etc. which are permanently installed or installed with limited period as required by the operating conditions on a ship or a similar floating structure classed with or intended to be classed with the Society. The requirements not specified in this Chapter are to be in accordance with the relevant parts of the Rules. **【See Guidance】**

(2) The requirements do not cover diving techniques or procedural requirements for the instruction of diving techniques.

2. Equivalence

For the equivalence of alternatives to the Rules or novel design principles are to be in accordance with **Pt 1, Ch 1, 104**.

102. Definition

For the purpose of this Rule, the terms used have the meaning defined in the followings unless expressly provided otherwise;

1. Diving system ***(2017)***

A diving system means the whole plant and equipment necessary for the conduct of diving operations using transfer under pressure techniques which includes diving bells, decompression chambers and ancillary equipment thereof and to be divided as following table.

	SUR (Surface Diving)	BOU (Bounce Diving)	SAT (Saturation Diving)
maximum depth and maximum operation time	d_{max} < 60 msw* T_{op}* < 8 hours	d_{max} < 125 msw* T_{op}* < 24 hours	None, except those imposed by the requirements and assumptions in the certificate.

* msw is meters of sea water.
* T_{op} is the maximum operation time of chambers when a diver lives in chamber

2. Deck decompression chamber means the part of a diving system which is equipped with the pressure vessel for human occupancy with means of controlling and monitoring the pressure within the chamber.

3. A mating device means that the equipment necessary for the connection or disconnection of diving bell to a surface compression chamber.

4. Hyperbaric Evacuation System (HES) means the whole plant and equipment necessary for the evacuation of divers in saturation from a deck decompression chamber to the Hyperbaric Reception Facility(HRF) where decompression can be carried out. The main components of a hyperbaric evacuation system include the Hyperbaric Rescue Unit (HRU), its handling system, the Hyperbaric Reception Facility and the evacuation procedures.

(1) Hyperbaric rescue unit(HRU) or hyperbaric evacuation uni (HEU) means a unit whereby Divers under pressure can be safely evacuated from a ship or floating structure to a place where decompression can be carried out. This can be included a hyperbaric rescue chamber(HRC) or self-propelled hyperbaric lifeboat(SPHL).

(2) Hyperbaric reception facility (HRF)

(3) Hyperbaric rescue chamber (HRC)

5. CO2 Scrubber means for removal of the carbon dioxide from the breathing gas.

6. Partial pressure means pressure of gas within a mixture which would prevail if the gas would fill by itself alone, the full volume occupied by the mixture. The sum of the partial pressures of the consistent parts of

the mixture, proportional to volumetric fractions, is equal to the total absolute pressure of the mixture.

7. **Oxygen system** is to be intended for a gas with a higher oxygen percentage than 25.

8. **Life support system** means the equipment used to maintain a suitable life environment for the divers in the pressurized compartments (DDC, closed bell, HRU) and prepare the breathing gas mixtures, supply the gases to the pressurized compartments, adjust the temperature and the humidity and monitor the life support parameters.

9. **Umbilical cable** means the link between the diving support unit and the diving bell(wet and closed) or the diving stage which is the assembly containing surveillance, communication and power supply cables, breathing gas and hot water hoses and covered by protective enclosure. The strength member for hoisting and lowering the diving bell may be part of the umbilical. However, umbilicals connected in the wet bell or the diving stage mean bunches of individual hose.

10. **A depth** means that the pressure, expressed in metres of seawater, to which the diver is exposed at any time during a dive or inside a surface compression chamber or diving bell.

11. **A pressure vessel** means a container capable of withstanding an internal working pressure of 0.1 MPa and over which allows gas transfer and storage under pressure.

12. **Built In Breathing System (BIBS)** means a system of gas delivery to masks located in the decompression chambers and diving bells (closed), used for oxygen decompression during surface decompression and caisson disease treatment and supplying breathing air in case of fire or gas pollution.

13. **A diving bell** means a submersible compression chamber, including its ancillary equipment, for transfer of divers under pressure between the work location and the surface compression chamber. However, wet bell means an open chamber to be transferred between underwater working place and deck.

14. **Gas reclaim unit** is used on saturation diving systems to recover the helium from the breathing gas.

15. **Bail-out gas** is Diver's emergency gas supply cylinder used as a backup system in case of a failure of the primary source of breathing gas.

16. **Launch and Recovery System (LARS)** means plant and equipment necessary for raising, lowering and transporting the diving bell between the work location and the surface compression chamber.

17. **A maximum operating depth** means that the depth in metres of seawater equivalent to the maximum pressure for which the diving system is designed.

18. **Minimum Breaking Load (MBL)** means the Minimum Breaking Load of wire ropes and fibre ropes are provided by the manufacturer in accordance with applied Standards.

19. **Breathing gas or breathing mixture** means that all gases or mixed gases which are used for breathing of divers during diving operation.

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

21. **Saturation condition** means when the nitrogen or inert gas breathed by a diver dissolves into the body's tissues maximally at the specific pressure, i.e., no more gas can be absorbed by the tissues.

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

Section 2 Classification Surveys [See Guidance]

201. General

1. Kinds of surveys

Kinds of surveys are as follows:

(1) Surveys for Classification (hereinafter referred to as "Classification Surveys")
  (A) Classification Surveys during Construction
  (B) Classification Surveys after Construction
(2) Surveys for Classification Maintenance

(A) Annual Surveys
(B) Special Surveys
(C) Occasional Surveys

2. Survey intervals

Surveys are to be carried out in accordance with the following requirements.
(1) A Classification Survey is to be carried out at the time when application for registration is made.
(2) Classification Maintenance Surveys are to be carried out at the times as prescribed below.
(A) Annual Surveys are to be carried out at intervals specified in **Pt 1, Ch 2, 201.**
(B) Special Surveys are to be carried out at intervals specified in **Pt 1, Ch 2, 401.**
(C) An Occasional Survey: at a time falling on any of mentioned below, independently of Special Surveys and Annual Surveys.
(a) When main parts of the systems have been damaged, repaired or renewed
(b) When the systems are modified or altered
(c) Whenever considered necessary by the Society

3. Preparation for surveys and others

(1) All such preparations as required for the Survey to be carried out as well as those which may be required by the Surveyor as necessary in accordance with the requirements in the Rules are to be made by the applicant of the survey. The preparations are to include provisions of an easy and safe access, necessary facilities, certificates and records for the execution of the survey, opening up of equipment, removal of obstacle and cleaning. Inspection, measuring and test equipment, which Surveyors rely on to make decisions affecting classification are to be individually identified and calibrated to a standard deemed appropriate by the Society. However, the Surveyor may accept simple measuring equipment(e.g. rulers, measuring tapes, micrometers, etc.) and gauge fitted on machinery(e.g. pressure gauges, temperature gauges, rpm gauges, etc.) without individual identification or confirmation of calibration, provided they are properly maintained and periodically compared with other similar equipment.
(2) The applicant for survey is to arrange a supervisor who is well conversant with the survey items intended for the preparation of the survey to provide the necessary assistance to the Surveyor according to his requests during the survey.
(3) The survey may be suspended where necessary preparations have not been made, any appropriate attendant mentioned in the previous (2) is not present, or the Surveyor considers that the safety for execution of the survey is not ensured.
(4) Where repairs are deemed necessary as a result of the survey, the Surveyor will notify his recommendations to the applicant of survey. Upon this notification, the repair is to be made to the satisfaction of the Surveyor.

202. Classification surveys

1. Drawings and data

(1) General
(A) Before the start of manufacture, plans and drawings of all components subject to compulsory inspection, to the extent specified below, are to be submitted to the Society with 3 copies .
(B) The drawings are to contain all the data necessary to check the design and loading of the equipment. Wherever necessary, calculations relating to components and descriptions of system are to be submitted.

(2) Diving system
(A) For approval

No.	Drawings and data
1	Firefighting equipment details
2	Description of the fire detection and alarm systems
3	Drawings/data of the securing of diving equipment

(B) For reference

No.	Drawings and data
1	Design basis - Maximum operating depth and equivalent allowable working pressure - Maximum operating time - maximum numbers of divers in water and in the deck decompression chambers - maximum operating time of occupancy expected in the deck decompression chambers - maximum operational wave height - minimum/maximum sea temperature and air temperature
2	Specification of the diving system - system description, emergency evacuation plan and other relevant technical specification - equipment list and manufacturer
3	The design loading conditions of the bell, its connection ot the LARS and the umbilical
4	Installation and commissioning - installation manual - commissioning procedure
5	Operating and maintenance - user manual, maintenance instruction and service record book
6	FMEA (Failure Modes and Effects Analysis) report
7	General arrangement of diving system
8	Material specification for inside the hyperbaric chambers

(3) PVHO

(A) For approval

No.	Drawings and data
1	Specification of the thermal and fire insulation material
2	Description welding procedure and welding details
3	Drawing of the pressure vessel structure
4	Drawing of the supporting structure and padeyes
5	Drawing of doors, clamping systems, mating devices and locks
6	Drawing of the penetrations
7	Specification and extent of non-destructive examination(NDE)
8	Description of marking

(B) For reference

No.	Drawings and data
1	Design basis and general specification - Maximum allowable working pressure (internal/external) - Design temperature (maximum/minimum) - Testing pressure (hydrostatic test pressure) - Local loads - Accelerations due to handling loads defined in **402. 4** - Number of design load cycles
2	Material, structure and geometric description of the pressure vessel
3	Description of the viewports and their material
4	Specification of the coating system
5	Specification of the heat treatment
6	Specification of the safety valves and the pressure relief valves
7	Justification of the means for expansion allowance of the interconnected pressure vessels
8	Inspection and testing procedure

(4) Deck decompression chamber

(A) For approval

No.	Drawings and data
1	Justification of the means for expansion allowance of the interconnected chambers
2	Electrical and communication wire description
3	Description of fire detection, alarm and fire fighting system
4	Description of environmental control system
5	Description of sanitary system
6	Description of CO2 scrubber system
7	Description of deck chamber supports and padeyes

(B) For reference

No.	Drawings and data
1	Design basis including characteristics, limitations and loading conditions, etc.
2	Specification including follows : - internal dimensions, volume and weight - communication systems - interface with the diving bell - interface with the HRU - interface with the life support system - equipment list
3	General arrangement of deck chamber
4	Inspection and testing procedure
5	Drawing defined in (3)

(5) Diving bell

(A) For approval

No.	Drawings and data
1	Description of the control panel in the bell − layout of the control panel − single line diagram of the piping, electrical and communication systems
2	Description of the electrical installations and control systems
3	Drawings of the diving bell structure including padeyes

(B) For reference

No.	Drawings and data
1	Design basis including characteristics, limitations and loading conditions, etc.
2	Specification including follows : - internal dimensions, volume and weight - communication systems - interface with the diving bell - interface with the HRU - interface with the life support system - equipment list
3	Calculation note of buoyancy and stability
4	General layout
5	Description of the heating system
6	Inspection and testing procedure
7	Drawing defined in (3)

(6) Life support system

(A) For approval

No.	Drawings and data
1	Breathing gas single line diagram and piping details
2	Structural drawings of the gas cylinders
3	Description of the safety relief valves
4	Description of the valves and fittings
5	Description of the material, scantling and welding details for piping
6	Description of the flexible hoses (reference standard, testing procedure, etc)

(B) For reference

No.	Drawings and data
1	Description of the gas storage arrangement
2	Description of the oxygen piping cleaning procedure
3	Description and FAT procedure of the environmental control system
4	Description and FAT of the fresh water unit
5	Description and FAT of the breathing gas reclaim unit
6	Description and FAT of the gas transfer system
7	Description and FAT of the diving hot water unit
8	Description of the diving umbilical − specification, drawing, reference standard − flexible hose description (see above table (A)) − electrical and communication wire description

(7) Electrical equipment and communication system

(A) For approval

No.	Drawings and data
1	Single line distribution diagram and detailed diagram of the installation, including de−scription and characteristics of cable, fuse and switchgears
2	Description of the automation system
3	Descriptions and details of the communication means between diving control station and diving systems, including single line diagram

(B) For reference

No.	Drawings and data
1	General layout of the control stations and their control panels
2	General description of the electrical installations and control systems
3	Description of electrical supply principles, failure scenarios, redundancy principles, emergency arrangement, load balance, storage batteries capacity etc.
4	General layout showing the electrical equipment, batteries, lighting and cable trays

(8) Launch and Recovery System

(A) For approval

No.	Drawings and data
1	General arrangement of the handling system and showing the working area and the different path of the rope
2	Structure drawings
3	Material specifications
4	Power unit and driving system specifications and general drawings
5	Hydraulic and electric system specifications
6	Drawings of the load carrying hydraulic cylinders

(B) For reference

No.	Drawings and data
1	Operational limitation, when relevant
2	Weight of diving device to be lifted in air and in water
3	Maximum hoisting speed
4	Safe working load
5	The specification of the steel wires or fiber ropes including end termination details and minimum breaking load
6	Calculation of the design loads for the handling system including rope data.
7	Description and characteristics of the winches, general drawing, structure drawing, main component list and relevant calculation data
8	Description and characteristics and design basis for guide wire and winch relating clump weight handling system

(9) HRU

(A) For approval

No.	Drawings and data
1	General layout of the life support control panel, single line diagram of the piping, electrical and communication systems
2	Description of the electrical installations
3	Description of the environmental control system
4	Description of the carbon dioxide scrubber system
5	Description of the sanitary system

(B) For reference

No.	Drawings and data
1	Design basis including characteristics, limitations and loading conditions, etc.
2	Specification including follows : - communication systems - life support system - internal dimensions and volume - interface with the hyperbaric reception facility
3	IMO Life saving appliance certificate for the lifeboat and its launching system (SPHL only)
4	Calculation note of buoyancy and stability
5	General layout
6	Inspection and testing procedure
7	Drawing defined in (3)

203. Classification maintenance surveys

1. Special surveys

(1) Diving test
  (A) Special survey is to include a diving test with the diving bell/basket lowered to the rated depth.
  (B) The bell/basket is to be weighted to its maximum rated weight.
  (C) During the diving test, the bell is to be tested for gas leakage by close visual inspection at depth, function test of electrical and communication system including through-water communication at maximum depth and function test of breathing gas supply.

(2) Portable diving systems
  (A) The Owner is to inform the Society about any installation and decommissioning operations of a portable diving system.
  (B) As a rule, the diving system is to be inspected and tested in accordance to the commissioning procedures before it is put back into service.

2. Lay-up and

(1) When the equipment is not used for a long period, the Owner may apply for a lay-up procedure.

(2) The lay-up maintenance program provides for a “laying- up survey” to be performed at the beginning of lay-up and subsequent “annual lay-up condition surveys” to be performed in lieu of the normal annual surveys which are no longer required to be carried out as long as the equipment remains laid-up. The other periodical surveys which become overdue during the lay-up period may be postponed until the re-commissioning of the equipment.

(3) Where the equipment has an approved lay-up maintenance program and the period of class expires, the equipment lay-up period is extended until it is re-commissioned.

(4) The minimum content of the lay-up maintenance program as well as the scope of the decommissioning, annual lay-up condition and recommissioning surveys are to be submitted to the Society for approval. The annual lay-up condition survey shall contain, through a lay-up log-book, the survey items of the annual survey as deemed necessary. The re-commissioning procedures shall contain, through a lay-up log-book, the survey items of the Class renewal survey, as deemed necessary.

(5) During the lay-up period, the exposed part of the equipment are to be adequately protected and regularly inspected.

Section 3 Inspection and Testing

301. General

1. Application

(1) This section provides requirements for the initial inspection and testing of diving systems.
(2) References are made to **IMCA D 004, IMCA D 018, IMCA D 023, IMCA D 024, IMCA D 037, IMCA D 040** for the inspection and testing.
(3) Other recognized standard may be accepted subject to the approval of the Society.
(4) For series-manufactured parts, test procedures other than those prescribed may be agreed with the Society provided that they are recognized as equivalent by the Society. **[See Guidance]**

302. Tests at the manufacturers works

1. Penetration

The testing protocol for penetration of cables is to be submitted to the Society. **[See Guidance]**

2. Compressor

(1) Any part of the compressor under pressure is to be pressure tested in accordance with the **Pt 5**, unless otherwise specified.
(2) Functional test for delivery rate and pressure are to be performed.
(3) The outlet gas from the compressor is to be tested for pollution content according to EN 12021.

3. Gas cylinder

Gas cylinder is to be tested in accordance with **Pt 5** or the standard applied for their design and construction.

4. Flexible hose

(1) Flexible hose is to be tested in accordance with **Pt 5, Guidance for Approval of Manufacturing Process and Type Approval, etc** or the technical standard applied for their design and construction.
(2) The tests generally include:
(A) internal pressure strength test (proof test) at a minimum testing pressure equal to 1,5 times the design pressure
(B) bursting pressure test
(C) tensile test
(D) resistance to low and high temperature
(E) low temperature flexibility test
(F) ambient temperature flexibility test
(G) resistance to ozone
(H) resistance to external pressure
(I) chemical inertia
(J) dimensional tolerances.
When the applied standard requires an internal oil resistance test, this may be omitted when the flexible hoses carry only gas or water.
(3) Flexible hoses intended to carry gas containing more than 25% of oxygen are to be shock tested in accordance with a recognized standard.

5. Umbilical cable

(1) Umbilicals are to be tested in accordance with the technical standard applied for their design and construction and the manufacturer's testing program.
(2) The Society may require to witness the manufacture of the umbilical.
(3) Flexible hoses are to be tested in accordance with the technical standard applied for their design and construction.
(4) The qualification tests generally include:
(A) bending test on a sample of umbilical, with the bending radius encountered in the normal service. No permanent strain is to be observed
(B) cycling load test on a sample of umbilical. To be conducted from zero to the design load. The number of cycle should be related to the category of the LARS. No permanent strain is to be observed
(C) tensile breaking test on a sample of umbilical.
(5) Flexible hoses used in umbilicals are to be tested in accordance with paragraph **4** before to be assembled in the umbilical.

(6) After assembly in the umbilical, the following tests are to be performed:
(A) overpressure test at 1,5 times the maximum working pressure taking into account that:
(a) all flexible hoses are to be pressure tested simultaneously
(b) the electrical cables are to be checked for damage after testing.
(B) leak test at the maximum working pressure The internal cleanliness is to be verified as appropriate to the intended duty.

303. PVHO

1. The inspection and testing of the PVHO is to include:
(1) pressure testing in accordance with **303. 2**
(2) gas leak testing in accordance with **303. 3**
(3) testing of the viewports in accordance with **303. 4**
(4) testing of the doors, hatches and medical locks
(5) visual examination of the signs of corrosion on the shell of the PVHO and particularly the bottom part inside and outside
(6) visual examination of the shell penetrators. All penetrators are to be marked to show their function
(7) visual examination of the supporting structure
(8) visual examination of the windows
(9) visual examination of the markings
(10) visual examination of the insulation, if any
(11) visual examination of the doors, hatches and their locking mechanisms
(12) visual examination of the medical lock
(13) visual examination of the associated piping and fittings
(14) visual examination of the valves and flow fuses. All valves are to be marked to show their function
(15) visual examination of the connecting flanges between chambers
(16) visual examination of the bilge drain
(17) visual examination of the protectors on the outlet lines.

2. Pressure test

Hydraulic pressure test at 1.5 times the Maximum Allowable Working Pressure (MAWP) is to be conducted and witnessed by the Society.

3. Gas leak test

(1) Gas leak tests are to be conducted in accordance with an agreed procedure.
(2) Gas leak test are to be conducted at maximum working pressure for medical/equipment locks and all doors, hatches, valves, pipe work, fittings and penetrations on each compartment of the PVHO.
(3) The maximum allowable gas leak rate is 0.25% of the PVHO volume over a period of 6 hours, calculated at constant .temperature
(4) The PVHO is to be pressurized for a minimum of 6 hours. The pressure and the temperature are to be noted on a record chart every hour or less.
(5) All part of pressure vessel, door, window, piping, valve and fittings are to be sprayed with a snooper leak detection liquid.
(6) When a leak presents a risk of escalation (e.g. through a crack in a weld) it is deemed not to be acceptable.
(7) When helium is intended to be used in the breathing gas, the gas leak test is to be conducted with a gas mixture containing 10% Helium as a minimum.

4. Viewport

Viewports are to be tested at a pressure equal to 1,25 times Maximum Allowable Working Pressure.

304. Deck decompression chambers

1. The following inspection and tests are to be conducted on the DDC, as a minimum:
(1) testing of the PVHO in accordance with **303.**
(2) testing of the breathing gas system in accordance with **306. 2**
(3) testing of the sanitary systems (toilets, sewage and fresh water)
(4) testing of the fire safety systems
(5) testing of the gas regeneration system (CO2 removal)
(6) testing of the breathing gas reclaim system, if fitted
(7) testing of the environmental control unit in accordance with **306. 3**

(8) testing of the instrumentation
(9) testing of the communication
(10) testing of the BIBS in accordance with **306. 6**
(11) testing of the bilge drain system

305. Diving bell and wet bell

1. The following inspection and tests are to be conducted on the diving bell/basket as a minimum:
(1) weighing in air and in water
(2) testing of the PVHO in accordance with **303.**
(3) testing of the breathing gas system in accordance with **306. 2**
(4) testing of the ballast release system in water, when relevant
(5) testing of the emergency systems
(6) testing of the location and communication systems
(7) testing of the diving bell heating system
(8) testing of the gas regeneration system (CO2 removal)
(9) testing of the diver reclaim system, if fitted
(10) testing of the BIBS in accordance with **306. 6**

2. The following inspection and tests are to be conducted on the wet bell/basket as a minimum:
(1) weighing in air and in water
(2) testing of the breathing gas system in accordance with Article [9]
(3) testing of the ballast release system in water, when relevant
(4) testing of the emergency systems

306. Life support system

1. Control station

The following inspection and tests are to be conducted on the control stations, as a minimum:
(1) functional testing of the fire safety systems
(2) switching from main to emergency power source
(3) functional testing of the communication and CCTV systems
(4) functional testing of the gas distribution panel
(5) functional testing of the gas analyzers
(6) functional testing of the alarms
(7) verification of the markings and diagrams.

2. Breathing gas system

(1) Testing of piping systems carrying breathing gas is to comply with **Pt 5** as applicable for piping Class 1.
(2) An overpressure test at 1,5 times the design pressure is to be conducted on all piping systems carrying breathing gas.
(3) A gas leak test in accordance with **303. 3** be conducted on all pressure vessels and piping carrying breathing gas.
(4) Each supply source of breathing gas is to be tested separately.
(5) The breathing gas supply system is to be tested during commissioning on-board for pollutant content according to EN 12021.
(6) Breathing gas samples are to be taken at the gas cylinders, in relevant parts of the breathing gas piping, inside the chambers, at the BIBS supply line and at the gas reclaim unit.
(7) The cleanliness of the breathing gas piping system is to comply with a recognized standard such as **ASTM G93** or an equivalent standard.
(8) Safety features against overpressure and accidental decompression of the deck chambers (e.g. alarms, relief valves, bursting disks) are to be tested in accordance with an agreed program.

3. Environmental control unit

(1) Testing of the ECU is to be conducted in accordance with an approved testing program.
(2) The accuracy of heating/chilling system in the DDC is to be tested. A maximum difference of +/− 1°C between the setting value and the measured value is allowed.
(3) The 100% redundancy of the heating/chilling and humidity system is to be tested.

4. Carbon dioxide removal system

(1) The carbon dioxide removal systems of the DDC and the diving bell are to be tested for performance and endurance according to an agreed program.

(2) The carbon dioxide levels are to be maintained under the partial pressure defined in **706. 1** (3).

5. Breathing gas reclaim system

(1) The breathing gas reclaim system is to be tested for performance and endurance according to an agreed program.
(2) The alarms and pressure relief valve on the gas bag are to be tested.

6. Built-in breathing system (BIBS)

The BIBS in the DDC and diving bell are to be tested in accordance with an approved procedure.

7. Divers hot water unit

The divers' heating units are to be inspected and tested as per an approved procedure.

8. Sanitary systems inside deck chamber

The toilet flush is to be function tested.

307. Electrical installation

1. All electrical installations are to be tested in accordance with **Pt 6**.

2. The following inspection and tests are to be conducted on the electrical installations, as a minimum:
(1) functional test of each sub-system
(2) testing of main and emergency power supply
(3) insulation resistance test on every electrical circuit.

308. Launch and recovery system

1. General

(1) In addition to the inspection and testing defined in this section, launch and recovery systems are to be surveyed in compliance with **Ch 2** as applicable.
(2) If fitted, heave compensation systems are to be function tested in the presence of the surveyor.
(3) The static load test is to be carried out equal to design load.

2. Umbilical cable winch

(1) Functional testing of the winch umbilical is to be witnessed by the Society.
(2) Pressure testing of the swivel is to be witnessed by the Society.

309. Hyperbaric rescue unit

1. General

(1) The Hyperbaric Rescue Unit is to be inspected and tested in accordance with an agreed testing program.
(2) The following inspection and tests are to be conducted:
(A) weighing in air
(B) testing of the evacuation procedure
(C) testing of the launching system
(D) testing of the sanitary systems
(E) testing of the fire safety systems
(F) testing of the CO2 removal system
(G) testing of the environmental control unit (heating / chilling)
(H) testing of the instrumentation
(I) testing of the communication system
(J) sea trials including propulsion, steering and towing tests, as relevant
(K) examination of the towing line
(L) examination of the markings as defined in **Sec 11**.
(M) inspection and testing applicable to lifeboats as per SOLAS/LSA requirements.
(3) The launching system of the HRU is to be inspected and tested in accordance with IMCA D004.
(4) An overload test at full outboard position is to be conducted.

310. On-board test and Commissioning

1. General

(1) The initial testing of the complete diving system and of each sub-system are to be carried out in accord-

ance with the commissioning procedures agreed by the Society.

(2) The commissioning is to include at the minimum:
  (A) verification of the conformity of the installation with regard to the layout drawings and specification
  (B) verification of the certificates of the diving system components and the marking plates
  (C) verification of the cleanliness of the breathing gas piping in accordance with **306. 2** (7)
  (D) verification of the marking of the breathing gas piping in accordance with the colour code in **703. 4**
  (E) verification of the oxygen gas storage area, piping, valves and alarms
  (F) examination and testing of each sub-systems in accordance with the procedures listed in **310. 2**.
  (G) final diving test as described in **310. 3**.

2. On-board test

(1) PVHO pressure testing and gas leak testing (chamber complex, diving bell, HRU) as per **303.**
(2) Breathing gas system testing (piping, fittings and gas cylinders) as per **306.**
  (A) pressure testing
  (B) gas leak testing
  (C) purity and cleanliness testing
  (D) BIBS testing
  (E) gas transfer system.
(3) diving control panel and life support control panel testing as per **306. 1** and including:
  (A) gas distribution arrangement
  (B) pressure rate
  (C) pressure testing
  (D) leak testing
  (E) functional tests
  (F) gas analyzers
  (G) electrical, communication and video equipment.
(4) depth gauges calibration and testing
(5) sanitary system: toilets, sewage and fresh water
(6) gas regeneration testing (CO_2 removal in chambers and diving bell) as per **306. 4**
(7) environmental control unit (temperature and humidity) as per **306. 3**
(8) gas reclaim system, if fitted, as per **306. 5**
(9) diver heating system as per **306. 7**
(10) launch and recovery system as per **308.**
(11) diving bell as per **305.**
(12) deck decompression chamber as per **304.**
(13) hyperbaric rescue Unit as per **309.**
(14) diving test procedure as per **310. 3**

3. Diving sea trial

(1) The final commissioning is to include a non-manned diving test with the diving bell/basket lowered to the rated depth. **[See Guidance]**
(2) The bell/basket is to be weighted to its maximum rated weight.
(3) During the diving test, the bell is to be tested for:
  (A) gas leakage by close visual inspection at depth
  (B) function test of electrical and communication system including through-water communication at maximum depth
  (C) function test of breathing gas supply.

Section 4 Design and Construction

401. General

1. This Section provides general requirements for the design and construction of diving systems.
2. HRU should comply with the requirements of IMO Guidelines.
3. Metallic materials are to comply with the requirements of **Pt 2** and **Pt 5** for materials and welding, unless otherwise specified.

402. General Design Requirements

1. General

(1) As far as reasonable and practicable, a diving system should be designed to minimize human error and constructed so that the failure of any single component.
(2) Diving systems and components thereof should be designed for the conditions under which they are certificated to operate.
(3) Materials for diving system components should be suitable for their intended use.
(4) All components in a diving system should be so designed, constructed and arranged as to permit easy cleaning, disinfection, inspection and maintenance.
(5) A diving system should include the control equipment necessary for safe performance of diving operations.
(6) The diving system should be capable of allowing the safe transfer of a person under pressure between the diving bell to the deck compression chambers.

2. General Layout

(1) The diving system is to be so arranged as to ensure that centralized control of the safe operation of the system can be maintained under all weather conditions.
(2) The control station is to provide control of diving operations and deck chambers, either in a unique location or in two distinct control stations with suitable means of communication.
(3) Requirements for the arrangements of the control stations are given in **Sec 8**.
(4) The foundations of the diving systems and their handling systems are to be strong enough to sustain the efforts arising from operating, emergency and stowage conditions.
(5) Provision should be made to ensure that the diving system and auxiliary equipment are securely fastened to the ship or floating structure and that adjacent equipment is similarly secured. Consideration should be given to the relative movement between the components of the system. In addition, the fastening arrangements should be able to meet any required survival conditions of the ship or floating structure.
(6) When bolts are used for load carrying connections, the bolts characteristics and the reference technical standard are to be submitted.

3. Failure Modes and Effects Analysis (FMEA)

(1) A FMEA is to be conducted at an early stage of the project.
(2) Reference is made to IMCA D039 - FMEA guide for diving systems, which is a recognized guidance to conduct FMEA.

4. Design conditions

(1) Any component of the diving system is to be designed to operate under the design conditions.
(2) Unless an hydrodynamic analysis of the diving support unit is performed to assess the maximum motions and accelerations, the rule values given **Table 9.7.1** are to be considered.
(3) Athwartships and fore-and-aft inclinations may occur simultaneously.
(4) Static inclination and dynamic inclination may occur independently.
(5) Any components and systems are to be available at all condition defined in **Annex 9-5**.

Table 9.7.1 Inclined position

Install location	Angle of Inclination (°)			
	Athwartships		For-and-aft	
	Static	Dynamic	Static	Dynamic
Compression chambers and other deck installation on ships	± 15	± 22.5	± 5	± 10
Mobile offshore units	± 15	-	± 15	-
Diving bells (Closed) or diving stage	± 22.5	± 45	-	-

(6) Unless otherwise specified, temperature and humidity conditions are given **Table 9.7.2**.

Table 9.7.2 Environmental conditions

Location	Temp (°C)	Humidity (%)	Other Condition
in chambers	5 ~ 55	100	Salty Air
outside chambers in air[1) 2)]	-10 ~ 55	100	
outside chambers in water	-2 ~ 32	-	Salt water containing 3.5% Salt
Control room	5 ~ 55	80	

NOTES :
1) In the case of facilities installed on the open deck, allowance is to be made for icing and temporary inundation with salt water and spray.
2) Other values may be permitted for installation in closed space

Section 5 PVHO

501. General

1. This section provides requirements for the design and construction of Pressure Vessels for Human Occupancy (PVHO) intended for diving systems.

2. For the design and construction of PVHO are to be followed ASME-PVHO or EN13445. Other recognized standard may be accepted subject to the approval of the Society.

3. Inspections and tests are in accordance with **Sec 2**.

502. Door, hatch and locking devices

1. General

(1) In the design of pressure vessels, including accessories such as doors, hinges, closing mechanisms and penetrators, the effects of rough handling and accidents should be considered in addition to design parameters such as pressure, temperature, vibration, operating and environmental conditions.
(2) The design of doors and hatches is to comply with the following:
(A) the clear opening diameter is to be at least 600 mm
(B) means of opening and closing is to be operable from both sides
(C) reverse over pressurization of the door is not to cause catastrophic failure of the locking device
(D) opening is not possible if the pressure is not equal on both sides
(E) means for securing the door in fully open position is to be provided
(F) a safety interlock system is to be fitted if pressure acts to open or unseat the hatch or door. This interlock system is not to allow pressurization of the door or hatch unless it is fully engaged.

2. Locking devices

(1) Locks should be designed to prevent accidental opening under pressure and, where necessary, interlocks should be provided for this purpose.
(2) The interlock system should have a safety device to prohibit the opening of the clamp when a pressure above atmospheric pressure remains in the trunk or the lock and to make it impossible to obtain a gas tight seal if the interlock is not properly closed.
(3) The locking device is to be fitted with an approved mechanical locking system.
(4) A safety device is to prevent un-locking if the internal pressure of the hub in not balanced with respect to ambient pressure.

3. Medical locks

(1) Pressure gauges on medical locks are to be so arranged that if the exhaust line of the medical lock is obstructed from the inside, the gauge will still indicate the correct pressure inside the lock.
(2) The size of the medical locks are to be adapted to the size of the equipment which may be transferred.
(3) Safety device is to be provided in accordance with the requirement **2** (2).

503. Piping system

1. Penetration

(1) Hull penetrations are not to create weak points in the pressure resistant shell. Requirements from a recognized standard regarding location of openings are to be complied with.
(2) All hull penetrators on chambers should be fitted with two shut off devices as close to the penetration as practicable. Where appropriate, one device should be a non-return valve. **【See Guidance】**
(3) The valve of the penetrations are to be used other than screw-down valve. (ex. ball valve)
(4) These valves are to be mounted directly on each side of the chamber shell plating or close to the chamber shell provided that the piping between the valve and the shell complies with the design standard of the PVHO.
(5) The position of each of these valves is to be clearly visible. They are to be secured in open position for normal operation but it is to be possible to override this locking.
(6) Where high diameter hull penetrations, likely to induce an hazardous decompression in case of breakage of the piping, are used in an external regeneration system, the internal safety isolating valves are to be replaced by a non-return for the in-coming piping, by an excess flow valve for the out-going piping (flow-fuse or flow rate sensitive valve).
(7) Requirements for electrical penetrators are given in **Sec 8**.

2. Piping and fittings

(1) Piping and fittings are to comply with applicable requirements of **Sec 7**.
(2) Any open ended exhaust pipe work is to be fitted with guards for finger protection, including those located in transfer trunkings and medical locks. The design of the guards should minimise the risk of injury the divers using the trunk.
(3) The use of flow-fuse or flow rate sensitive valve is to be considered to limit the exhaust rate.
(4) Any gas inlet pipe work are to be fitted with some form of diffuser inside the PVHO, except those located in transfer trunkings.
(5) Pipe systems should be so designed as to minimize the noise inside the diving bell and the deck decompression chambers during normal operation.

3. Pressure relief valves

(1) All PVHO are to be fitted with a pressure relief valve rated to the design pressure. As an alternative, overpressure alarm may be provided as allowed by (2).
(2) All deck decompression chambers and diving bells which may be pressurized separately should be fitted with overpressure alarms or pressure relief valves.
(3) If pressure relief valves are fitted, a quick-operating manual shut off valve should be installed between the chamber and the pressure relief valve and should be wired opened with a frangible wire. This valve should be readily accessible to the attendant monitoring the operation of the chamber. All other pressure vessels and bottles should be fitted with a pressure relief device.

504. Viewports

1. General

(1) Viewports are to be designed and constructed in accordance with ASME PVHO-1.
(2) The term viewport means both the window and its sealing.
(3) The certification process of the viewports includes:
  (A) design review
  (B) fabrication procedure
  (C) material certification
  (D) material testing
  (E) pressure testing.(The pressure test may be done with the viewport installed on the chamber.)
(4) Operating limitations
  The viewports are subject to the following operating limitations:
  (A) Maximum pressure ratio for acrylic plastic viewports(or windows) : 10 bar/sec
  (B) the number of pressure cycles is not to exceed 10,000 or the total duration is not to exceed 40,000 hours
  (C) the minimum design temperature is −18°C and the maximum design temperature is +66°C.
(5) The design life of the viewports is not to exceed 10 years from the date of fabrication unless otherwise allowed in accordance with ASME PVHO-1 Safety standard for pressure vessels for human occupancy.

2. Marking

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

(A) design pressure
(B) maximum and minimum operating temperatures
(C) referenced certification standard
(D) name or symbol of the certification body
(E) serial number or equivalent
(F) year and month of fabrication.

(2) The marking is to be performed by means of a stencil in a legible and indelible way, preferably on the edge of the viewport and in accordance with ASME PVHO-1. The marking is not to cause any damage to the viewport which may cause a crack propagation.

(3) If the serial number or other identifying mark for each viewport is not visible when fitted in situ then it is to be prominently marked on the outside of the chamber adjacent to each viewport.

505. Material and Fabrication

1. The referenced standard is to be complied with regarding:
   (1) material
   (2) structural scantling
   (3) welders qualification
   (4) welding procedure and testing
   (5) testing
   (6) marking.

2. Material

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

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

3. Fabrication

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

Section 6 Deck Decompression Chambers and divers transfer system

601. General

1. This Section provides the requirements for the design and fabrication of Deck Decompression Chambers (DDC), closed diving bell and divers transfer system.

2. Inspections and tests are in accordance with **Sec 3**.

3. The pressure vessel forming the deck chamber should be designed as a pressure vessel for human occupancy according to **Sec 5**.

4. The requirements given in this Section are additional to the requirements given in relevant section.

602. Deck decompression chambers

1. General

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

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

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

compartment. Deck decompression chamber used for saturation diving are to have a minimum diameter of 1800 mm.

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

(5) Deck decompression chambers in surface diving are to comply with general provisions regarding deck chambers. Their conditions of use are as follow:
   (A) the filling gas is compressed air or mixed gas
   (B) the regeneration of the hyperbaric atmosphere is performed by ventilation
   (C) built-in Breathing Systems (BIBS) are available for breathing over oxygenated mixes and pure oxygen
   (D) an oxygen analyzer is to be available
   (E) if the chamber is not installed in a temperate room, it is to be fitted with a thermal protection and environmental control unit, as relevant.

(6) The supporting structure of the DDC is to be designed to withstand the motions and accelerations of the supporting unit as defined in **402. 4** and the loading conditions due to internal load.

(7) The volume of the deck chamber is to be accurately known to allow gas calculations to be carried out.

2. Medical lock

Each pressure compartment should have medical lock as defined **502. 3**.

3. Viewports

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

4. Protection against overpressure

(1) Penetrations for safety valves shall be provided with shut-off valves on both sides of the shell plating. These shut off valves shall be sealed in the open position.

(2) Visual and audible overpressure alarm alerting the operators at the control station shall be provided.

5. Transfer under pressure and Mating device

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

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

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

(4) Safety device for mating device or mating clamp is to be provided in accordance with the requirement **502. 2** (2).

(5) A display of the internal pressure of the hub is to be available at the control station of the opening.

6. Gas analysis

(1) Gas analyzers are to be provided in deck decompression chambers.

(2) Gas piping used for analysis purpose is to be kept to the minimum diameter.

7. Control system

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

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

(3) A secondary system is to be available for controlling the internal environment of the chamber.

8. Temperature and humidity control, Carbon dioxide removal and Breathing gas reclaim

(1) Regeneration system used for the removal of the carbon dioxide is to comply with **706. 1**.

(2) A secondary system is to be available for removing the carbon dioxide.

(3) Temperature and humidity control units are to comply with **708**.

(4) A secondary system is to be available for temperature and humidity control inside the deck chamber.

(5) The breathing gas reclaim system, when fitted, is to comply with the requirements of **706. 2**.

9. BIBS

(1) BIBS are to comply with requirements defined in **705.**.

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

10. Sanitary Equipment

(1) The sanitary equipment is to comply with 707..
(2) Deck decompression chambers used for saturation diving are to be provided with a sanitary room accessible by each diver in saturation.
(3) The toilet bowl is to be designed in order not to be sealed when a person is seated on it.
(4) Flush type toilet are to be fitted with sufficient interlocks to stop it being flushed while occupied.
(5) Hot and cold potable water are to be provided in each sanitary room with washing facilities including shower.
(6) An hyperbaric toilet is to be provided in each sanitary room.

11. Electrical installations and control systems

The electrical installations and control systems are to comply with the requirements of **Sec 8**.

12. Fire safety

Fire safety requirements inside the hyperbaric chambers are given in **Sec 9**.

603. Closed Diving Bell

1. General

(1) The diving bell should be provided with adequate protection against mechanical damage during handling operation.
(2) The diving bell should be equipped with means whereby each diver using the bell is able to enter and leave it safely as well as with means for taking an unconscious diver up into a dry bell.
(3) The diving bell should provide a suitable environment and facilities for the persons who use it, having regard to the type and duration of the diving operation.
(4) Diving bells should be so designed as to provide adequate space for the number of occupants envisaged, together with the equipment.
(5) A seat with safety belt is to be available for each occupant.
(6) Diving bells should have a volume of at least 1.5 m3 per diver.
(7) Volume of the bell is to be accurately known to allow breathing gas and stability calculations to be carried out.
(8) The diving bell is normally designed in order to have a resistance against external pressure at least equal to the one against internal operating pressure. If not, restrictive operational conditions are to be taken into account.‘
(9) The diving bell should be fitted with a manifold at a suitable point close to the main lifting attachment which should include connections for the following services:
(A) ¾ inch NPT (female) - for hot water
(B) ½ inch NPT (female) - for breathing mixture.
The manifold should be clearly marked and suitably protected.
(10) The duration of working of all survival means embarked is to be at least 24 hours. The survival means should include at least: **【See Guidance】**
(A) reserves of breathing gas
(B) beverage
(C) food
(D) breathing gas regeneration means
(E) thermal protection
(F) lighting
(G) emergency communications
(H) ultra-sonic pinger
(I) visual beacon.
This assessment is to be carried out at the maximum immersion, in fully disconnected situation.
(11) Locations are to be provided for the storage of the following safety equipment:
(A) emergency breathing equipment
(B) first aid kit
(C) sanitary bags
(D) reserve food and beverage
(E) appropriate thermal protection means
(F) adequate repair tools

(G) checks, instructions and safety procedures lists
(H) reserves of products for regeneration (soda lime/sorb)
(I) emergency lighting.

(12) When means to control the water level inside the bell are fitted, it is to automatically limit the upper level in order to protect the equipment which may be damaged when immersed. The valve actuating the water level is to be accessible to a diver inside the access hub.

(13) Means are to be provided to empty a tilted bell partially filled with water.

2. Viewports

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

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

3. Access doors

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

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

(3) The handling of doors of vertical accesses is to be assisted.

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

(5) The lower opening devoted to the going-out of divers should have a minimum passing through diameter of 800 mm.

(6) The lower outer hatch may be closed from the inside of the bell.

4. Protection against overpressure

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

5. Mating system

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

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

(3) Safety device for mating device or mating clamp is to be provided in accordance with the requirement **502. 2** (2).

6. Medical lock

Each pressure compartment should have medical lock as defined **502. 3**.

7. Breathing gas system

(1) There is to be a means by which the divers in the bell can analyze the atmosphere for O2 and CO2 independent of the surface.

(2) Consideration should be given to providing a means of monitoring the bell atmosphere for hydrocarbons and H2S.

(3) There is to be a powered scrubber unit to provide primary CO2 removal from the atmosphere.

(4) Each diver's gas supply is to be arranged so that if one line fails then this does not interfere with the gas supply to another diver.

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

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

(7) The oxygen coming into the bell is to be fitted with a system which limits either the rate of flow or the volume which can enter in order to minimize the risk of excess O2 building up in the bell.

8. Gas reserve

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

(2) The reserves of breathing gas outside the bell are to be sufficient:
  (A) to empty the bell filled with 50% of water at the maximum operating depth, or
  (B) to support each working diver plus the bellman outside the bell for a minimum of 30 minutes at a breathing rate of 40 liters/minute at the maximum depth of the diving operation.
(3) The pressure of all on-board gases are to be reduced to a maximum of 30 bar over ambient pressure before it enters the bell interior.
(4) Sufficient oxygen is to be available for metabolic consumption by the maximum number of divers at 0.5 liters/minute per diver for at least 24 hours at the end of a bell run.

9. BIBS

(1) BIBS are to comply with requirements defined in **705.**.
(2) An oral/nasal or full face BIBS mask is to be supplied for each occupant of the bell. This should be capable of providing breathing gas either from the surface or from the on-board cylinders

10. Piping, valves, fitting and hoses

(1) Piping bringing fluids in the bell are to be fitted inside with isolating valves and outside with non-return valves.
(2) Wall penetrations devoted to the passage of hot sea water are to be protected against corrosion.
(3) Internal compression and decompression controls are to be made by means of "dead man" safety valves which close when the handle is released.
(4) The system of injection of pure oxygen is to be such that an unintentional addition may not induce an unacceptable rise of the partial pressure of oxygen.
(5) The piping of the safety valve is to be fitted, inside with an isolating valve sealed in open position.
(6) Valves are to be free of corrosion and should move freely through their full range of operation.
(7) Any open ended exhaust pipe work is to be fitted with guards to prevent suction hazard.
(8) Any gas inlet pipe work should be fitted with some form of diffuser.
(9) There should be a valve fitted to allow partial flooding of the bell by the bellman. This should be in an easily accessible position and clearly visible. This valve should be in addition to the internal hull stop valve.

11. Instrumentation

(1) General requirements regarding life support instrumentation are given in **Sec 7**.
(2) Valves, gauges and other fittings should be provided outside the bell as necessary to control and indicate the pressure and safe environment within the diving bell. The external pressure on the diving bell should also be indicated inside the bell.
(3) Gauges are to be provided inside the bell to let the divers know both the internal and external pressure.
(4) The relative pressure of gas supplies (normal and emergency) may be read inside the bell.
(5) The temperature (and possibly the flow rate) of hot water devoted to the heating of the diver may be read inside the bell.

12. Umbilical cable

(1) Diving bells are to be provided with a main supply umbilical for supplying breathing gases, hot water, electrical power, communication, etc., to the bell.
(2) Umbilicals are to be securely attached to the bell by means of a strength member or strain relief fitting so that the individual connections are not subjected to loads.

13. Temperature and humidity control, Carbon dioxide removal and Breathing gas reclaim

(1) Regeneration system used for the removal of the carbon dioxide is to comply with **706. 1**.
(2) A secondary system is to be available for removing the carbon dioxide.
(3) Temperature and humidity control units are to comply with **708**.
(4) As required in **603. 1**, there should be means to maintain the divers within the diving bell in thermal balance in an emergency for at least 24 hours. Such requirements may be satisfied by use of passive means carried in the bell.
(5) The breathing gas reclaim system, when fitted, is to comply with the requirements of **706. 2**.

14. Electrical installations and Communication

(1) The electrical installations and control systems are to comply with the requirements of **Sec 8**.
(2) An autonomous flashing light located on the emerged part of the diving bell when floating at the surface is to be provided.
(3) Sufficient internal lighting are to be provided to allow valves and controls to be operated safely.
(4) The diving bell is to be equipped with an emergency locating device with a frequency of 37.5 kHz designed to enable personnel on the surface to establish and maintain contact with the submerged diving bell if the umbilical to surface is served. The locating equipment must conform to the relevant requirements of

the **IMO Res. A.831(19).**

15. Structure

(1) The structure of the diving bell is to be checked against lifting loads.
(2) The lifting rope attachment to the diving device is to be a properly designed lifting padeye.
(3) The diving bell should be equipped with one extra lifting point designed to take the entire dry weight of the bell including ballast and equipment as well as the weight of the divers staying on in the bell.
(4) There should be a secondary attachment point on the diving bell if the main one is damaged. This secondary point should also be a properly designed pad eye or similar (it may be a second hole in the same pad eye).
(5) The connection of the lifting rope to the padeye is to have two retaining means for the removable pin (eg: nut locked with a split spin).

16. Emergency recovery means

(1) In the event of single component failure of the main handling system, an alternative means should be provided whereby the bell can be returned to the deck decompression chamber.
(2) In addition, provisions should be made for emergency retrieval of the bell if the main and alternative means fail. If this involves buoyant ascent, the bell should have sufficient stability to maintain a substantially upright position and means should be provided to prevent accidental release of the ballast weights.
(3) Provisions are to be taken in order that it will be possible to release suspension ropes, guide ropes and umbilical from the inside of the bell. These systems are to be actuated through two voluntary actions from the personnel and are to be efficiently protected against undue actions. One of these systems is to be of mechanical type, for each release system.
(4) A ballast release system may be fitted and designated for use as an emergency recovery means.
(5) The release of the ballast weight is to work in a safe way in the most unfavorable attitudes specified for the bell.
(6) At least, one mechanical system is to be fitted. This release system may be actuated through two voluntary actions from the personnel and is to be efficiently protected from undue actuation.
(7) If the release mechanism is operated by means of pressurization (gas or hydraulic) then isolations need to be in place such that they cannot be activated accidentally by external water pressure or internal gas pressure.
(8) The ballast weights are not to be capable of being shed accidentally, for example if the bell is inadvertently tilted.
(9) If the system uses only one weight then there is to be no single component whose failure could cause the weight to become detached. This requirement does not apply if there are two or more weights operating independently.
(10) The amount of positive buoyancy is to be carefully considered in case of ballast release in order that the bell is not moving up too fast.
(11) When buoyant ascent of the diving bell may be used as an emergency means of recovery, the bell ability to remain in upright position is to be checked.

604. Wet bell and diving basket

1. General

(1) Arrangements are to be in place to recover an injured or unconscious diver from the water to the deck.
(2) Wet bells /diver baskets should be designed for the carriage of at least two divers, including their equipment. The bells are to have suitable dimensions to carry the divers in an uncramped position.
(3) Wet bells /diver baskets are to be provided with internal handholds to support the divers.
(4) Each wet bell/ diving basket is to be provided with a handling system to ensure safe transportation between the subsea work location and the surface. Handling systems for wet bell/diving baskets are to meet the applicable requirements of **Sec 10**.
(5) There is to be a main lift point to attach the lift wire to the wet bell / diving basket. This can be a padeye, a shackle point or a captive ring. There is to be a suitable place to attach a secondary lift wire if the main lift point fails (the secondary lift does not need to be fitted).

2. Diving basket

(1) Diving baskets are to be fitted with a gate or chain to prevent divers from falling out.
(2) Diving baskets are to be fitted with protection at the top to prevent injury to the divers from dropped objects.
(3) There is to be at least one emergency air cylinder fitted in the basket, fitted with a content gauge and a first stage regulator.

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

3. Wet Bell

(1) Wet bells are to be provided with an enclosed upper section that provides an envelope capable of maintaining a bubble of breathing gases for the divers.
(2) Wet bells are to be fitted with a gate or chain to prevent divers from falling out.
(3) The wet bell is to be fitted with masks for each diver plus one spare.
(4) The wet-bell is to be fitted with an exhaust system operated by a spring-loaded valve that closes when the valve handle is released.
(5) In addition to the main umbilical supply, wet bells are to be provided with emergency supplies of breathing gas sufficient to supply the divers at nominal diving depth for a period covering the recovery of the divers including decompression (minimum two hours) and with an emergency breathing mask for each diver.
(6) There is to be at least two emergency air cylinder fitted in the wet bell, fitted with a content gauge and a first stage regulator.
(7) An individual diving equipment is to be provided including SCUBA mouthpiece and valved flexible hose connection for air supply.
(8) Wet bells are to be provided with a main supply umbilical for supplying breathing gases, hot water, electrical power, communication, etc., to the bell. The umbilical is to be securely attached to the bell by means of a strength member or strain relief fitting so that the individual connections are not subjected to loads.
(9) The wet bell is to be provided with a depth gauge.
(10) Main and emergency lighting are to be provided to allow the divers to see and operate all controls.
(11) A visual monitoring of the wet bell and the operating site by video system is recommended.
(12) An emergency communication system is to be fitted on the wet bell to communicate with the surface.

605. Rescue chambers (transportable)

1. General

(1) This article is to be applicable to transportable rescue chambers.
(2) Pressure vessels for human occupancy are to comply with the requirements specified **Sec 4**.

2. PVHO

(1) In addition to the diver the transport chamber shall be capable of accommodating an accompanying person.
(2) The main chamber shall be provided with a supply lock. The dimensions of the supply lock shall not be less than 200 mm in diameter and 300 mm in length. The means of closure of the supply lock shall be interlocked in such a way that they cannot be opened simultaneously. Pressure equalizing apertures shall be safeguarded to prevent them from being rendered ineffective by obstructions. The pressure in the supply lock shall be indicated by a pressure gauge or a suitable device mounted externally at the lock controls.
(3) All open penetrations for gas, measurements and analysis shall be protected by replaceable filters mounted on the inside of the pressure chamber.
(4) It shall be possible to lodge the diver in the transportable chamber securely enough to prevent injury due to motions during transfer. Suitable holding devices respectively belts shall be provided.
(5) Transportable chambers shall have an inside length of at least 2.0 m and shall have an access port with a clear diameter of at least 0.5 m.
(6) Transportable chambers shall regarding their total weight and dimensions be designed such that they can be carried or moved otherwise by helpers over short distances and loaded onto a transport vehicle without the assistance of a crane.
(7) Transportable chambers shall be equipped with lifting handles, at least two fastening eyes and the necessary hoisting sling.
(8) Transportable chambers shall be fitted with observation windows giving a good view to the head of the occupant in the chamber.

3. Mating system and medical lock

(1) Transportable chambers shall be fitted with a bayonet flange connection as per EN 14931 (NATO flange) to enable them to be coupled to a treatment chamber. It shall be secured that the bayonet flange connection cannot get under impermissible overpressure.
(2) The design has to ensure that, for operation according to instructions; the means of closure of the transportable chamber can only be opened until the closure is subjected to the same pressure from inside and

outside.

(3) The main chamber shall be provided with a medical lock. The dimensions of the medical lock shall not be less than 200 mm in diameter and 300 mm in length. The size of the medical lock may smaller and shall be agreed with the Society.

4. Piping

(1) Chambers are to be equipped with a suitable safety device which automatically prevents the maximum permissible working pressure from being exceeded by more than 10 %. In addition, diver pressure chambers are to be equipped with a reliable safeguard against any inadmissible pressure drop.

(2) Safety valves are to be so designed that they respond only when the maximum permissible working pressure has been exceeded and close before the pressure drops below this level. Safety valves are to be mounted in such a way that they are protected from mechanical damage and accidental operation. The connection of safety valves on diver pressure chamber are to be so designed that they cannot be sealed off unintentionally. **[See Guidance]**

(3) Instead of the pressure relief device, equipment may be fitted which automatically interrupts the pressure supply when the maximum permissible working pressure is exceeded and simultaneously trips a visual and audible alarm. The alarm signal shall be such that it is at all times clearly perceptible to the operating personnel.

(4) Each pressurized gas supply and exhaust line shall at least be fitted with a shut-off valve immediately at the pressure chamber wall. This shut-off valve may be dispensed if the connection to the first valve is short and well protected.

5. Breathing gas supply

(1) Diver pressure chambers shall be so designed that a working pressure of at least 5 bar can be reached and maintained without fail. Provision shall be made for raising the working pressure from 0 bar to 5 bar within 6 minutes. A pressure reduction from 0.4 bar to 0.2 bar shall be possible within one minute.

(2) Transportable chambers shall be equipped with compressed air containers with at least 8000 litres (at atmospheric pressure) air supply. This supply of air is intended for the sole purpose of flushing the atmosphere in the event of an interruption of the normal air supply. Adequate flushing of the atmosphere means 25 litres per minute and person measured at the maximum pressure in the chamber.

(3) A flow of flushing air of at least 25 L/min and person (measured at the chamber pressure) shall be secured at each pressure stage.

(4) Each person to be accommodated shall be provided in the main chamber with a source of oxygen supplying at least 75 L/min at atmospheric pressure. The oxygen shall be supplied to the breathing connection via a demand breathing system at the pressure prevailing in the chamber. The exhaled gas shall not be introduced in the chamber atmosphere.

6. Electrical equipment and communication

(1) The electrical installations and communication are to comply with the requirements of **Sec 8**.

(2) A communication system with loudspeakers shall be provided between the inside of the transportation chamber and the outside controls. On the outside, the system shall be permanently switched to "receive", and reversal of the direction of communication shall only be possible by the operation of a self-resetting switch mounted on the outside. On the outside the communication system is also to be equipped with a head-set.

7. Control system and Instrumentation

(1) Transportable chambers shall be equipped with at least the following controls and monitoring instruments:
- (A) air inlet valve
- (B) exhaust air valve
- (C) flushing air valve
- (D) pressure gauge (class 0.25) for chamber pressure
- (E) pressure-reducing valve, with inlet and outlet pressure gauge, to which the compressed air containers called for in **5** (1) are connected
- (F) an additional means of connection, with shut-off device, comprising a suitable high-pressure hose at least 1.5 m in length for connecting the operational compressed air supply to the pressure-reducing valve
- (G) measuring instrument for monitoring of the oxygen volume concentration or partial pressure.

(2) When the transportable chamber is connected to the pressure chambre, the controls and indicating instruments shall be capable of being operated or observed. They shall be located close to a window in the vessel in such a way that the operating personnel can observe the persons in the transportable chamber without changing position.

Section 7 Life Support System

701. General

1. This Section provides requirements for the design and construction of the life support system intended for diving systems.

2. The life support system includes the following functions and installations:

(1) breathing gas storage, mixture and distribution
(2) oxygen installations
(3) breathing gas analysis
(4) breathing gas regeneration
(5) pressure control
(6) temperature and humidity control
(7) fresh water installations
(8) sewage installations
(9) umbilicals from surface to diving bell
(10) gas cylinders
(11) piping, valves and fittings
(12) filters and compressors.

3. Inspection and test requirements are provided in **Sec 3**.

4. When relevant, the machinery and piping systems are to comply with the requirements of **Pt 5**, in addition to this Section.

702. Breathing gas supply

1. General

(1) Each deck decompression chamber and diving bell should be fitted with adequate equipment for supplying and maintaining the appropriate breathing mixtures to its occupants at all depths down to maximum operating depth. When adding pure oxygen to the chamber, a separate piping system should be provided.
(2) Piping systems containing gases with more than 25% oxygen should be treated as systems containing pure oxygen. Such piping systems are to comply with **710.** in addition to the present Article.
(3) Any diving bell or deck chamber is to be supplied with two independent sources of breathing gas.
(4) When automatic, the commutation from one gas source to the other is to trigger an alarm.
(5) On PVHO designed for operation in a continuous ventilation mode, means of indicating the rate of flow of ventilation gas are to be provided.
(6) The distribution is to be so arranged as to allow isolation of any filter, regulator and valve without interrupting gas supply.
(7) Inlet end inside the chambers Exhaust lines should be fitted with an anti-suction device on the inlet side. Anti-suction devices in deck chambers are to comply with requirements defined in **503. 2**.
(8) Gases vented from the diving system should be vented to the open air away from sources of ignition, personnel or any area where the presence of those gases could be hazardous.
(9) Every breathing gas piping system is to be provided with means for manually reducing the pressure.
(10) Minimum rate of gas supply is to be ensured in order to compensate for any leak.
(11) Decompression rate of the deck chamber is to be in accordance with specified decompression tables (e.g. US NAVY diving tables).

2. Protection against overpressure

(1) Piping systems which may be subjected to a higher pressure than designed for should be fitted with a pressure relief device.
(2) The flow rates of the safety valves or the discharge valves fitted to pumps and compressors are to be determined so that the pressures in these units are not exceeding by more than 10% the design pressure when operating with the discharge shut.

3. Gas mixing equipment

(1) Efficient ventilation of the breathing mixture is to be provided for in order to obtain a proper homogeneity of the breatheable mixture.
(2) The oxygen content at the gas mixing equipment location is to be measured in compliance with **704. 3** (6).
(3) In case of oxygen content failing to comply with the tolerances set, the gas supply is to be switched to a secondary source. This should be documented in the FMEA of the diving system.

703. Breathing gas storage

1. Location

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

2. Gas storage capacity

(1) It shall be ensured that there are enough spaces to store permanent or portable gas containers and the capacity of gas storage containers is enough to store breathing gas to supply to divers at maximum operating depth for both normal and emergency modes. **【See Guidance】**

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

3. Protection against overpressure

(1) Pressure vessels and gas cylinders are to be fitted with relief valves and shut-off valves.

(2) Any relief valves or bursting discs should be piped to dump overboard and not in to the enclosed space.

4. Marking

For piping systems and gas storage bottles/pressure vessels, the colour codes defined in Tab 1 are to be used. In addition, each bottle/pressure vessel is to be marked with the name and symbol of the gases it contains. The marking and colour coding of the gas storage bottles is to be visible from the valve end.

Table 9.7.4 Marking of gas system

Gas	Chemical symbol	Colour
Oxygen	O_2	white
Nitrogen	N_2	gray
Air	-	black
Helium	He	brown
Oxygen/Helium gas mixture	O_2/He	white and brown

704. Control of pollutants

1. General

(1) The breathing gas delivered from compressors has to meet the requirements of EN 12021 Respiratory protective devices - Compressed air for breathing apparatus, or an equivalent standard.

(2) Deck decompression chambers should be equipped with such valves, gauges and other fittings as necessary to control and indicate the internal pressure and safe environment of each compartment from outside the chamber at a centralized position. (See Table 9.7.5

Table 9.7.5 Operating parameters to be monitored

Parameter	Compression chamber compartment	Diving bell
Pressure or depth(1)	O	O(2)
Temperature(1)	O	
Humidity	O	
Oxygen partial pressure(1)	O	O
CO_2 partial pressure	O	O

(Note)
(1) These parameters are to be displayed continuously
(2) The pressure or depth inside and outside the diving bell are to be indicated

2. Pressure gauge

(1) Pressure gauges are to comply with a recognized standard.
(2) The scale of gauges used for depth indication or pressure in the deck chambers are to be appropriate to the duty and large enough to be read easily and accurately. Pressure gauges are to normally operate in the range 25 to 75% of full scale deflection and in the 0 to 25% range if used for decompression. If used for the final stages of decompression they are to have scale divisions of no more than 0.5msw. When pressure gauges are digital, reading is to be displayed with one decimal point.
(3) All pressure gauges are to have the same unit marking system (metric or imperial or both).

3. Breathing gas analysis

(1) The composition, pressure and temperature of the breathing mixture, especially where dangerous gases are likely to be emitted, are to be subject of the utmost attention.
(2) Suitable devices are to be provided to analyze the following content in the breathing gas:
  (A) oxygen content
  (B) carbon dioxide content
  (C) content of each dangerous gas likely to occur (eg: carbon monoxide)
  (D) An appropriate sensor, in the diving bells which contain batteries, and in working enclosures where explosive mixtures (hydrogen and hydrocarbons) are likely to originate.
(3) The following oxygen analyzers are to be provided:
  (A) 1 analyzer in the diving bell
  (B) 2 analyzers in each compartment of the deck decompression chamber
  (C) 1 analyzer on each gas distribution panel
  (D) 1 analyzer in the gas supply panel
  (E) 1 analyzer directly at the output of the gas reclaim system.
(4) The oxygen analyzer for the oxygen partial pressure (PPO2) is to have an accuracy of ± 0.015 bar of partial pressure (PPO2) of O2 or ± 1% in concentration of O2 at atmospheric pressure.
(5) In case of long missions (exceeding 24 hours), a calibration system of the checking devices by means of known and stables mixtures or a device of equivalent reliability is to be provided.
(6) Oxygen analyzers are to comply with a recognized standard(EU directive on marine equipment).
(7) The analyzer for the carbon dioxide partial pressure (PPCO2) is to have an accuracy of ± 0.001 bar of CO2 partial pressure.
(8) Carbon dioxide gas is to be provided for calibration purpose.

705. BIBS

1. General

(1) In addition to the main breathing gas system, each deck decompression chamber and diving bell should contain a separately controlled built-in breathing system (BIBS) for oxygen, therapeutic gas or bottom mix gas. Means are to be provided to prevent any dangerous accumulation of gases.
(2) BIBS are to be overboard dump type with exhausts piped outside the PVHO and also outside the compartment containing the PVHO.

706. CO2 Scrubber and Breathing gas reclaim system

1. CO2 Scrubber

(1) Closed diving bell and each compartment of the deck chambers are to be provided with carbon dioxide (CO_2) removal systems.
(2) CO_2 scrubber is to be redundant for each separately pressurized PVHO.
(3) CO_2 removal systems are to have the capacity to maintain a CO_2 partial pressure of less than 0,005 bar in the DDC and less than 0,02 bar in the diving bell, taking into account a production rate of 59 grammes per occupant per hour (or 30 litres/hour/occupant at standard temperature and pressure).

2. Breathing gas reclaim system

(1) A reclaim system may be fitted in order to recover the breathing gas from divers and/or deck chambers.
(2) When fitted, gas reclaim systems are to be designed to reduce the content of bacteria and contaminants in the reclaimed gas below the maximum allowable.
(3) When used, gas bag are to be fitted with an overpressure protection device.

707. Sanitary installations

1. General

(1) Sanitary installations are to be provided in deck decompression chambers intended to be occupied for more than 12 hours.
  (A) When the DDC is intended to be occupied for less than 24 hours, hand washing facilities and handling sanitary waste are to be provided.
  (B) When the DDC is intended to be occupied for more than 24 hours, the flushing toilet, shower, hand-washing sink and external holding tank is to be provided.

2. Fresh water

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

3. The sanitary and sewage installations

(1) The sanitary and sewage installations are to comply with ASME PVHO-1 or an equivalent standard.
(2) The toilet arrangement is to prevent flushing while somebody is sitting on the toilet.

708. Temperature and humidity control

1. General

(1) The diving system should include adequate plantand equipment to maintain the divers in safe thermal balance during normal operations.
(2) For saturation diving systems, the heating and cooling systems are to be 100% redundant in case of power failure.

2. Deck decompression chambers

(1) There is to be suitable means to provide heating/cooling and humidity control inside each deck chamber.
(2) Means for controlling the humidity content is to be provided in the deck chambers.
(3) External heating coils are to be fitted with 2 temperature indicators.

3. Divers and diving bell

(1) For saturation diving, means for heating the breathing gas of the divers are to be provided.
(2) Means for reading the heating medium temperature and its flow rate are to be provided inside the diving bell.
(3) The diver heating system is to include a low and high temperature level alarm at the diving control station.

709. Piping and fittings

1. General

(1) Piping arrangement and materials used for breathing gas is to comply with Class I of **Pt 5**.
(2) Protection against mechanical damage All high-pressure piping is to be protected against mechanical damage.
(3) Piping carrying breathing gas is to be kept away from electrical cables.
(4) Valves used on the breathing gas system are to comply with a recognized standard.
(5) Pressure regulators used on breathing gas systems are to meet the standard EN 738.

2. Material and welding

(1) The materials of the piping system is to comply with the relevant provisions of **Pt 2** and **Pt 5**.
(2) As a rule, ordinary bronze is not permitted for accessories where the design pressure exceeds 15 bars.
(3) Copper and copper alloy pipes are to be of a type without longitudinal seam.
(4) Welding material and welders qualification are to comply with the relevant requirements of the **Pt 2** and **Pt 5**.

3. Flexible hoses

(1) Flexible hoses are to be designed and constructed in accordance with **Pt 5** and a recognized standard.
(2) Flexible hoses, except for umbilicals, should be reduced to a minimum.
(3) Flexible hoses are to be kept as short as practically possible.
(4) Shut-off devices are to be provided to allow isolating the flexible hose.
(5) Provisions are to be taken in such a way that flexible hoses may not accidentally un-tie and whip in case of rupture.

(6) All flexible hoses other than charging whips are to be appropriately supported and secured at intervals not exceeding 2,0 m.
(7) When carrying oxygen, flexible hoses are to comply with the relevant requirements of **710**.
(8) Flexible hoses and associated couplings are to be selected with a minimum burst pressure the greatest of:

$PB = 4 \cdot DP + 5$
$PB = 20$
where:
PB : Minimum burst pressure, in bar
DP : Design Pressure, in bar

(9) As a rule, flexible hoses intended to carry breathing gas at a pressure greater than 10 bar, as well as those carrying oil, are to be metal braided. In addition to its mechanical strength, the function of the metal braid is to conduct heat in case of fire. The metal braid is to be made of stainless steel.
(10) The radius of curvature of the flexible hose is not to be less than the minimum recommended by the manufacturer.

710. Oxygen installations

1. General

(1) A recognized standard is to be applied for the design of the oxygen installation and submitted to the Society for approval.
(2) Special attention should be paid to the design and choice of material for the construction of pressure vessels containing oxygen.
(3) Breathing gas mixtures containing more than 25% of oxygen are to be considered like pure oxygen for installation purpose.

2. Oxygen supply

(1) Any material used in a plant which is intended to carry oxygen is to be compatible with oxygen at working pressure and flow rate.
(2) The use of high-pressure oxygen piping is to be minimized by the fitting of pressure reducing devices, as close as practicable to the storage cylinders.
(3) Ball valves should not be used for oxygen supply.
(4) Oxygen systems with pressure greater than 1,72 bar are to have slow-opening shutoff valves except pressure boundary shutoff valves.
(5) Hoses for oxygen are to be of fire-retardant construction and type approved.
(6) The partial pressure of oxygen on the breathing gas is to be maintained within physiologically acceptable limits taking into account the duration of the mission.

3. Oxygen storage

(1) Oxygen and gases with an oxygen volume percentage higher than 25 per cent should be stored in bottles or pressure vessels exclusively intended for such gases.
(2) Oxygen bottles should be installed in a well-ventilated location.
(3) Oxygen bottles are not to be stored near flammable substances.
(4) As far as practicable, oxygen should be stored on an open deck or in enclosed space specially intended for that purpose.
(5) A visual and audible high-low oxygen alarm is to be fitted when oxygen is stored in an enclosed space in order that any personnel is warned before entering the space. This alarm is to be repeated on the ship command center.
(6) The pressure of oxygen or mixes containing over 25% oxygen should be regulated down at the quad or cylinder to a maximum of 40 bar for breathing gas or 60 bar for supplies to gas blenders.

4. Oxygen cleaning

(1) Any materials used in a plant which is intended to carry oxygen is to be cleaned of hydrocarbons and debris to avoid explosions.
(2) Reference is to be made to ASTM G93 - Oxygen cleaning method - or an equivalent standard.
(3) All valves and pipe work are to be cleaned for oxygen service when used for gas mixes containing more than 25% oxygen. This may be demonstrated by means of a suitable procedure to ensure cleanliness which is applied when any components are new or after there has been any significant alteration.

711. Gas cylinder

1. General

(1) Gas cylinders shall be designed, constructed and tested according to **Pt 5** or recognised international standards.
(2) Cylinders and quads are to be colour coded and marked with the name and chemical symbol of the contents, in accordance with **703. 4**.
(3) Gas cylinders intended for oxygen storage are to comply with **710.**.
(4) Thickness increment of the cylinder shell of typically 1 mm is to be considered for wastage allowance.
(5) Individual cylinders or multiple cylinders grouped together by means of a manifold, are to be provided with:
  (A) an isolation valve rated for the maximum allowable working pressure of the cylinder
  (B) a protective device to relieve excess pressure
  (C) means for eliminating moisture when used for gas reclaim purpose.

712. Compressor

1. General

(1) Compressors are to comply with **Pt 5**.
(2) Diaphragm type compressors are to be fitted with a cracked plate detector which will automatically stop the compressor in the event of failure.
(3) Any compressor or pump intended for pumping oxygen or any gas mixture containing more than 25% oxygen are to be designed for that purpose.
(4) Any compressor used for gas transfer, and not intended for use with gases containing over 25% oxygen, should be fitted with a protective device which will shut the compressor down if the oxygen percentage entering the compressor exceeds 25%.
(5) Safety relief valves are to exhaust to a safe location.
(6) The intakes of all air compressors are to be sited in an area where they are not exposed to any pollution – particularly exhaust fumes.

2. Pollutant content

The breathing gas delivered from compressors has to meet the requirements of EN 12021 or an equivalent standard.

713. Umbilical cable

1. General

(1) As a rule, umbilicals are to be designed and constructed in accordance with a recognized standard(ISO 13628- 5, API 17E, ISO 15333).
(2) The following information are to be submitted to the Society:
  (A) applied technical standard
  (B) mechanical properties including minimum breaking strength
  (C) design load envelope: maximum tension, bending etc.
  (D) minimum Bending Radius (MBR) with respect to applied tensile load
  (E) design life
  (F) arrangement and diameter of sheaves and winch drum.
(3) Flexible hoses used in umbilicals are to comply with the provisions of **709. 3**.
(4) Electrical cables used in umbilicals are to comply with the provisions of **Sec 8**.
(5) Hoses and electrical cables used in umbilicals are not to have any intermediate connection.
(6) Sheathing is to be such that internal overpressure arising from the leakage of a hose be prevented from being built-up.

2. Main bell umbilical

(1) The main bell umbilical ensures the connection between the diving bell and the surface.
(2) The main bell umbilical is to be securely attached to the bell by means of a strength member or strain relief fitting so that neither the individual components or any bell penetrations are subject to load.
(3) The diving bell umbilical may include means for the transfer of:
  (A) breathing gas
  (B) hot water
  (C) communication, video and controls
  (D) electrical power.

(4) When the main bell umbilical is paid out manually, it is to be marked at regular intervals in order for the operator to know exactly the amount paid out at any time during the diving operation.

3. Diver's umbilical

(1) The diver's umbilical ensures the connection between the diving bell and the diver.
(2) Umbilicals are to be marked for length at least every 10 meters using a recognized system which allows easy visual identification of the length paid out.'
(3) Any hoses carrying concentration of oxygen greater than 25% are to be oxygen compatible.

Section 8 Electrical, Control and Communication Systems

801. General

1. This Section provides requirements for the design and construction of electrical installations and control systems, in addition to the requirements defined in the **Pt 6**.

802. General design requirements

1. Environment

(1) All electrical equipment and installations, including power supply arrangements, should be designed for the environment in which they will operate to minimize the risk of fire, explosion, electrical shock and emission of toxic gases to personnel, and galvanic corrosion of the deck decompression chamber or diving bell.
(2) Reference is made to IMCA D045 Code of practice of the safe use of electricity under water, as amended.

2. Electricity under water and inside hyperbaric chambers

(1) The use of electricity inside hyperbaric chambers is to be kept to a minimum. Equipment used is to be of adequate design and construction against hyperbaric and oxygen enriched environment.
(2) Electrical receptacles installed inside the deck chambers are to be waterproof.

3. Maximum voltages

(1) Inside the deck chambers, the voltage should not exceed:
  (A) 30 V D.C for plugs, portable equipment and communication, monitoring and remote control
  (B) 250 V A.C for power system: A.C Systems with voltage between 7,5 V and 250 V are to be protected against accidental touching and fitted with suitable earth leakage protection.
  (C) Higher voltage may be allowed provided that effective protection is fitted and subject to agreement from the Society.
(2) Inside the bell, the voltage should not exceed 30 V D.C.

4. Lighting

(1) Main and emergency lighting is to be provided in spaces containing diving equipment.
(2) Each deck decompression chamber and diving bell should have adequate means of normal and emergency lighting to allow an occupant to read gauges and operate the system within each compartment.
(3) Lighting equipment installed inside PVHO are to be rated at a pressure equal to 1,5 times the MAWP.
(4) Illumination levels within the diving system are to be adequated for the tasks to be performed. Sufficient internal lighting are to be provided to allow valves and controls to be operated safely.

5. Electric motors

Electrical motors inside the deck chambers or diving bell are to be suitable for the intended use as required in **2**.

803. Power source

1. General

The electrical installations are to be supplied from two independent sources of electrical power, a main and an emergency source of power.

2. Emergency source of power

(1) In the event of failure of the main source of electrical power supply to the diving system, an independent

source of electrical power is to be available for the safe termination of the diving operation. It is admissible to use the unit's emergency source of electrical power as an emergency source of electrical power if it has sufficient electrical power capacity to supply the diving system and the emergency load for the vessel at the same time.

(2) The emergency source of electrical power is to be located outside the machinery casings to ensure its functioning in the event of fire or other casualty causing failure to the main electrical installation.

(3) As a minimum, the emergency source of power is to be of sufficient capacity to supply the following emergency services:
   (A) the breathing gas supply, analysis and regeneration systems
   (B) the emergency communication system
   (C) the emergency lighting in the deck decompression chambers, the diving bell and the control stations
   (D) the launch and recovery system of the diving bell
   (E) the handling system required for emergency launching of the HRU
   (F) any emergency system necessary for life support.

(4) The emergency source of power is to be capable of supplying the emergency services for a minimum period in accordance with the intended procedure to decompress or evacuate the divers in a safe manner, and as defined in the operating manual.

(5) The emergency source of electrical power is to be self-contained and independent of the main electrical installation and may be either a generator or an accumulator battery.

(6) The following emergency services are to remain available during switching from main to emergency source of power:
   (A) emergency lighting
   (B) alarm systems (diving and life support system)
   (C) emergency communication systems.

(7) Where the emergency source of electrical is a generator, it is to be started automatically upon failure of the main source of electrical power in order to supply the required emergency loads in less than 45s.

(8) A transitional source of emergency electrical power is to be provided, so arranged as to supply automatically and for half an hour the services referred to in (6) or for which a permanent or temporary degradation may occur during the switchover period.

(9) When an accumulator battery is used as the emergency source of power or as a transitional source of power, it shall operate without recharging while maintaining the voltage of the battery throughout the discharge period within 12% above or below its nominal tension.

(10) When switching from the main source of power to the emergency source of power, an audible and visible alarm is to be actuated in the diving and life support control stations, with the indication of the source of power connected.

3. Accumulator batteries

(1) Storage batteries are not to be located inside the diving bells nor the deck decompression chambers.

(2) Any battery devoted to supply essential services is to be fitted with an indicator of the status of charging and a low level alarm.

(3) When batteries are used within an hyperbaric enclosure, reference is made to IMCA D002 Battery packs in pressure housings, as amended. In particular, the following is to be observed when using batteries in pressure housing:
   (A) battery terminals/leads are to be adequately insulated to protect against short circuit
   (B) periodic examination, testing and renewal of the cells as necessary should be included within the planned maintenance system
   (C) as a general rule shunt diodes should be provided across each cell of a primary battery to avoid the possibility of polarity-reversal occurring in any cell under discharge conditions
   (D) the battery housing is to be fitted with an appropriate pressure relief device
   (E) the battery casing should not be opened in a confined space and should be fully vented
   (F) lead acid batteries should not be used in a hyperbaric environment.

804. Distribution system

1. General

(1) The distribution system is to be of an insulated neutral type (IT).

(2) The structure or hull return distribution system is not permitted.

(3) The distribution system is to be such that the failure of a single circuit will not endanger or render any other circuit inoperative for longer periods.

(4) When the system is supplied through a distribution board, at least two sections of this board are to be supplied by two independent electrical power circuits.

(5) Every insulated distribution system for power, heating or lighting, shall be provided with a device capable of continuously monitoring the insulation level to earth (i.e. the values of electrical insulation to earth) and of giving an audible and visual indication of abnormally low insulation values.

2. Circuit protection

(1) Circuit breakers and fuses are to be provided on all conductors in order to protect the circuit against overload and short-circuit.
(2) Fuses and circuit breakers are not to be fitted within the bell or the deck decompression chambers.

3. Earthing

Deck chambers and bells are to be provided with earthing connection.

4. Distribution panel

(1) Distribution panels are to comply with the requirements of the **Pt 6**.
(2) The distribution panel is to be readily accessible from the control stations.
(3) It is to be possible to disconnect each deck decompression chamber separately.

5. Electrical penetrators for pressure vessels

(1) Electrical penetrators on the boundary of the pressure vessels are to be specially designed and manufactured for that purpose and approved by the Society.
(2) Electrical penetrators in pressure vessels are to remain gas tight and watertight under the design pressure of the vessel, even if the electrical cable passing through the penetrator is damaged.

6. Electrical cables

(1) Electrical cables and wiring are to comply with **Pt 6**.
(2) Electrical cables are to be separated from piping installations carrying breathing gas.

805. Diving control station and Life support control station

1. Diving control station

(1) The control station of the diving bell is to provide the diving supervisor with all information, controls, monitoring systems and means of communication needed for the command of the diving operation and the diving bell.
(2) When there are two diving bells, two diving control stands are to be provided.
(3) The control panel is to be provided with the diagram of the gas flow lines.
(4) The information on the control panel is to include:
  (A) internal pressure of the bell
  (B) depth of immersion of the bell: by measurement of the external pressure and by measurement of the paid-out suspension rope length
  (C) indications on the proper paying-out of the umbilical (information on the length paid-out, view on the pay-out device, information from the bell etc.)
  (D) depth of immersion of each divers working outside the bell
  (E) pressure of the gases supplied at the diving bell
  (F) pressure before and after all pressure reducers on the gas flow lines
  (G) pressure in the storage gas cylinders
  (H) results of the breathing gas analysis defined in Sec 3:
    (a) partial pressure of oxygen served out in umbilical
    (b) partial pressure of oxygen in the bell
    (c) partial pressure of carbon dioxide
    (d) partial pressure of helium (in case of 3 gases mix)
    (e) content of pollutants if any.
  (I) controls parameters of heating means: temperature of the hot water being supplied to the divers and flow rate.
  (J) alarms including:
    (a) low and high level alarm for the oxygen partial pressure of the breathing gas supplied to the divers
    (b) low and high level alarm for the oxygen partial pressure in the diving control station
    (c) alarm when the water temperature used as a diver heating medium moves outside the pre-set limits
    (d) alarm when main source of power is failing
    (e) alarm for electrical insulation fault with an indication of the concerned circuit
    (f) alarm for the failure of the station keeping system.
  (K) indication of the source of electrical power connected

(L) communication and video watching of the diving bell.

(5) Provisions should be made within the bell for an independent means of monitoring oxygen and carbon dioxide levels.

(6) Any audio alarm is to be capable of being muted if it is so obtrusive that it does not allow to hear other means of communications.

(7) A monitoring system is to be provided to continuously record the oxygen and carbon dioxide content in the bell.

(8) The diving control station is to include the following direct and remote controls:
- (A) electrical controls of the bell (lighting, video, communication, gas reclaim systems, etc)
- (B) controls of the supply of the umbilical: breathing gas for each diver, hot water, etc.)
- (C) control of the sources of energy for the tools.

(9) When emergency source of power is to be manually actuated, the manual switch is to be provided in the control station.

(10) When fitted, cross-over valves on breathing gas supply or depth gauge lines are either be fixed in one position or to indicate very clearly which source they are connected to. In any event any gauge fitted with a cross-over valve is to indicate very clearly at all times exactly what it is reading.

(11) For surface diving, the diving control station where the diving supervisor operates is to gather:
- (A) the information needed for the control of the dive:
  - (a) communication and video
  - (b) measurement of the immersion of the wet bell/diving basket
  - (c) Pressure of the breathing gas storage
  - (d) partial pressure of oxygen (for surface mixed gas diving)
  - (e) clock.
- (B) controls actuating:
  - (a) main and emergency supply
  - (b) pure oxygen supply (if needed).
- (C) the input pressure of the umbilical of the wet bell/diver basket if the umbilical is independent from the supply of the divers.

(12) Indicators and analyzers are to comply with **Sec 7**.

(13) Oxygen analyzers are to be provided in control stations.

2. Life support control station

(1) The control station of the deck decompression chambers is to provide the operator with all information, controls and means of communication needed for the command of the life support operations.

(2) The control panel is to be provided with the diagram of the gas flow lines.

(3) The information on the control panel is to include:
- (A) pressure in each compartment of the deck chambers including the trunks with at least one separate gauge for each compartment
- (B) pressure inside the diving bell
- (C) pressure of supply of the breathing gases into the deck chambers
- (D) pressure of the storage gas cylinders
- (E) pressure before and after all pressure reducers on the gas flow lines
- (F) results of the breathing gas analysis defined in Sec 3:
  - (a) partial pressure of oxygen in each compartment
  - (b) partial pressure of carbon dioxide in each compartment
  - (c) partial pressure of oxygen served out at Built-in Breathing Apparatus (BIBS)
  - (d) content of pollutants if any.
- (G) alarms including:
  - (a) low and high level alarm for the oxygen partial pressure
  - (b) alarm when main source of power is failing
  - (c) alarm for electrical insulation fault with an indication of the concerned circuit
  - (d) alarm for the failure of the station keeping system
  - (e) alarm for oxygen content in oxygen storage areas
- (H) indication of the source of electrical power connected
- (I) temperature and humidity content in each compartment of the deck chambers and indication whether each environmental control unit is running or not
- (J) video watching of each compartment of the deck chambers.

(4) A monitoring system is to be provided to continuously record the oxygen, the carbon dioxide content, the helium content if a 3 gases mix is used, the temperature and humidity in each compartment.

(5) The life support control station is to include the following controls:
- (A) compression and decompression of each compartment
- (B) command of valves for each gas supply

(C) gas supply for the Built-in Breathing Apparatus (BIBS)
(D) switching on and off the electrical equipment of the chamber:
(a) lighting, video, communication
(b) regeneration
(c) addition of oxygen
(d) electrical sensor (pressure, ppO2…).
(E) switching on and off the electrical power (1 general electrical switch for each chamber)
(F) actuation of the fixed fire-fighting system in the deck chambers
(G) selection of the gas bank
(H) amount of oxygen supply for each compartment
(I) manual switching from main to emergency electrical power, when applicable
(J) control of the opening of the transfer from the bell to the deck chambers.

(6) Indicators and analyzers are to comply with **Sec 7**.
(7) Oxygen analyzers are to be provided in control stations.

806. Communication

1. General

(1) Communication means described in this Article are to be provided in control stations, diving bell and DDC. Direct two-way communication are to be provided in control station, diving bell and DDC.
(2) Alternative means of communication with divers in the deck decompression chamber and diving bell should be available in case of emergency.
(3) Each deck decompression chamber and diving bell should be connected to a speech unscrambler when used with gas systems, including helium.

2. Diving control station

(1) The communication system should be arranged for direct 2-way communication between the diving control station and:
(A) the diver in water
(B) the diving bell
(C) each compartment of the chambers
(D) diving system handling positions
(E) dynamic positioning room
(F) bridge, ship's command centre or drilling floor.
(2) The diving control station is also to include communication with the bell and divers through an ultra-sonic system in damaged condition.
(3) There is to be both primary and secondary means of communication between the diving control station and:
(A) the ship command centre
(B) the life support control station
The primary link is to be hard wired, immediately available and unable to be interrupted. One of these links is to be able to operate without the need for external power supply.
(4) A recording system is to be fitted to record all communications between divers and supervisor.

3. Life support system control station

(1) The life support control station is to include the following means of communication with:
(A) each compartment of the deck chambers, including interphone with unscrambler, when relevant
(B) the exterior of each medical lock fitted on the deck decompression chambers
(C) the diving control station
(D) the ship command centre
(E) the launching station of the hyperbaric rescue unit
(F) inside the hyperbaric rescue unit (inside and outside the PVHO).
(2) There is to be two-way communications between the divers inside each compartment of the chamber.
(3) A secondary (back up) communication system (such as a sound powered phone) should exist between the divers inside each compartment of the chamber and those outside at the life support control station.

4. Diving bell

A self-contained through-water communication system should be provided for emergency communication with diving bells when operating under water.

5. Visual control

(1) For saturation diving systems, means for visual control of the divers in the diving bell (e.g. CCTV) from

the diving control stand are to be provided.
(2) All compartments of the deck chambers are to be provided with means for visual control.
(3) Means for visual control of the launch and recovery area from the diving control stand (directly or through CCTV) are to be provided.

Section 9 Fire Protection, Extinction and Detection

901. General

1. This Section provides design and construction requirements regarding the fire protection, detection and extinction applicable to diving systems.

2. Inspections and tests are in accordance with **Sec 2**.

902. Fire Protection

1. Material

(1) All materials and equipment used in connection with the diving system should be, as far as is reasonably practicable, of fire-retardant type in order to minimize the risk of fire and sources of ignition.
(2) All materials used in the diving system and especially in the inner area of the hyperbaric chambers, are to be selected so as to offer a minimum risk of combustion and a flame propagation velocity as slow as possible, particularly the wall coating, taking into account high partial pressure of oxygen.
(3) Where selecting materials, particularly plastics, the toxicity and the quantity of noxious gases likely to escape during combustion of the chosen materials is to be taken into account.
(4) Requirements regarding materials for oxygen installations are given in **Sec 7**.
(5) Lubricants are to be approved for use in over-oxygenated environment.
(6) The choice of materials is to be justified and submitted to the Society for approval; the Society reserves the right to call for tests.
(7) Requirements regarding the electrical equipment are given in **Sec 8**.
(8) Electrical equipment are to be selected so as to prevent static electricity to build up and the risk of spark.

2. Area of installation of diving system

(1) The ship or floating structure on which the diving system is installed is required to conform to the fire protection regulations of the classification society responsible and, where applicable, to the relevant requirement of **Pt 8**.
(2) Where pressure vessels are situated in enclosed spaces, a permanently installed water spray system having an application rate of $10\,l/m^2$ related to the horizontal projected area is to be provided for cooling in the event of fire. These water spray systems may be manually activated and operated. For pressure vessels installed on the open deck, cooling by means of fire hoses connected to the general fire extinguishing system is permitted.

903. Fire detection

1. Fire detection and alarm

(1) In outer spaces where no regular human supervision is ensured, a fire detection system allowing to signalize automatically any incipient fire and its location is to be provided for.
(2) In each compartment of the deck chambers, a fire detection and alarm system is to be provided.
(3) The alarm is to be audio and visual both locally and at the life support control station.

904. Fire extinction

1. General

(1) Each compartment in a deck decompression chamber should have suitable means of extinguishing a fire in the interior which would provide rapid and efficient distribution of the extinguishing agent to any part of the chamber.
(2) The fire extinguishers provided for are to be suitable for operation at the pressure prevailing within the enclosure.
(3) The fire-fighting equipment is to be permanently available.

2. Saturation diving system

(1) Each compartment of the deck chambers in a saturation diving system is to be provided with a fixed fire-extinguishing system.
(2) The fixed fire-fighting system is to be operable from both inside and outside of the deck chambers.
(3) The fire extinguishing agent is to be atomized water. The use of other product is to be submitted to the Society for approval.
(4) In addition to the fixed fire-fighting system, portable fire extinguishers are to be provided.
(5) Reference is made to NFPA 99 - Health care facilities code - for the fire-fighting system inside hyperbaric chambers. Other standard may be accepted subject to approval of the Society.

3. Surface diving system

Portable extinguishers may be sufficient in deck decompression chambers of surface diving systems.

905. Other fire protection equipment

Emergency breathing apparatus are to be available at diving and life support control stations.

Section 10 Launch and Recovery System [See Guidance]

1001. General

1. This Section provides requirements for the design and construction of launch and recovery systems of diving bells.

2. The requirements given in the present Section are additional to the requirements given in **Ch 2**.

3. Inspections and tests are in accordance with **Sec 3**.

1002. General design requirements

1. General

(1) A diving system should be equipped with a main handling system to ensure safe transportation of the diving device between the work location and the deck decompression chamber.
(2) The handling system should be designed with adequate safety factors considering the environmental and operating conditions, including the dynamic loads which are encountered while handling the diving bell through the air-water interface.
(3) The handling system should enable smooth and easily controllable handling of the diving bell.
(4) The lowering of diving devices under normal conditions should not be controlled by brakes, but by the drive system of the winches.
(5) The handling system is to be suitable for man riding.
(6) Handling systems should enable easy and firm connection or disconnection of a closed diving bell to a deck decompression chamber, even under conditions where the support ship or floating structure is rolling, pitching or listing to predetermined degrees.
(7) The SWL is to be clearly marked on every winch and on the A frame, trolley or similar.
(8) When the LARS is powered by hydraulics, the hoses used are to be suitably supported and secured at intervals not exceeding 2 m.
(9) If a heave compensation system is fitted, a warning (light) is to be visible at the dive control stand an d the LARS control stand when the system is in operation.

2. Calculations

(1) The 'working load' of the handling system comprises the weight of the diving bell, the total weight of the fully equipped divers at 150 kgf each, the weight of the equipment and the ballast weights. The 'dead load' is the weight of the handling system.
(2) Regardless of the tape of handling system and the size of the working load, the dimensional design of the handling system is to allow for a working load factor Y = 2,0 and a dead load factor F of 1.5. It is assumed here that the use of the system in a seaway will be limited to significant wave heights of 2 m or less. Where it is proposed that handling operations should be performed in even more unfavourable conditions, previous agreement with the Society is necessary.
(3) Calculations are to be based on the assumption that the angle of engagement of the hoisting and lowering strength member may be 12 off perpendicular in any direction.

(4) The maximum static tensile stress imposed on steel wire ropes by the working load may not exceed 12.5 % of the proven rupture strength of the ropes.
(5) Where ropes made of natural or synthetic fibres are used, the maximum static tensile stress imposed by the working load may not exceed 10 % of the proven rupture strength of the ropes.
(6) The stress limits for components are specified in guidance.
(7) Rope tension shall not exceed the design load below.
  (A) Wire rope's safety factor is 4 times design load factor. (Design load shall not exceed 1.5 times working weight.)
  (B) Synthetic fiber's safety factor is 5 times design load factor.
(8) All interchangeable components such as blocks, hooks, shackles etc. are to be complied with the recognized standards and are to be designed for twice the working load.

1003. Machinery and electrical equipment

1. Winch

(1) The winch rated pull capacity is to take into account allowance for dynamic effects.
(2) The winch raise/lower control is to be designed to return to the neutral position when released by the operator.
(3) If any sort of clutch mechanism is fitted to the winch, there is to be a positive means of preventing it becoming disengaged during operation.
(4) The winch drum is to be able to accept the full length of wire being used. This means that there should be a clear space between the outside of the top layer of wire and the edge of the drum flange of at least 2,5 times the wire diameter.
(5) Any winch used to handle the diving bell is to have:
  (A) a second motor
  (B) means to ensure that the wire being recovered is correctly spooled
  (C) means by which the winch operator can see how much of the main bell lift wire and main bell umbilical have been paid out. This may be by line-out meters or at its simplest by marking the bell wire and umbilical at 10 metres intervals, using the same marking system.

2. Brake

(1) If the energy supply to the handling system fails or the operating lever is returned to neutral position, brakes should be engaged automatically.
(2) Winch for personnel hoisting is to be provided with double brakes.
(3) In addition to the normal brake, the winch shall be equipped with a mechanically and operationally independent secondary brake with separate control system.

3. Secondary means of recovery

(1) In the event of single component failure of the main handling system, an alternative means should be provided whereby the bell can be returned to the deck decompression chamber.
(2) In case of failure of the main handling system, there is to be a secondary means of recovering the diving device to the surface, bringing it on-board and mating it to the chamber system. This is to be independent of the main recovery system.
(3) The secondary recovery system is to have a certified SWL which is at least equal to the weight of the fully loaded diving device in air and in water, in addition to its main task when relevant.

4. Emergency power source

(1) An independent (secondary) power source is to be available in case of failure of the primary power.
(2) The emergency power source is to comply with the requirements provided in **Sec 8**.

1004. Ropes and padeyes and umbilical handling system

1. Lifting rope and guide wires

(1) The lifting rope is to be of non-rotating type.
(2) Operating the release system of the main lifting rope is to be dependent on 2 independent self-willed actions.
(3) The wire rope is to be adequately protected against corrosion.
(4) For saturation diving systems, a system is to be provided to restrict excessive lateral or rotational movement of the diving device in the water. Usually, this system consists in a pair of guide wires stabilized with a weight.
(6) This system may be used as an emergency means of recovery. In this case, the guide wires and their winch are to be suitable for man riding.

(7) The lifting rope attachment to the diving device is to be a properly designed lifting padeye.
(8) The connection of the lifting rope to the padeye is to have two retaining means for the removable pin (eg: nut locked with a split spin).

2. Umbilical handling system

(1) Provisions should be made in order that the handling system of the umbilical is not used to lift the diving device, unless it is designed for that function.
(2) The winding diameter (reel, sheave) should be at least 3 times the umbilical natural curvature radius.
(3) Umbilicals in surface diving systems are to be marked in order for the LARS operator to know the amount of umbilical paid out at any time during the diving operation.

Section 11 Hyperbaric Rescue Unit

1101. General

1. This Section provides requirements for the design and construction of Hyperbaric Rescue Units (HRU) including:
(A) self-propelled hyperbaric lifeboat (SPHL)
(B) hyperbaric rescue chamber (HRC) non propelled.

2. Saturation diving systems are to be provided with an hyperbaric rescue unit.

3. Where the hyperbaric evacuation system permanently connected to the diving system is provided it is to be applied with the 'Guidelines and Specifications for Hyperbaric Evacuation Systems', **Res. A.692(17).** Other standard may be accepted subject to approval of the Society.

4. Inspections and tests are in accordance with **Sec 3**.

1102. Evacuation system

1. General

(1) An evacuation system should be provided having sufficient capacity to evacuate all divers under pressure, in the event of the ship having to be abandoned, and should be in accordance with the provisions of IMO Guidelines and specifications for hyperbaric evacuation systems Resolution A692.
(2) he design and construction of the hyperbaric evacuation system should be such that it is suitable for the environmental conditions envisaged, account being taken of the horizontal or vertical dynamic snatch loads that may be imposed on the system and its lifting points particularly during evacuation and recovery.
(3) On floating units intended for drilling, production or storage of hydrocarbon, the HRU is to have means of propulsion or other method to ensure it can rapidly move clear of the site.
(4) Arrangement is to be provided to enable an unconscious diver to be taken into the unit.
(5) Various methods are available for evacuating divers and the suitability of the various options depends on a number of factors including geographical area of operation, environmental conditions, and any available offshore or onshore medical and support facilities. Options available to diving system operators include:
(A) hyperbaric self-propelled lifeboats
(B) hyperbaric rescue chambers which may or may not be towable suitable for off loading on to an attendant facility
(C) transfer of the diving bell to another facility
(D) transfer of the divers from one diving bell to another when in the water and under pressure
(E) negatively buoyant unit with inherent reserves of buoyancy, stability and life support capable of returning to the surface to await independent recovery.
(6) The Hyperbaric Rescue Unit (HRU) can be an Hyperbaric Rescue Chamber or a Self-Propelled Hyperbaric Lifeboat.

2. Hyperbaric rescue chamber (HRC)

(1) The hyperbaric rescue chamber is a deck chamber specially fitted to be launched and to work continuously and passively during the specified minimum autonomy. This implies:
(A) an interface with handling means
(B) a stability study
(C) a protection against impact
(D) a specific thermal protection
(E) means of making vital and communication functions autonomous in flotation condition.

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

3. Self-Propelled hyperbaric lifeboat (SPHL)

(1) The SPHL is to comply with international regulations applicable to rescue craft (IMO LSA code).
(2) A non-pressurized steering and control station is to be provided for at least one sailor and one deck chamber operator.
(3) The deck chamber operator is to be able to watch inside the chamber from its control panel through a viewport.

1103. General design requirements

1. General

(1) The HRU is to be capable of maintaining the divers at the correct pressure and with life support for a minimum of 72 hours.
(2) Assessment of reserves in soda lime, heating/ refrigerating means, survival rations, reserves of gas, etc. is to be made considering the required autonomy.
(3) Breathing gas reserves and gas reclaim are to cover the consumption of the designed number of persons as well as the compensation of possible leaks. The embarked gas reserve is to allow at least to keep the chamber of the HRU at its operating pressure during the survival duration.
(4) Where hyperbaric rescue units are designed to be placed on board a rescue vessel, attachment points should be provided on the unit to enable it to be secured to the deck.
(5) Hyperbaric rescue units designed to float should be provided with adequate stability for all envisaged operating and environmental conditions and be self-righting. In determining the degree of stability to be provided, consideration should be given to the adverse effects of large righting moments on the divers. Consideration should also be given to the effect which equipment and rescue personnel, required to be placed on the top of the system to carry out a recovery from the sea, may have on the stability of the hyperbaric rescue unit.
(6) Towing attachment points should be so situated that there is no likelihood of the hyperbaric rescue unit being capsized as a result of the direction of the tow line. Where towing harnesses are provided they should be lightly clipped or secured to the unit and, so far as is possible, be free from snagging when pulled free.
(7) Hyperbaric rescue units designed to float should have sufficient reserves of buoyancy to enable the necessary rescue crew and equipment to be carried.
(8) The access trunk is to be part of the resistant structure. It should allow the personnel to easily pass through.
(9) There is to be emergency means of lighting of the access trunk.
(10) The evacuation route should be such that access for divers to the HRU is possible in all normal circumstances. This should include the possibility of an injured diver requiring evacuation by stretcher. If it is necessary to use a pulley type system to move the stretcher then the pulley is to be of a length that allows connection at the furthest extremity of the trunk. The attachment point of the pulley(s) inside the HRU is to be submitted.
(11) The means provided for access into the HRU chambe should be such as to allow safe access to or from the deck decompression chambers. Interlocks should be provided to prevent the inadvertent release of the hyperbaric rescue unit from the deck decompression chamber while access trunking is pressurized. The mating flange should be adequately protected from damage at all times including during the launch and recovery stages.
(12) The design and construction of the interface between the HRU and HRF should comply with the recommended standard defined in IMCA D051 Hyperbaric Evacuation Systems (HES) - Interface Requirements.

2. Marking

(1) Dedicated hyperbaric rescue units should be coloured orange (internal distress orange) and be provided with retro-reflective material to assist in their location during hours of darkness.
(2) Each hyperbaric rescue unit designed to be waterborne should be marked with at least three identical signs. One of these markings should be on top of the unit and be clearly visible from the air and the other two be mounted vertically on either side and as high as possible and be capable of being seen while the unit is afloat. **【See Guidance】**
(3) Where applicable, the following instructions and equipment should be clearly visible and be kept readily available while the unit is afloat:
  (A) towing arrangements and buoyant towline
  (B) all external connections, particularly for the provision of emergency gas, hot/cold water and communications
  (C) maximum gross weight of unit in air

(D) lifting points
(E) name of the parent ship and port of registration and
(F) emergency contact telephone.

(4) Where appropriate, the following instructions should be permanently displayed on every hyperbaric rescue unit in two separate locations so as to be clearly visible while the unit is afloat,
"Unless specialised diving assistance is available:
(A) do not touch any valves or other controls
(B) do not try to get occupants out
(C) do not connect any gas, air, water or other supplies
(D) do not attempt to give food, drinks or medical supplies to the occupants and
(E) do not open any hatches".

3. Pressure vessel for human occupancy

(1) Pressure vessels for human occupancy used in HRU and access to HRU are to comply with the requirements specified Sec 5.
(2) Hyperbaric chambers used for hyperbaric evacuation are to have a minimum diameter of 1750 mm.
(3) A medical lock should be provided and be so designed as to prevent accidental opening while the HRU chamber is pressurized. Where necessary, interlock arrangements should be provided for this purpose. The dimensions of the medical lock should be adequate to enable essential supplies, including CO2 scrubber canisters, to be transferred into the HRU chamber, and be of such dimensions as to minimize the loss of gas when the lock is being used.

4. Life support system

(1) Life support systems are to comply with the relevant provisions of **Sec 7**.
(2) Two separate distribution systems should be provided for supplying oxygen to the decompression chamber. Components in the system should be suitable for oxygen service.
(3) A Built-In Breathing System should be provided with a sufficient number of masks for all the occupants under pressure plus one spare. BIBS should be overboard dump type with exhausts piped both outside the chamber and outside the enclosed cockpit area in the case of lifeboat type.
(4) Where it is intended that divers may be decompressed within the hyperbaric rescue unit, provision should be made for the necessary equipment and gases, including therapeutic mixtures, to enable the decompression process to be carried out safely.
(5) Provision should be made external to the hyperbaric rescue unit, and in a readily accessible place, for the connection of emergency hot or cold water and breathing therapeutic mixture. The dimensions of the connections provided should be as follows:
(A) 3/4 in. NPT (female) - hot or cold water
(B) 1/2 in. NPT (female) - breathing mixture.
The connections are to be clearly and permanently marked and be suitably protected.
(6) The decompression chamber should provide a suitable environment and adequate facilities, including, where appropriate, seat belts, for the maximum number of persons for which the unit is designed. The seating or other arrangements provided should be designed to provide an adequate degree of protection to the divers from impact collisions during launch and while the unit is afloat.
(7) Where the HRU is intended to be occupied for more than 12 h, arrangements for the collection or discharge of human waste should be provided. Where discharge arrangements are provided they should be fitted with suitable interlocks.
(8) In addition to any controls and equipment fitted externally, decompression chambers should be provided with adequate controls within for supplying and maintaining the appropriate breathing mixtures to the occupants, at any depth down to the maximum operating depth. The persons operating the chamber, whether they are within or outside it, should be provided with adequate controls to provide life support. As far as practicable, the controls should be capable of operation without the person who operates them having to remove his/her seat belt.

5. Electrical installations, control systems and Communication

(1) Communication means are to be provided between the HRU decompression chamber and:
(A) the HRU launching station
(B) the DDC control station.
(2) If breathing mixtures containing helium or hydrogen are used, a self-contained primary communication system fitted with an unscrambler device should be arranged for direct two-way communication between the divers and those outside the compression chamber. A secondary communication system should also be provided.
(3) The HRU is to be fitted with: flashing light and radar deflector.
(A) radar deflector

(B) strobe light
(C) radio location devices (EPIRB or similar).

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

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

6. Fire safety

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

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

7. Launch and Recovery System

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

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

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

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

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

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

Present	Amendment	Reason
CHAPTER 9 CARGO VAPOUR EMISSION CONTROL SYSTEMS **Section 1 General** **101. Application** **1. <omitted>** **2.** The requirements in this Chapter are based on the technical requirements of **IMO MSC/Circ. 585** and **USCG CFR 46 Part 39**, and the connection with each Section are as follows: (1) ~ (3) <omitted>	**CHAPTER 9 CARGO VAPOUR EMISSION CONTROL SYSTEMS** **Section 1 General** **101. Application** **1. <omitted>** **2.** The requirements in this Chapter are based on the technical requirements of **IMO MSC/Circ. 585** and **USCG CFR 46 Part 39**. The Rules apply to be registered the class notation in accordance with **Pt 1, Ch 1, Sec 2**. (1) ~ (3) <deleted>	(amended) - IMO MSC./Circ.585 & USCG CFR 46 Part 39

Present	Amendment	Reason
Section 2 Requirements for VEC1 Notation	**Section 2 Requirements for VEC1 Notation**	
203.	**203.**	
204. Cargo tank high level alarm	**204. Overfill control system**	(Amended) - IMO MSC./Circ.585 & USCG CFR 46 Part 39
1. Each cargo tank is to be equipped with an high level alarm. The high level alarm is to: (1) be independent of the cargo gauging system; (2) come into operation when the normal tank loading procedures fail to stop the tank liquid level exceeding the normal full condition; (3) give a visual and audible tank overflow alarm to the ship's operator; (4) ~ (7) <omitted> (8) <newly added>	**1.** Each cargo tank is to be equipped with an overfill control system. The overfill control system is to: (1) be independent of the cargo gauging system required by **203.**; (2) come into operation when the normal tank loading procedures fail to stop the tank liquid level exceeding the normal full condition. The overfill alarm is to be activated early enough to allow the person in charge of transfer operations to stop the cargo transfer before the tank overflow; (3) give a visual and audible tank overfill alarm to the ship's operator; (4) ~ (7) <same as the present> (8) The overfill alarms are to be identified with the labels "TANK OVERFILL ALARM" respectively, in black letters at least 50 mm high on a white background.	
Section 3 Requirements for VEC2 Notation	**Section 3 Requirements for VEC2 Notation**	
302. Overfill Alarm	**302. High level alarm system**	
1. Each cargo tank of a tanker is to be equipped with an overfill alarm system (High-high level) which complies with the followings: (1) The overfill alarm system is to be independent of the cargo gauging system and the high level alarm system; (2) At each cargo control station, the high level alarms required by **204.** and the overfill alarms are to be identified with the labels "HIGH LEVEL ALARM" and "TANK OVERFILL ALARM" respectively, in black letters at least 50 mm high on a white background; (3) The high level alarm required by **204.** is to be set at no less than that corresponding to 95 % of tank capacity. The overfill alarm is to come into operation after the high level alarm, but early enough to allow for action to prevent tank overflow;	**1.** Each cargo tank of a tanker is to be equipped with an High level alarm system which complies with the followings: (1) High level alarm system is to be independent of the high level alarm system; (2) The high level alarms is to be identified with the labels "HIGH LEVEL ALARM" in black letters at least 50 mm high on a white background; (3) The high level alarm ~~required by **204.**~~ is to be set at no less than that corresponding to 95 % of tank capacity. The high level alarm is to come into operation before overfill alarm .	

Present	Amendment	Reason
(4) The overfill alarm system is to give a visual and audible tank overfill alarm to the ship's operator; (5) Visible and audible alarms are to be fitted so that it can be seen and heard at the cargo control station and in the cargo deck area; **[See Guidance]** *(2018)* (6) The overfill alarm system is to alarm in the event of loss of power to the alarm system or failure of the electrical circuitry to the tank level sensor; and (7) The overfill alarm system is to be able to be checked at the tank for proper operation prior to each transfer or contain an electronic self-testing feature which monitors the condition of the alarm circuitry and sensor.	(4) The high level alarm system is to give a visual and audible tank high level alarm to the ship's operator; ~~(5) Visible and audible alarms are to be fitted so that it can be seen and heard at the cargo control station and in the cargo deck area;~~ ~~**[See Guidance]** *(2018)*~~ (6) The high level alarm system is to alarm in the event of loss of power to the alarm system or failure of the electrical circuitry to the tank level sensor; and (7) The high level alarm system is to be able to be checked at the tank for proper operation prior to each transfer or contain an electronic self-testing feature which monitors the condition of the alarm circuitry and sensor.	(Amended) - IMO MSC./Circ.585 & USCG CFR 46 Part 39

Rules for the Classification of Steel Ships Revision

(Part 9 Additional Installations)

Ch 2 Cargo Handling Appliances

Present	Amendment	Reason
CHAPTER 2 CARGO HANDLING APPLIANCES **Section 1 General** **101. General** **1. <same as the present Rules>** **2. Equivalency** (1) Cargo gear, cargo ramps and loose gear which do not comply with the requirements of the Rules may be accepted, provided that they are considered by the Society to have the effectiveness equivalent to those complying with the Rules. (2) Any existing cargo gear, cargo ramps and loose gear designed and manufactured not under the requirements of the Rules may be deemed by the Society to comply with the Rules, provided that they comply with any rules or standards recognized by the Society to be appropriate and have passed the tests and inspection required by the Society. **[See Guidance]** <hereafter, same as the present Rules>	**CHAPTER 2 CARGO HANDLING APPLIANCES** **Section 1 General** **101. General** **1. <same as the present Rules>** **2. Equivalency** The equivalence of alternative and novel features which deviate from or are not directly applicable to the Rules is to be in accordance with **Pt 1, Ch 1** of the Rules for the Classification of Steel Ships. *(2020)* **[See Guidance]** <hereafter, same as the present Rules>	* amendment due to reorganization of rules related to equivalency

Present	Amendment	Reason
Section 2 Surveys **201. ~ 202. <same as the present Rules>** **203. Registration Surveys** **1. Drawings and Other Documents to be Submitted [See Guidance]** <same as the present Rules> **2. Examinations for Workmanship [See Guidance]** <same as the present Rules> <newly added> <hereafter, same as the present Rules>	**Section 2 Surveys** **201. ~ 202. <same as the present Rules>** **203. Registration Surveys** **1. Drawings and Other Documents to be Submitted [See Guidance]** <same as the present Rules> **2. Examinations for Workmanship [See Guidance]** <same as the present Rules> **3. On board installation survey** (1) survey for connection between the structural members and hull structure (A) survey for welded connection between the structural members and hull structure (B) non-destructive testing(where requested by the Surveyor) (2) On board operation tests and load tests (3) Other tests considered necessary by the Society **4. Registration Surveys for cargo handing appliances already installed on board a ship** (1) Identification of materials and equipment certificates for cargo handing appliances (2) On board operation tests and load tests (3) Other tests considered necessary by the Society <hereafter, same as the present Rules>	* reflecting Request for eatablishment / revision of classification techical rules(SUR3000-1562-2019) amended to clarify the scope of registration survey

Rules for the Classification of Steel Ships

(Final)

Part 9 Additional Installations

- Chapter 3 Automatic and Remote Control Systems
- Chapter 4 Dynamic Positioning Systems

2019. 12.

Machinery Rule Development Team

Effective Date : 1 January 2020

(The contract date for ship construction or an application date for certification of an engine)

◉ reflected IACS UR M35(Rev.8 Jan 2019) and M36(Rev.6 Dec 2018)

- The requirements for alarm of high oil mist concentrations in the crankcase have been amended to alarm the operation of the oil mist detection device or the bearing lubricant outlet temperature or the operation of the bearing temperature monitoring device.

Present	Amendment	Remark
CHAPTER 3 AUTOMATIC AND REMOTE CONTROL SYSTEMS	**CHAPTER 3 AUTOMATIC AND REMOTE CONTROL SYSTEMS**	
Section 1 - 2 <same as the present Rules>	**Section 1 - 2 <same as the present Rules>**	
Section 3 Centralized Monitoring and Control Systems for Main Propulsion and Essential Auxiliary Machinery	**Section 3 Centralized Monitoring and Control Systems for Main Propulsion and Essential Auxiliary Machinery**	
301. - 304. <same as the present Rules>	**301. - 304. <same as the present Rules>**	
305. Automatic and remote control of main propulsion machinery or controllable pitch propellers [See Guidance]	**305. Automatic and remote control of main propulsion machinery or controllable pitch propellers [See Guidance]**	(Amended) - Reflecting the IACS UR M35(Rev.8), alarm for high oil mist concentrations in the crankcase have been amended to alarm the operation of the oil mist detection device or the bearing lubricant outlet temperature or the operation of the bearing temperature monitoring device.
1. - 4. <same as the present Rules>	**1. - 4. <same as the present Rules>**	
Table 9.3.1 Crosshead diesel engines *(2017)* **Table 9.3.2 Trunk piston diesel engines** *(2017)*	**Table 9.3.1 Crosshead diesel engines** *~~(2017)~~(2020)* **Table 9.3.2 Trunk piston diesel engines** *~~(2017)~~(2020)*	
306. <same as the present Rules>	**306. <same as the present Rules>**	

<Amendments>

Table 9.3.1 Crosshead diesel engines ~~(2017)~~(2020)

Systems	Monitored parameters [H: High L: Low O: Abnormal status]		AA	RI	Auto slow down with alarm	Auto start of Stand by pump with alarm	Auto shut down with alarm	Notes [AA = Alarm Activation RI = Remote Indication* ●=apply]
Sensors	Common or separate		c	c	c	s	s	c = common; s = separate
Lubri-cating oil	~~Oil mist concentration in crankcase - H or Main, crank, crosshead bearing temp. (or bearing oil outlet temp).- H~~ Activation of oil mist detection arrange-ments (or activation of the temperature monitoring systems or equivalent devices of: - the engine main, crank and crosshead bearing oil outlet; or - the engine main, crank and crosshead bearing)	~~H~~ O	●		●			For engines having power ≧ 2250 kW or cylinder bore > 300 mm (1)

<Amendments>

Table 9.3.2 Trunk piston diesel engines *(2017)(2020)*

Systems	Monitored parameters [H: High L: Low O: Abnormal status]		AA	RI	Auto slow down with alarm	Auto start of Stand by pump with alarm	Auto shut down with alarm	Notes [AA = Alarm Activation RI = Remote Indication* ●=apply]
Sensors	Common or separate		c	c	c	s	s	c = common; s = separate
Lubricating oil (Diesel engine)	~~Oil mist in crankcase, mist concentration(H) or main & connecting rod bearing temp. (or oil outlet temp.) (H) or an equivalent device~~ Activation of oil mist detection arrangements (or activation of the temperature monitoring systems or equivalent devices of: - the engine main and crank bearing oil outlet; or - the engine main and crank bearing)	H O	●				●	Only for medium speed engines having power ≧ 2250 kW or cylinder bore > 300 mm. ~~Single sensor~~ : for each engine, one oil mist detector (or engine bearing temperature monitoring system or equivalent device) having two independent outputs for initiating alarm and for shutdown will satisfy independence of alarm and shut-down systems. (1) An equivalent device could be interpreted as measures applied to high speed engines where specific design features to preclude the risk of crankcase explosions are incorporated.

Present	Amendment	Remark
307. Automatic and remote control of electric generating sets **1. - 4. <same as the present Rules>** **Table 9.3.8 Auxiliary diesel engines and auxiliary turbines** *(2017)* **308. - 310. <same as the present Rules>** **Section 4 - 5 <same as the present Rules>**	**307. Automatic and remote control of electric generating sets** **1. - 4. <same as the present Rules>** **Table 9.3.8 Auxiliary diesel engines and auxiliary turbines** *~~(2017)~~(2020)* **308. - 310. <same as the present Rules>** **Section 4 - 5 <same as the present Rules>**	(Amended) - Reflecting the IACS UR M36(Rev.6), alarm for high oil mist concentrations in the crankcase have been amended to alarm the operation of the oil mist detection device or the bearing lubricant outlet temperature or the operation of the bearing temperature monitoring device.

<Amendments>

Table 9.3.8 Auxiliary diesel engines and auxiliary turbines *~~(2017)~~(2020)*

Engine	System	Monitored parameters [H: High L: Low O: Abnormal status]		AA	RI	Auto start of Stand by pump with alarm	Auto shut down with alarm	Notes [AA = Alarm Activation RI = Remote Indication* ●=apply]
Diesel Engine	Lubricating oil	~~Oil mist in crankcase, mist concentration(H) or main & connecting rod bearing temp. (or oil outlet temp.) (H) or an equivalent device.~~ Activation of oil mist detection arrangements (or activation of the temperature monitoring systems or equivalent devices of: - the engine main and crank bearing oil outlet; or - the engine main and crank bearing)	~~H~~ O	●			●	Only for medium speed engines having power ≧ 2250 kW or cylinder bore > 300 mm. ~~Single sensor~~ : for each engine, one oil mist detector (or engine bearing temperature monitoring system or equivalent device) having two independent outputs for initiating alarm and for shutdown will satisfy independence of alarm and shut-down systems.(1) An equivalent device could be interpreted as measures applied to high speed engines where specific design features to preclude the risk of crankcase explosions are incorporated.

Effective Date : 1 July 2020

(The contract date for ship construction)

- Chapter 4 Dynamic Positioning Systems : reflected MSC.1/Circ.1580

Present	Amendment	Remark
CHAPTER 4 DYNAMIC POSITIONING SYSTEMS **Section 1 General** **101. General** **1. Application** The requirements in this Chapter apply to the ships intended to be registered as ships provided with dynamic positioning systems. **2.** <same as the present Rules> **3. Classes of dynamic positioning systems** Dynamic positioning systems are classified and defined by their worst case failure modes as follows: (1) DPS(0), DPS(1) Loss of position may occur in the event of a single fault. (2) DPS(2) A loss of position is not to occur in the event of a single failure in any active component or system. Normally static components will not be considered to fail where adequate protection from damage is demonstrated. Single failure criteria include: (A) - (B) <same as the present Rules> (3) DPS(3) A loss of position is not to occur in the event of a single failure. A single failure includes: (A) - (C) <same as the present Rules>	**CHAPTER 4 DYNAMIC POSITIONING SYSTEMS(DP SYSTEMS)** **Section 1 General** **101. General** **1. Application** The requirements in this Chapter apply to the ships intended to be registered as ships provided with dynamic positioning systems(hereafter referred to as "DP system(s)"). **2.** <same as the present Rules> **3. Classes of ~~dynamic positioning~~ DP systems** ~~Dynamic positioning~~ DP systems are classified and defined by their worst case failure modes as follows: (1) DPS(0), DPS(1) Loss of position and/or heading may occur in the event of a single fault. (2) DPS(2) A loss of position and/or heading is not to occur in the event of a single failure in any active component or system. Normally static components will not be considered to fail where adequate protection from damage is demonstrated. Single failure criteria include: (A) - (B) <same as the present Rules> (3) DPS(3) A loss of position and/or heading is not to occur in the event of a single failure. A single failure includes: (A) - (C) <same as the present Rules>	(Amended) - Pt 9, Ch 4 of the Rules was based on MSC/Circ.645, but it has been fully amended to reflect MSC.1/Circ.1580 which was revised in MSC/Circ.645. (Changed terms) - dynamic positioning systems → DP system(s) - position → position and/or heading

Present	Amendment	Remark
102. Definitions Terms used in this Chapter are defined as follows: <Newly added>	**102. Definitions** Terms used in this Chapter are defined as follows: (1) **Dynamically positioned vessel (DP vessel)** means a unit or a vessel which automatically maintains its position and/or heading (fixed location, relative location or predetermined track) by means of thruster force.	- The definition of DP vessel has been newly added.
(1) **Dynamic positioning systems** comprise the following sub-systems, control panels, and back-up systems which are necessary to dynamically positioning the ship. (A) Thruster system (B) Power system (C) Control system	~~(1)~~(2) **Dynamic positioning systems (DP system)** ~~comprise the following sub-systems, control panels, and back-up systems which are necessary to dynamically positioning the ship.~~ means the complete installation necessary for dynamically positioning a vessel comprising, but not limited to, the following sub-systems: (A) ~~Thruster~~ Power system (B) ~~Power~~ Thruster system (C) ~~Control~~ DP control system	- The definition of DP system has been amended.
(2) **Thruster system** comprise the followings: (A) Thruster, power transmission gears driving thruster, thruster control hardware for control of thruster speed, pitch and heading (B) Main propellers and other propulsion units when these are included in dynamic positioning control mode.	~~(2) **Thruster system** comprise the followings:~~ ~~(A) Thruster, power transmission gears driving thruster, thruster control hardware for control of thruster speed, pitch and heading~~ ~~(B) Main propellers and other propulsion units when these are included in dynamic positioning control mode.~~	- The definition of thruster system has been moved to (4).
(3) **Power system** means all components and systems necessary to supply the dynamic positioning system with power and include the followings (A) Prime movers with necessary auxiliary systems including piping (B) Generators (C) Switchboards (D) Distributing system (cabling and cable routing) (E) Power management system	(3) **Power system** means all components and systems necessary to supply the ~~dynamic positioning~~ DP system with power and include the followings: (A) Prime movers with necessary auxiliary systems including piping, fuel, cooling, pre-lubrication and lubrication, hydraulic, pre-heating, and pneumatic systems; (B) Generators; (C) Switchboards; (D) Distributing system (cabling and cable routing); (E) Power supplies, including uninterruptible power supplies (UPS); and ~~(E)~~(F) Power management system(s) (as appropriate).	- The definition of power system has been amended.

Present	Amendment	Remark
<Newly added>	(4) **Thruster system** means all components and systems necessary to supply the DP system with thrust force and direction. The thruster system includes: (A) Thrusters with drive units and necessary auxiliary systems including piping, cooling, hydraulic, and lubrication systems, etc.; (B) Main propellers and rudders if these are under the control of the DP system; (C) thruster control system(s); (D) manual thruster controls; and (E) associated cabling and cable routing.	- The definition of thruster system has been moved from (2).
(4) **Control system** means all control components and systems, hardware and software necessary to dynamically position the vessel and include the followings. (A) Control systems (a) Remote control system(Joystick) (b) Automatic control system (B) Measuring system (C) Control panel (D) associated cabling and cable routing	~~(4)~~(5) **~~Control~~ Dynamic Positioning control system (DP control system)** means all control components and systems, hardware and software necessary to dynamically position the vessel and include the followings~~.~~: (A) ~~Control systems~~ Computer system/joystick system; ~~(a) Remote control system(Joystick)~~ ~~(b) Automatic control system~~ (B) ~~Measuring system~~ Sensor system(s); (C) ~~Control panel~~ Control stations and display system (operator panels); (D) Position reference system(s); ~~(D)~~(E) ~~associated~~ Associated cabling and cable routing; and (F) Networks.	- The terminology for control system has been changed to the DP definition of DP system has been amended.
<Newly added>	(6) **Dynamic Positioning control station (DP control station)** means a workstation designated for DP operations, where necessary information sources, such as indicators, displays, alarm panels, control panels and internal communication systems are installed (this includes: DP control and independent joystick control operator stations, required position reference systems' Human Machine Interface (HMI), manual thruster levers, mode change systems, thruster emergency stops, internal communications).	- The definition of DP control station has been newly added.

Present	Amendment	Remark
(5) **Remote control system(Joystick)** is a semi-automatic control system, which enables the operator to give a defined thrust (force and direction) and a turning moment to the vessel.	~~(5) **Remote control system(Joystick)** is a semi-automatic control system, which enables the operator to give a defined thrust (force and direction) and a turning moment to the vessel.~~ (7) **Joystick system** means a system with centralized manual position control and manual or automatic heading control.	- The definition of joystick system has been amended.
(6) **Measuring system** comprise all hardware and software for the following position reference system and environmental sensor to supply information and corrections necessary to give position and heading reference. (A) - (B) <same as the present Rules>	~~(6)~~(8) **Measuring system** comprise all hardware and software for the following position reference system and environmental sensor to supply information and corrections necessary to give position and heading reference. (A) - (B) <same as the present Rules>	- Numbering (6)-(8) → (8)-(10)
(7) **Control panels** comprise centrally and locally situated panels for operating the dynamic positioning system.	~~(7)~~(9) **Control panels** comprise centrally and locally situated panels for operating the ~~dynamic positioning~~ DP system.	
(8) **Failure** is an occurrence in a component or system causing one or both of the following effects. (A) - (B) <same as the present Rules>	~~(8)~~(10) **Failure** is an occurrence in a component or system causing one or both of the following effects. (A) - (B) <same as the present Rules>	
<Newly added>	(11) **Failure Modes and Effects Analysis (FMEA)** means a systematic analysis of systems and sub-systems to a level of detail that identifies all potential failure modes down to the appropriate sub-system level and their consequences.	- The definitions of failure modes and effects analysis, FMEA proving trials, consequence analysis, hidden failure have been newly added.
<Newly added>	(12) **FMEA proving trials** means the test program for verifying the FMEA.	
<Newly added>	(13) **Consequence analysis** means a software function continuously verifying that the vessel will remain in position even if the worst-case failure occurs.	
<Newly added>	(14) **Hidden failure** means a failure that is not immediately evident to operations or maintenance personnel and has the potential for failure of equipment to perform an on-demand function, such as protective functions in power plants and switchboards, standby equipment, backup power supplies or lack of capacity or performance.	

Present	Amendment	Remark
<Newly added>	(15) **Loss of position and/or heading** means that the vessel's position and/or heading is outside the limits set for carrying out the DP activity in progress.	- The definition of loss of position and/or heading, position keeping have been newly added.
<Newly added>	(16) **Position keeping** means maintaining a desired position and/or heading or track within the normal excursions of the control system and the defined environmental conditions (e.g. wind, waves, current, etc.).	
(9) **Operational Mode** is the manner of control under which the dynamic positioning system may be operated and comprise the followings: (A) - (D) <same as the present Rules>	~~(9)~~(17) **Operational Mode** is the manner of control under which ~~the dynamic positioning~~ DP system may be operated and comprise the followings: (A) - (D) <same as the present Rules>	- Numbering (9)-(11) → (17)-(19)
(10) **Redundancy** is the ability of a component or system to maintain its function when a single failure has occurred. Redundancy can be achieved for instance by installation of multiple components, systems or alternative means of performing a function.	~~(10)~~(18) **Redundancy** is the ability of a component or system to maintain its function when a single failure has occurred. Redundancy can be achieved for instance by installation of multiple components, systems or alternative means of performing a function.	
(11) **Reliability** is the ability of a component or system to perform its required function without failure during a specified time interval.	~~(11)~~(19) **Reliability** is the ability of a component or system to perform its required function without failure during a specified time interval.	
<Newly added>	(20) **Worst-Case Failure Design Intent (WCFDI)** means the specified minimum DP system capabilities to be maintained following the worst-case failure. The worst-case failure design intent is used as the basis of the design. This usually relates to the number of thrusters and generators that can simultaneously fail.	- The definition of worst-case failure design intent has been newly added.
(12) **Worst case failure** is failure modes which, after a failure, results in the largest reduction of the position and/or heading keeping capacity. This means loss of the most significant redundancy group, given the prevailing operation.	~~(12) **Worst case failure** is failure modes which, after a failure, results in the largest reduction of the position and/or heading keeping capacity. This means loss of the most significant redundancy group, given the prevailing operation.~~	- The definition of worst-case failure has been amended.
<Newly added>	(21) **Worst-Case Failure (WCF)** means tthe identified single fault in the DP system resulting in maximum detrimental effect on DP capability as determined through the FMEA.	

Present	Amendment	Remark
103. Drawings and data **1. General** In the case of the ships intended to be registered as ships provided with dynamic positioning systems, the drawings and data to be submitted for approval before the commencement of work are generally as follows: (1) Drawings (A) Plans showing the construction and layout of the dynamic positioning system (B) <same as the present Rules> (C) Plans with respect to the automatic and remote control of the dynamic positioning system (a) - (e) <same as the present Rules> (D) <same as the present Rules> (2) Data (A) Equipment list of dynamic positioning systems (Name of equipment, model, type, Manufacturer) (B) <same as the present Rules> (C) Operation manuals (including details of the dynamic positioning system operation, installation of equipment, maintenance and fault finding procedures together with a section on the procedure to be adopted in emergency) (D) <same as the present Rules> **2. Reference data** For the ships intended to be registered as ships provided with dynamic positioning systems, in addition to the requirements in **Par 1** above, the following data is to be submitted : (1) - (2) <same as the present Rules>	**103. Drawings and data** **1. General** In the case of the ships intended to be registered as ships provided with ~~dynamic positioning~~ DP systems, the drawings and data to be submitted for approval before the commencement of work are generally as follows: (1) Drawings (A) Plans showing the construction and layout of the ~~dynamic positioning~~ DP system (B) <same as the present Rules> (C) Plans with respect to the automatic and remote control of the ~~dynamic positioning~~ DP system (a) - (e) <same as the present Rules> (D) <same as the present Rules> (2) Data (A) Equipment list of ~~dynamic positioning~~ DP systems (Name of equipment, model, type, Manufacturer) (B) <same as the present Rules> (C) Operation manuals (including details of the ~~dynamic positioning~~ DP system operation, installation of equipment, maintenance and fault finding procedures together with a section on the procedure to be adopted in emergency) (D) <same as the present Rules> **2. Reference data** For the ships intended to be registered as ships provided with ~~dynamic positioning~~ DP systems, in addition to the requirements in **Par 1** above, the following data is to be submitted : (1) - (2) <same as the present Rules>	

Present	Amendment	Remark
Section 2 Requirements of Dynamic Positioning Systems	**Section 2 Requirements of Dynamic Positioning Systems**	
201. General	**201. General**	
The ships intended to be registered as ships provided with dynamic positioning systems are to be provided dynamic positioning systems specified in **202.** and **203.**	**1.** The ships intended to be registered as ships provided with ~~dynamic positioning~~ DP systems are to be provided ~~dynamic positioning~~ DP systems specified in ~~**202. and 203.**~~ this Section.	(Newly added) - The requirements for the design of DP system have been newly added to consider the external forces from mission-related systems.
<Newly added>	**2.** If external forces from mission-related systems (cable lay, pipe lay, mooring, etc.) have a direct impact on DP performance, the influence of these systems shall be considered and factored into the DP system design.	
<Newly added>	**3.** The ships In order to meet the single failure criteria given in **101. 3**, redundancy of components will normally be necessary as follows: (1) For DPS(2), redundancy of all active components; and (2) For DPS(3), redundancy of all components and A-60 physical separation of the components.	
<Newly added>	**4.** For DPS(3), full redundancy of the control systems may not be possible. (i.e. there may be a need for a single changeover system from the main computer system to the backup computer system). Such connections between otherwise redundant and separated systems may be accepted when these are operated so that they do not represent a possible failure propagation path during DP operations.	- The requirements for redundancy of DP systems have been newly added.
<Newly added>	**5.** For DPS(2) and DPS(3), connections between otherwise redundant and separated systems shall be kept to a minimum and made to fail to the safest condition. Failure in one system shall in no case be transferred to the other redundant system.	

Present	Amendment	Remark
<Newly added>	**6.** The DP control station shall be arranged where the operator has a good view of the vessel's exterior limits and the surrounding area. Equipment that shall be located at the DP control station includes, but is not limited to: (1) DP control and independent joystick control operator stations; (2) Manual thruster levers; (3) Mode change systems; (4) Thruster emergency stops; (5) Internal communications; and (6) Position reference systems' HMI, when considered necessary.	(Newly added) - The requirements for the arrangement of DP control station and for the equipment to be located at the DP control station have been newly added.

Present	Amendment	Remark
202. Requirements of dynamic positioning systems **1. Thruster system** (1) Design and location of thruster (A) Thrusters are to be designed to minimize potential interference with other thrusters, sensors, hull or other surfaces which could be encountered in the service for which the ship is intended. (B) Thruster intakes are to be located at sufficient depth to reduce the possibility of ingesting floating debris and vortex formation. (2) Performance of thruster (A) The response and repeatability of thrusters to changes in propeller pitch, speed or direction of rotation are to be suitable for maintaining the area of operation and the heading deviation specified. (B) Vessels with DPS(0) or DPS(1) are to have thrusters in number and of capacity sufficient to maintain position and heading under the specified maximum environmental conditions. (C) Vessels with DPS(2) or DPS(3) are to have thrusters in number and of capacity sufficient to maintain position and heading, in the event of any single fault, under the specified maximum environmental conditions. This includes the failure of any one thruster. (3) Alarm for thruster Each thruster unit is to be provided with a high power alarm. The setting of this alarm is to be adjustable and below the maximum thruster output.	**202. Requirements of ~~dynamic positioning~~ DP systems** **~~1. Thruster system~~** ~~(1) Design and location of thruster~~ ~~(A) Thrusters are to be designed to minimize potential interference with other thrusters, sensors, hull or other surfaces which could be encountered in the service for which the ship is intended.~~ ~~(B) Thruster intakes are to be located at sufficient depth to reduce the possibility of ingesting floating debris and vortex formation.~~ ~~(2) Performance of thruster~~ ~~(A) The response and repeatability of thrusters to changes in propeller pitch, speed or direction of rotation are to be suitable for maintaining the area of operation and the heading deviation specified.~~ ~~(B) Vessels with DPS(0) or DPS(1) are to have thrusters in number and of capacity sufficient to maintain position and heading under the specified maximum environmental conditions.~~ ~~(C) Vessels with DPS(2) or DPS(3) are to have thrusters in number and of capacity sufficient to maintain position and heading, in the event of any single fault, under the specified maximum environmental conditions. This includes the failure of any one thruster.~~ ~~(3) Alarm for thruster~~ ~~Each thruster unit is to be provided with a high power alarm. The setting of this alarm is to be adjustable and below the maximum thruster output.~~	(Moved) - The requirements for thruster system have been moved to 202. 2.

Present	Amendment	Remark
2. Power system (1) Electrical generating system (A) Capacity of electrical generating system For electrically driven thruster, the total capacity of electrical generating system is to be not less than the maximum dynamic positioning load together with the maximum auxiliary load. This may be achieved by parallel operation of two or more generating sets provided that the requirements of **Pt 6, Ch 1, 202.** are complied with. (B) <same as the present Rules> (2) - (3) <same as the present Rules> (4) Common source Where the electrical auxiliary services necessary for maintaining the ship normally in operational and habitable conditions, and the electrical service necessary for operating the dynamic positioning thrusters are supplied from a common source, the following requirements are to be complied with: (A) - (C) <same as the present Rules> (5) Number and rating of transformers The number and ratings of power transformers are to be sufficient to ensure full load operation of the dynamic positioning system even when one transformer is out of service. (6) Alarm for electrical generating system An alarm is to be initiated at the dynamic positioning control stations when the total electrical load of all operating thruster units exceeds a preset percentage of the running generators capacity. This alarm is to be adjustable between 50 and 100 percent of the full load capacity having regard to the number of electrical generators in service.	**~~2.~~1. Power system** (1) Electrical generating system (A) Capacity of electrical generating system For electrically driven thruster, the total capacity of electrical generating system is to be not less than the maximum ~~dynamic positioning~~ DP load together with the maximum auxiliary load. This may be achieved by parallel operation of two or more generating sets provided that the requirements of **Pt 6, Ch 1, 202.** are complied with. (B) <same as the present Rules> (2) - (3) <same as the present Rules> (4) Common source Where the electrical auxiliary services necessary for maintaining the ship normally in operational and habitable conditions, and the electrical service necessary for operating the ~~dynamic positioning~~ DP thrusters are supplied from a common source, the following requirements are to be complied with: (A) - (C) <same as the present Rules> (5) Number and rating of transformers The number and ratings of power transformers are to be sufficient to ensure full load operation of the ~~dynamic positioning~~ DP system even when one transformer is out of service. (6) Alarm for electrical generating system An alarm is to be initiated at the ~~dynamic positioning~~ DP control stations when the total electrical load of all operating thruster units exceeds a preset percentage of the running generators capacity. This alarm is to be adjustable between 50 and 100 percent of the full load capacity having regard to the number of electrical generators in service.	- Numbering 2. → 1. (Changed terms) - dynamic positioning → DP

Present	Amendment	Remark
<Moved>	**2. Thruster system** (1) Design and location of thruster (A) Thrusters are to be designed to minimize potential interference with other thrusters, sensors, hull or other surfaces which could be encountered in the service for which the ship is intended. (B) Thruster intakes are to be located at sufficient depth to reduce the possibility of ingesting floating debris and vortex formation. (2) Performance of thruster (A) The response and repeatability of thrusters to changes in propeller pitch, speed or direction of rotation are to be suitable for maintaining the area of operation and the heading deviation specified. (B) Vessels with DPS(0) or DPS(1) are to have thrusters in number and of capacity sufficient to maintain position and heading under the specified maximum environmental conditions. (C) Vessels with DPS(2) or DPS(3) are to have thrusters in number and of capacity sufficient to maintain position and heading, in the event of any single fault, under the specified maximum environmental conditions. This includes the failure of any one thruster. (3) Alarm for thruster Each thruster unit is to be provided with a high power alarm. The setting of this alarm is to be adjustable and below the maximum thruster output.	(Moved) - The requirements for thruster system have been moved from 202. 1.

Present	Amendment	Remark
3. Control system	**3. ~~Control~~ DP control system**	(Changed terms) - control system → DP control system
(1) General	(1) General	
(A) In general the DP-control system is to be arranged in a DP-control station where the operator has a good view of the vessel's exterior limits and the surrounding area.	(A) In general the ~~DP-control~~ DP control system is to be arranged in a ~~DP-control~~ DP control station where the operator has a good view of the vessel's exterior limits and the surrounding area.	
(B) The control station is to display information from the power system, thruster system and control system to ensure that these systems are functioning correctly. Information necessary to operate the DP system safely is to be visible at all times.	(B) The DP control station is to display information from the power system, thruster system and DP control system to ensure that these systems are functioning correctly. Information necessary to operate the DP system safely is to be visible at all times.	
(C) - (D) <same as the present Rules>	(C) - (D) <same as the present Rules>	(Newly added) - The requirements for alarm of DP control system have newly added. - The requirements for redundancy of DP control system have newly added.
<Newly added>	(E) Alarms and warnings for failures in all systems interfaced to and/or controlled by the DP control system shall be audible and visual. A record of their occurrence and of status changes shall be provided together with any necessary explanations.	
<Newly added>	(F) The DP control system shall prevent failures being transferred from one system to another. The redundant components shall be so arranged that any failed component or components may be easily isolated so that the other component(s) can take over smoothly with no loss of position and/or heading.	
(E) Minimum number of control system, position reference system and environmental sensor for dynamic positioning systems is to be in accordance with the **Table 9.4.1**:	~~(E)~~(G) Minimum number of control system, position reference system and environmental sensor for ~~dynamic positioning~~ DP systems is to be in accordance with the **Table 9.4.1**:	(Changed terms) Table 9.4.1 - remote control system → joystick system - automatic control system → DP control system - emergency automatic control system → backup DP control system

<Amendments>

Table 9.4.1 Minimum Number of Control System, Position reference System and Environmental Sensor

Class	Control system	Position reference system	Environmental sensor		
			Heading reference system	Vertical reference sensor	Means to ascertained the wind and direction
DPS(0)	~~Remote control~~ Joystick system(1) 1 set	1 set	1 set	1 set	each 1 set
DPS(1)	~~Automatic~~ DP control system(2) 1 set ~~Remote control~~ Joystick system(1)(2) 1 set	2 sets(3)	1 set	1 set	1 set
DPS(2)	~~Automatic~~ DP control system(2) 2 sets	3 sets(3)(4)	3 sets(3)	3 sets(3)	each 3 sets(3)
DPS(3)	~~Automatic~~ DP control system(2) 2 sets ~~Emergency automatic~~ Backup DP control system(2) 1 set	3 sets(3)(4)	3 sets(3)	3 sets(3)	each 3 sets(3)
(NOTES) (1) - (4) <same as the present Rules>					

Present	Amendment	Remark
(2) <same as the present Rules> <Newly added>	(2) <same as the present Rules> (3) Computer systems (A) For DPS(2), the DP control system shall consist of at least two computer systems so that, in case of any single failure, automatic position keeping ability will be maintained. Common facilities such as self-checking routines, alignment facilities, data transfer arrangements and plant interfaces shall not be capable of causing failure of more than one computer system. An alarm shall be initiated if any computer fails or is not ready to take control. (B) For DPS(3), the main DP control system shall consist of at least two computer systems arranged so that, in case of any single failure, automatic position keeping ability will be maintained. Common facilities such as self-checking routines, alignment facilities, data transfer arrangements and plant interfaces shall not be capable of causing failure of more than one computer system. The two or more computer systems mentioned above do not include the backup computer system; thus, in addition, one separate backup DP control system shall be arranged, see paragraph (D). An alarm shall be initiated if any computer fails or is not ready to take control. (C) For DPS(2) and DPS(3), the DP control system shall include a software function, normally known as "consequence analysis", which continuously verifies that the vessel will remain in position even if the worst-case failure occurs. This analysis shall verify that the thrusters, propellers and rudders (if included under DP control) that remain in operation after the worst-case failure can generate the same resultant thruster force and moment as required before the failure. The consequence analysis shall provide an alarm if the occurrence of a worst-case failure were to lead to a loss of position and/or heading due to insufficient thrust for the prevailing environmental conditions (e.g. wind, waves, current, etc.). For operations which will take a long time to safely terminate, the consequence analysis shall include a function which simulates the remaining thrust and power after the worst-case failure, based on input of the environmental conditions. (D) For DPS(3), the backup DP control system shall be in a room separated by an A-60 class division from the main DP control station. During DP operation, this backup control system shall be continuously updated by input from at least one of the required sets of sensors, position reference system, thruster feedback, etc. and be ready to take over control. The switchover of control to the backup system shall be manual, situated on the backup computer, and shall not be affected by a failure of the main DP control system. Main and backup DP control systems shall be so arranged that at least one system will be able to perform automatic position keeping after any single failure.	(Newly added) - The requirements for the computer system constituting the DP control system have been newly added.

Present	Amendment	Remark
(3) Measuring system (A) - (B) <same as the present Rules> (C) Validation for measuring system Suitable processing and comparative techniques are to be provided to validate the. control system inputs from position reference systems and other environmental sensors, to ensure the optimum performance of the dynamic positioning system. (4) Indicators Indications of the following are to be provided at each station from which it is possible to control the dynamic positioning system. (A) - (E) <same as the present Rules> (5) <same as the present Rules> **4. <same as the present Rules>**	(D) Each DP computer system shall be isolated from other on-board computer systems and communications systems to ensure the integrity of the DP system and command interfaces. This isolation may be effected via hardware and/or software systems and physical separation of cabling and communication lines. Robustness of the isolation shall be verified by analysis and proven by testing. ~~(3)~~(4) Measuring system (A) - (B) <same as the present Rules> (C) Validation for measuring system Suitable processing and comparative techniques are to be provided to validate the. control system inputs from position reference systems and other environmental sensors, to ensure the optimum performance of the ~~dynamic positioning~~ DP system. ~~(4)~~(5) Indicators Indications of the following are to be provided at each station from which it is possible to control the ~~dynamic positioning~~ DP system. (A) - (E) <same as the present Rules> ~~(5)~~(6) <same as the present Rules> **4. <same as the present Rules>**	

Present	Amendment	Remark
203. Additional requirements for dynamic positioning systems	**203. Additional requirements for dynamic positioning systems**	
1. DPS(1)	**1. DPS(1)**	
(1) - (2) <same as the present Rules> (3) A manually initiated emergency alarm, clearly distinguishable from all other alarms associated with the dynamic positioning system is to be provided at the dynamic positioning control station to warn all relevant personnel in the event of a total. loss of dynamic positioning capability. In this respect consideration is to be given to additional alarms being provided at locations such as the master's accommodation and operational control stations. (4) For electrically driven thruster units, the following requirements are to be complied with: *(2019)* (A) Indication of absorbed electrical power and available on-line generating capacity is to be provided at the main dynamic positioning control station. (B) <same as the present Rules>	(1) - (2) <same as the present Rules> (3) A manually initiated emergency alarm, clearly distinguishable from all other alarms associated with the ~~dynamic positioning~~ DP system is to be provided at the ~~dynamic positioning~~ DP control station to warn all relevant personnel in the event of a total. loss of ~~dynamic positioning~~ DP capability. In this respect consideration is to be given to additional alarms being provided at locations such as the master's accommodation and operational control stations. (4) For electrically driven thruster units, the following requirements are to be complied with: *(2019)* (A) Indication of absorbed electrical power and available on-line generating capacity is to be provided at the main ~~dynamic positioning~~ DP control station. (B) <same as the present Rules>	
2. DPS(2)	**2. DPS(2)**	
(1) - (3) <same as the present Rules> <Newly added> <Newly added>	(1) - (3) <same as the present Rules> (4) The power available for position keeping shall be sufficient to maintain the vessel in position after worst-case failure according to **101. 3**. (5) At least one automatic power management system (PMS) shall be provided and shall have redundancy according to the equipment class and a blackout prevention function.	(Newly added) - The requirements for power's capability and power management system of DPS(2) vessel have been newly added.

Present	Amendment	Remark
(4) For electrically driven thruster units, the following requirements are to be complied with: *(2019)* (A) With one generating set out of action, the capacity of the remaining generating sets is to be not less than the maximum dynamic positioning load with the most effective thruster inoperative together with all electrical auxiliary services necessary for maintaining the ship in normal operational and habitable conditions. (B) Where generating sets are arranged to operate in parallel, the supplies to, essential services are to be protected by the tripping of non-essential loads as required by **Pt 6, Ch 1, 205. 10** and additionally, on loss of a running generating set, a reduction in thrust demand may be accepted provided the, arrangements are such that a sufficient level of dynamic position capability is retained to permit the maneuverability of the ship. (C) In relation to (A) and (B), in order not to loss of position, provision is to be made for automatic starting synchronization and load sharing of a non-running generator before the load reaches the alarm level required by **202. 2** (6). If necessary, power management system may be added. (5) - (6) <same as the present Rules>	~~(4)~~(6) For electrically driven thruster units, the following requirements are to be complied with: *(2019)* (A) With one generating set out of action, the capacity of the remaining generating sets is to be not less than the maximum ~~dynamic positioning~~ DP load with the most effective thruster inoperative together with all electrical auxiliary services necessary for maintaining the ship in normal operational and habitable conditions. (B) Where generating sets are arranged to operate in parallel, the supplies to, essential services are to be protected by the tripping of non-essential loads as required by **Pt 6, Ch 1, 205. 10** and additionally, on loss of a running generating set, a reduction in thrust demand may be accepted provided the, arrangements are such that a sufficient level of ~~dynamic position~~ DP capability is retained to permit the maneuverability of the ship. (C) In relation to (A) and (B), in order not to loss of position, provision is to be made for automatic starting synchronization and load sharing of a non-running generator before the load reaches the alarm level required by **202. 2** (6). ~~If necessary, power management system may be added.~~ ~~(5) - (6)~~(7) - (8) <same as the present Rules>	(amended) - 203. 2 (3) has been newly added to require a power management system for DPS(2) vessel. And the requirement of (6) (C) has been amended.

Present	Amendment	Remark
3. DPS(3) (1) <same as the present Rules> (2) The power system arrangement is to comply with the following requirements : (A) The divided power system is to be located in different spaces separated by A-60 class division. (B) - (C) <same as the present Rules> (3) <same as the present Rules> (4) The switchboard supplying the dynamic positioning system is to be split into at least two equal sections each fitted in a separate compartment and capable of being connected by bus section switches. (5) An emergency automatic control system is to be provided at an emergency control station, in a compartment separated by A-60 class division from that for the main control station. During DP-operation this emergency automatic control system is to be continuously updated by input from the sensors, position reference system, thruster feedback, etc., and be ready to take over control. The switch-over of control to the emergency automatic control system is to be manual, situated on the back-up computer and is not to be affected by failure of the main control system. (6) Arrangements are to be provided such that in the event of a failure of the working and standby control systems a smooth transfer of control to the emergency control system may be effected from the emergency control station by manual means.	**3. DPS(3)** (1) <same as the present Rules> (2) The power system arrangement is to comply with the following requirements : (A) For DPS(3), the power system shall be divisible into two or more systems so that, in the event of failure of one system, at least one other system will remain in operation and provide sufficient power for station keeping. The divided power system is to be located in different spaces separated by A-60 class divisions. (B) - (C) <same as the present Rules> (3) <same as the present Rules> (4) The switchboard supplying the dynamic positioning system is to be split into at least two equal sections each fitted in a separate compartment and capable of being connected by bus section switches. ~~(5) An emergency automatic control system is to be provided at an emergency control station, in a compartment separated by A-60 class division from that for the main control station. During DP-operation this emergency automatic control system is to be continuously updated by input from the sensors, position reference system, thruster feedback, etc., and be ready to take over control. The switch-over of control to the emergency automatic control system is to be manual, situated on the back-up computer and is not to be affected by failure of the main control system.~~ ~~(6) Arrangements are to be provided such that in the event of a failure of the working and standby control systems a smooth transfer of control to the emergency control system may be effected from the emergency control station by manual means.~~	(Amended) - The requirements for power system arrangement has been amended to prepare for power system failure. (Deleted) - The requirements of (5) and (6) are the same as the requirements of 202. 3 (3) (D), therefore the requirements (5) and (6) have been deleted.

Present	Amendment	Remark
(7) - (8) <same as the present Rules> (9) Signals from the environmental sensors required by **Table 9.4.1** are to supply the emergency automatic control system. (10) The emergency automatic control system is to be supplied from its own independent uninterruptible power supplies. (11) <same as the present Rules>	~~(7) - (8)~~(5) - (6) <same as the present Rules> ~~(9)~~(7) Signals from the environmental sensors required by **Table 9.4.1** are to supply the ~~emergency automatic~~ backup DP control system. ~~(10)~~(8) The ~~emergency automatic~~ backup DP control system is to be supplied from its own independent uninterruptible power supplies. ~~(11)~~(9) <same as the present Rules>	

Present	Amendment	Remark
Section 3 Testing and Inspection	**Section 3 Testing and Inspection**	
301. <same as the present Rules>	**301. <same as the present Rules>**	
302. On-board tests After installation on board, the dynamic positioning system is to be tested under the condition as close to the actual operation as practicable and confirmed that each equipment functions appropriately. However, the tests may be carried out at the sea trial, when their testing items are considered impracticable to be conducted at occasions other than the sea trials.	**302. On-board tests** After installation on board, the ~~dynamic positioning~~ DP system is to be tested under the condition as close to the actual operation as practicable and confirmed that each equipment functions appropriately. However, the tests may be carried out at the sea trial, when their testing items are considered impracticable to be conducted at occasions other than the sea trials.	
303. Sea trials In the sea trials, performance tests of the dynamic positioning system are to be carried out in accordance with the sea trial schedule including the followings approved by the Society. (1) - (3) <same as the present Rules>	**303. Sea trials** In the sea trials, performance tests of the ~~dynamic positioning~~ DP system are to be carried out in accordance with the sea trial schedule including the followings approved by the Society. (1) - (3) <same as the present Rules>	
304. Maintaining records and data regarding the performance capability of the dynamic positioning system Records and data regarding the performance capability of the dynamic positioning system are to be maintained on board the ship and are to be made available at the time of the periodical survey.	**304. Maintaining records and data regarding the performance capability of the ~~dynamic positioning~~ DP system** Records and data regarding the performance capability of the ~~dynamic positioning~~ DP system are to be maintained on board the ship and are to be made available at the time of the periodical survey.	

Present	Amendment	Remark
305. Survey Assigned to Maintain Classification Periodical survey interval and survey items of dynamic positioning systems(DPS) are to be applied as follows. **1. Annual survey** (1) <same as the present Rules> (2) The electrical installations comprising the DPS, such as controllers and operating stations for DP and independent joystick, references systems, sensors and mode change system, are to be visually inspected. (3) The technical condition of the DPS is to be verified during the survey. (4) - (5) <same as the present Rules> (6) For class notation DPS(3), normal working condition of the back-up DP control system is to be verified. If the survey is carried out during regular operations, then control need not be transferred to the back-up DP control system. (7) Emergency stop of thrusters from the DP control centre is to be tested. If the survey is carried out when the vessel is undergoing regular operations, then testing is not to be performed if there is any possibility of introducing unacceptable risks.	**305. Survey Assigned to Maintain Classification** Periodical survey interval and survey items of ~~dynamic positioning~~ DP systems~~(DPS)~~ are to be applied as follows. **1. Annual survey** (1) <same as the present Rules> (2) The electrical installations comprising the ~~DPS~~ DP systems, such as controllers and ~~operating stations for~~ DP control station and independent joystick, references systems, sensors and mode change system, are to be visually inspected. (3) The technical condition of the ~~DPS~~ DP systems is to be verified during the survey. (4) - (5) <same as the present Rules> (6) For ~~class notation~~ DPS(3), normal working condition of the ~~back-up~~ backup DP control system is to be verified. If the survey is carried out during regular operations, then control need not be transferred to the ~~back-up~~ backup DP control system. (7) Emergency stop of thrusters from the DP control ~~centre~~ station is to be tested. If the survey is carried out when the vessel is undergoing regular operations, then testing is not to be performed if there is any possibility of introducing unacceptable risks.	

Present	Amendment	Remark
2. Special survey (1) - (2) <same as the present Rules> (3) The different modes of thruster control from the DP control centre are to be tested. (A) - (D) <same as the present Rules> (4) <same as the present Rules> (5) Emergency stop of DP thrusters from DP control centre is to be tested. (6) - (7) <same as the present Rules> (8) The electrical installations comprising the DPS, such as controllers and operating stations for DP and independent joystick, references systems, sensors and mode change system, are to be visually inspected. (9) - (11) <same as the present Rules> (12) For class notation DPS(2) & DPS(3), the required redundancy with respect to defined single failures modes is to be verified by redundancy testing. (13) For class notation DPS(2) & DPS(3), the FMEA report and FMEA test program are to be verified to ensure that they have been updated when alterations have been done. (14) For class notation DPS(2) & DPS(3), correct functioning of the Consequence Analysis facility is to be verified as far as possible. (15) For class notation DPS(3), testing is also to be performed on the back-up DP control system. Switchover to back-up is to be tested, and monitoring of back-up control system status on the main control system is to be verified.	**2. Special survey** (1) - (2) <same as the present Rules> (3) The different modes of thruster control from the DP control ~~centre~~ station are to be tested. (A) - (D) <same as the present Rules> (4) <same as the present Rules> (5) Emergency stop of DP thrusters from DP control ~~centre~~ station is to be tested. (6) - (7) <same as the present Rules> (8) The electrical installations comprising the ~~DPS~~ DP systems, such as controllers and ~~operating stations for~~ DP control stations and independent joystick, references systems, sensors and mode change system, are to be visually inspected. (9) - (11) <same as the present Rules> (12) For ~~class notation~~ DPS(2) & DPS(3), the required redundancy with respect to defined single failures modes is to be verified by redundancy testing. (13) For ~~class notation~~ DPS(2) & DPS(3), the FMEA report and FMEA test program are to be verified to ensure that they have been updated when alterations have been done. (14) For ~~class notation~~ DPS(2) & DPS(3), correct functioning of the Consequence Analysis facility is to be verified as far as possible. (15) For ~~class notation~~ DPS(3), testing is also to be performed on the ~~back-up~~ backup DP control system. Switchover to back-up is to be tested, and monitoring of ~~back-up~~ backup control system status on the main control system is to be verified.	

RULES FOR THE CLASSIFICATION OF STEEL SHIPS

(Development Review : External opinion inquiry)

Part 9 ADDITIONAL INSTALLATIONS

(Ch 7 Diving System)

2019. 09.

Machinery Rule Development Team

-Main Amendments-

(1) Effective Date : 1 July 2020(Date of which contracts for construction are signed)

◉ Complete revision

CHAPTER 7 DIVING SYSTEMS *(2020)*

Section 1 Classification

101. General

1. Application

The requirements of this Chapter apply to diving systems such as diving bells, decompression chambers, etc. which are permanently installed or installed with limited period as required by the operating conditions on a ship or a similar floating structure classed with or intended to be classed with the Society. The requirements not specified in this Chapter are to be in accordance with the relevant parts of the Rules. **[See Guidance]**

2. Equivalence

For the equivalence of alternatives to the Rules or novel design principles are to be in accordance with **Pt 1**, **Ch 1**, **104**.

102. Definition

For the purpose of this Rule, the terms used have the meaning defined in the followings unless expressly provided otherwise;

1. Diving system *(2017)*

A diving system means the whole plant and equipment necessary for the conduct of diving operations using transfer under pressure techniques which includes diving bells, decompression chambers and ancillary equipment thereof and to be divided as following table.

	SUR (Surface Diving)	BOU (Bounce Diving)	SAT (Saturation Diving)
maximum depth and maximum operation time	d_{max} < 60 msw* T_{op} < 8 hours	d_{max} < 125 msw* T_{op} < 24 hours	None, except those imposed by the requirements and assumptions in the certificate.

* msw is meters of sea water.
* T_{op} is the maximum operation time of chambers when a diver lives in chamber

2. Deck decompression chamber means the part of a diving system which is equipped with the pressure vessel for human occupancy with means of controlling and monitoring the pressure within the chamber.

3. A mating device means that the equipment necessary for the connection or disconnection of diving bell to a surface compression chamber.

4. Hyperbaric Evacuation System (HES) means the whole plant and equipment necessary for the evacuation of divers in saturation from a deck decompression chamber to the Hyperbaric Reception Facility(HRF) where decompression can be carried out. The main components of a hyperbaric evacuation system include the Hyperbaric Rescue Unit (HRU), its handling system, the Hyperbaric Reception Facility and the evacuation procedures.

(1) Hyperbaric rescue unit(HRU) or hyperbaric evacuation uni (HEU) means a unit whereby Divers under pressure can be safely evacuated from a ship or floating structure to a place where decompression can be carried out. This can be included a hyperbaric rescue chamber(HRC) or self-propelled hyperbaric lifeboat(SPHL).
(2) Hyperbaric reception facility (HRF)
(3) Hyperbaric rescue chamber (HRC)

5. CO2 Scrubber means for removal of the carbon dioxide from the breathing gas.

6. Partial pressure means pressure of gas within a mixture which would prevail if the gas would

fill by itself alone, the full volume occupied by the mixture. The sum of the partial pressures of the consistent parts of the mixture, proportional to volumetric fractions, is equal to the total absolute pressure of the mixture.

7. **Oxygen system** is to be intended for a gas with a higher oxygen percentage than 25.

8. **Life support system** means the equipment used to maintain a suitable life environment for the divers in the pressurized compartments (DDC, closed bell, HRU) and prepare the breathing gas mixtures, supply the gases to the pressurized compartments, adjust the temperature and the humidity and monitor the life support parameters.

9. **Umbilical cable** means the link between the diving support unit and the diving bell(wet and closed) or the diving stage which is the assembly containing surveillance, communication and power supply cables, breathing gas and hot water hoses and covered by protective enclosure. The strength member for hoisting and lowering the diving bell may be part of the umbilical. However, umbilicals connected in the wet bell or the diving stage mean bunches of individual hose.

10. **A depth** means that the pressure, expressed in metres of seawater, to which the diver is exposed at any time during a dive or inside a surface compression chamber or diving bell.

11. **A pressure vessel** means a container capable of withstanding an internal working pressure of 0.1 MPa and over which allows gas transfer and storage under pressure.

12. **Built In Breathing System (BIBS)** means a system of gas delivery to masks located in the decompression chambers and diving bells (closed), used for oxygen decompression during surface decompression and caisson disease treatment and supplying breathing air in case of fire or gas pollution.

13. **A diving bell** means a submersible compression chamber, including its ancillary equipment, for transfer of divers under pressure between the work location and the surface compression chamber. However, wet bell means an open chamber to be transferred between underwater working place and deck.

14. **Gas reclaim unit** is used on saturation diving systems to recover the helium from the breathing gas.

15. **Bail-out gas** is Diver's emergency gas supply cylinder used as a backup system in case of a failure of the primary source of breathing gas.

16. **Launch and Recovery System (LARS)** means plant and equipment necessary for raising, lowering and transporting the diving bell between the work location and the surface compression chamber.

17. **A maximum operating depth** means that the depth in metres of seawater equivalent to the maximum pressure for which the diving system is designed.

18. **Minimum Breaking Load (MBL)** means the Minimum Breaking Load of wire ropes and fibre ropes are provided by the manufacturer in accordance with applied Standards.

19. **Breathing gas or breathing mixture** means that all gases or mixed gases which are used for breathing of divers during diving operation.

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

21. **Saturation condition** means when the nitrogen or inert gas breathed by a diver dissolves into the body's tissues maximally at the specific pressure, i.e., no more gas can be absorbed by the tissues.

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

Section 2 Surveys

201. General

1. Kinds of surveys

Kinds of surveys are as follows:
(1) Surveys for Classification (hereinafter referred to as "Classification Surveys")
  (A) Classification Surveys during Construction
  (B) Classification Surveys after Construction
(2) Surveys for Classification Maintenance
  (A) Annual Surveys
  (B) Special Surveys
  (C) Occasional Surveys

2. Survey intervals

Surveys are to be carried out in accordance with the following requirements.
(1) A Classification Survey is to be carried out at the time when application for registration is made.
(2) Classification Maintenance Surveys are to be carried out at the times as prescribed below.
  (A) Annual Surveys are to be carried out at intervals specified in **Pt 1, Ch 2, 201.**
  (B) Special Surveys are to be carried out at intervals specified in **Pt 1, Ch 2, 401.**
  (C) An Occasional Survey: at a time falling on any of mentioned below, independently of Special Surveys and Annual Surveys.
    (a) When main parts of the systems have been damaged, repaired or renewed
    (b) When the systems are modified or altered
    (c) Whenever considered necessary by the Society

3. Preparation for surveys and others

(1) All such preparations as required for the Survey to be carried out as well as those which may be required by the Surveyor as necessary in accordance with the requirements in the Rules are to be made by the applicant of the survey. The preparations are to include provisions of an easy and safe access, necessary facilities, certificates and records for the execution of the survey, opening up of equipment, removal of obstacle and cleaning. Inspection, measuring and test equipment, which Surveyors rely on to make decisions affecting classification are to be individually identified and calibrated to a standard deemed appropriate by the Society. However, the Surveyor may accept simple measuring equipment(e.g. rulers, measuring tapes, micrometers, etc.) and gauge fitted on machinery(e.g. pressure gauges, temperature gauges, rpm gauges, etc.) without individual identification or confirmation of calibration, provided they are properly maintained and periodically compared with other similar equipment.
(2) The applicant for survey is to arrange a supervisor who is well conversant with the survey items intended for the preparation of the survey to provide the necessary assistance to the Surveyor according to his requests during the survey.
(3) The survey may be suspended where necessary preparations have not been made, any appropriate attendant mentioned in the previous (2) is not present, or the Surveyor considers that the safety for execution of the survey is not ensured.
(4) Where repairs are deemed necessary as a result of the survey, the Surveyor will notify his recommendations to the applicant of survey. Upon this notification, the repair is to be made to the satisfaction of the Surveyor.

202. Classification surveys

1. Drawings and data

(1) General
  (A) Before the start of manufacture, plans and drawings of all components subject to compulsory inspection, to the extent specified below, are to be submitted to the Society with 3 copies .
  (B) The drawings are to contain all the data necessary to check the design and loading of the equipment. Wherever necessary, calculations relating to components and descriptions of system are to be submitted.

(2) Diving system

(A) For approval

No.	Drawings and data
1	Firefighting equipment details
2	Description of the fire detection and alarm systems
3	Drawings/data of the securing of diving equipment

(B) For reference

No.	Drawings and data
1	Design basis - Maximum operating depth and equivalent allowable working pressure - Maximum operating time - maximum numbers of divers in water and in the deck decompression chambers - maximum operating time of occupancy expected in the deck decompression chambers - maximum operational wave height - minimum/maximum sea temperature and air temperature
2	Specification of the diving system - system description, emergency evacuation plan and other relevant technical specification - equipment list and manufacturer
3	The design loading conditions of the bell, its connection ot the LARS and the umbilical
4	Installation and commissioning - installation manual - commissioning procedure
5	Operating and maintenance - user manual, maintenance instruction and service record book
6	FMEA (Failure Modes and Effects Analysis) report
7	General arrangement of diving system
8	Material specification for inside the hyperbaric chambers

(3) PVHO

(A) For approval

No.	Drawings and data
1	Specification of the thermal and fire insulation material
2	Description welding procedure and welding details
3	Drawing of the pressure vessel structure
4	Drawing of the supporting structure and padeyes
5	Drawing of doors, clamping systems, mating devices and locks
6	Drawing of the penetrations
7	Specification and extent of non-destructive examination(NDE)
8	Description of marking

(B) For reference

No.	Drawings and data
1	Design basis and general specification - Maximum allowable working pressure (internal/external) - Design temperature (maximum/minimum) - Testing pressure (hydrostatic test pressure) - Local loads - Accelerations due to handling loads defined in **402. 4** - Number of design load cycles
2	Material, structure and geometric description of the pressure vessel
3	Description of the viewports and their material
4	Specification of the coating system
5	Specification of the heat treatment
6	Specification of the safety valves and the pressure relief valves
7	Justification of the means for expansion allowance of the interconnected pressure vessels
8	Inspection and testing procedure

(4) Deck decompression chamber

(A) For approval

No.	Drawings and data
1	Justification of the means for expansion allowance of the interconnected chambers
2	Electrical and communication wire description
3	Description of fire detection, alarm and fire fighting system
4	Description of environmental control system
5	Description of sanitary system
6	Description of CO2 scrubber system
7	Description of deck chamber supports and padeyes

(B) For reference

No.	Drawings and data
1	Design basis including characteristics, limitations and loading conditions, etc.
2	Specification including follows : - internal dimensions, volume and weight - communication systems - interface with the diving bell - interface with the HRU - interface with the life support system - equipment list
3	General arrangement of deck chamber
4	Inspection and testing procedure
5	Drawing defined in (3)

(5) Diving bell

(A) For approval

No.	Drawings and data
1	Description of the control panel in the bell - layout of the control panel - single line diagram of the piping, electrical and communication systems
2	Description of the electrical installations and control systems
3	Drawings of the diving bell structure including padeyes

(B) For reference

No.	Drawings and data
1	Design basis including characteristics, limitations and loading conditions, etc.
2	Specification including follows : - internal dimensions, volume and weight - communication systems - interface with the diving bell - interface with the HRU - interface with the life support system - equipment list
3	Calculation note of buoyancy and stability
4	General layout
5	Description of the heating system
6	Inspection and testing procedure
7	Drawing defined in (3)

(6) Life support system

(A) For approval

No.	Drawings and data
1	Breathing gas single line diagram and piping details
2	Structural drawings of the gas cylinders
3	Description of the safety relief valves
4	Description of the valves and fittings
5	Description of the material, scantling and welding details for piping
6	Description of the flexible hoses (reference standard, testing procedure, etc)

(B) For reference

No.	Drawings and data
1	Description of the gas storage arrangement
2	Description of the oxygen piping cleaning procedure
3	Description and FAT procedure of the environmental control system
4	Description and FAT of the fresh water unit
5	Description and FAT of the breathing gas reclaim unit
6	Description and FAT of the gas transfer system
7	Description and FAT of the diving hot water unit
8	Description of the diving umbilical - specification, drawing, reference standard - flexible hose description (see above table (A)) - electrical and communication wire description

(7) Electrical equipment and communication system

(A) For approval

No.	Drawings and data
1	Single line distribution diagram and detailed diagram of the installation, including description and characteristics of cable, fuse and switchgears
2	Description of the automation system
3	Descriptions and details of the communication means between diving control station and diving systems, including single line diagram

(B) For reference

No.	Drawings and data
1	General layout of the control stations and their control panels
2	General description of the electrical installations and control systems
3	Description of electrical supply principles, failure scenarios, redundancy principles, emergency arrangement, load balance, storage batteries capacity etc.
4	General layout showing the electrical equipment, batteries, lighting and cable trays

(8) Launch and Recovery System

(A) For approval

No.	Drawings and data
1	general arrangement of the handling system and showing the working area and the different path of the rope
2	structure drawings
3	material specifications
4	power unit and driving system specifications and general drawings
5	hydraulic and electric system specifications
6	drawings of the load carrying hydraulic cylinders

(B) For reference

No.	Drawings and data
1	Operational limitation, when relevant
2	Weight of diving device to be lifted in air and in water
3	Maximum hoisting speed
4	Safe working load
5	The specification of the steel wires or fiber ropes including end termination details and minimum breaking load
6	Calculation of the design loads for the handling system including rope data.
7	Description and characteristics of the winches, general drawing, structure drawing, main component list and relevant calculation data
8	Description and characteristics and design basis for guide wire and winch relating clump weight handling system

(9) HRU

(A) For approval

No.	Drawings and data
1	General layout of the life support control panel, single line diagram of the piping, electrical and communication systems
2	Description of the electrical installations
3	Description of the environmental control system
4	Description of the carbon dioxide scrubber system
5	Description of the sanitary system

(B) For reference

No.	Drawings and data
1	Design basis including characteristics, limitations and loading conditions, etc.
2	Specification including follows : - communication systems - life support system - internal dimensions and volume - interface with the hyperbaric reception facility
3	IMO Life saving appliance certificate for the lifeboat and its launching system (SPHL only)
4	Calculation note of buoyancy and stability
5	General layout
6	Inspection and testing procedure
7	Drawing defined in (3)

203. Classification maintenance surveys

1. Special surveys

(1) Diving test

(A) Special survey is to include a diving test with the diving bell/basket lowered to the rated depth.

(B) The bell/basket is to be weighted to its maximum rated weight.

(C) During the diving test, the bell is to be tested for gas leakage by close visual inspection at depth, function test of electrical and communication system including through-water communication at maximum depth and function test of breathing gas supply.

(2) Portable diving systems

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

(B) As a rule, the diving system is to be inspected and tested in accordance to the commissioning procedures before it is put back into service.

2. Lay-up and

(1) When the equipment is not used for a long period, the Owner may apply for a lay-up

procedure.

(2) The lay-up maintenance program provides for a "laying- up survey" to be performed at the beginning of lay-up and subsequent "annual lay-up condition surveys" to be performed in lieu of the normal annual surveys which are no longer required to be carried out as long as the equipment remains laid-up. The other periodical surveys which become overdue during the lay-up period may be postponed until the re-commissioning of the equipment.

(3) Where the equipment has an approved lay-up maintenance program and the period of class expires, the equipment lay-up period is extended until it is re-commissioned.

(4) The minimum content of the lay-up maintenance program as well as the scope of the decommissioning, annual lay-up condition and recommissioning surveys are to be submitted to the Society for approval. The annual lay-up condition survey shall contain, through a lay-up log-book, the survey items of the annual survey as deemed necessary. The re-commissioning procedures shall contain, through a lay-up log-book, the survey items of the Class renewal survey, as deemed necessary.

(5) During the lay-up period, the exposed part of the equipment are to be adequately protected and regularly inspected.

Section 3 Inspection and Testing

301. General

1. Application

(1) This section provides requirements for the initial inspection and testing of diving systems.

(2) References are made to **IMCA D 004, IMCA D 018, IMCA D 023, IMCA D 024, IMCA D 037, IMCA D 040** for the inspection and testing.

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

(4) For series-manufactured parts, test procedures other than those prescribed may be agreed with the Society provided that they are recognized as equivalent by the Society.

302. Tests at the manufacturers works

1. Penetration

The testing protocol for penetration of cables is to be submitted to the Society.

2. Compressor

(1) Any part of the compressor under pressure is to be pressure tested in accordance with the **Pt 5**, unless otherwise specified.

(2) Functional test for delivery rate and pressure are to be performed.

(3) The outlet gas from the compressor is to be tested for pollution content according to EN 12021.

3. Gas cylinder

Gas cylinder is to be tested in accordance with **Pt 5** or the standard applied for their design and construction.

4. Flexible hose

(1) Flexible hose is to be tested in accordance with **Pt 5, Guidance for Approval of Manufacturing Process and Type Approval, etc** or the technical standard applied for their design and construction.

(2) The tests generally include:

(A) internal pressure strength test (proof test) at a minimum testing pressure equal to 1,5 times the design pressure

(B) bursting pressure test

(C) tensile test

(D) resistance to low and high temperature

(E) low temperature flexibility test

(F) ambient temperature flexibility test

(G) resistance to ozone
(H) resistance to external pressure
(I) chemical inertia
(J)dimensional tolerances.
When the applied standard requires an internal oil resistance test, this may be omitted when the flexible hoses carry only gas or water.

(3) Flexible hoses intended to carry gas containing more than 25% of oxygen are to be shock tested in accordance with a recognized standard.

5. Umbilical cable

(1) Umbilicals are to be tested in accordance with the technical standard applied for their design and construction and the manufacturer's testing program.
(2) The Society may require to witness the manufacture of the umbilical.
(3) Flexible hoses are to be tested in accordance with the technical standard applied for their design and construction.
(4) The qualification tests generally include:
(A) bending test on a sample of umbilical, with the bending radius encountered in the normal service. No permanent strain is to be observed
(B) cycling load test on a sample of umbilical. To be conducted from zero to the design load. The number of cycle should be related to the category of the LARS. No permanent strain is to be observed
(C) tensile breaking test on a sample of umbilical.
(5) Flexible hoses used in umbilicals are to be tested in accordance with paragraph **4** before to be assembled in the umbilical.
(6) After assembly in the umbilical, the following tests are to be performed:
(A) overpressure test at 1,5 times the maximum working pressure taking into account that:
(a) all flexible hoses are to be pressure tested simultaneously
(b) the electrical cables are to be checked for damage after testing.
(B) leak test at the maximum working pressure The internal cleanliness is to be verified as appropriate to the intended duty.

303. PVHO

1. The inspection and testing of the PVHO is to include:
(1) pressure testing in accordance with **303. 2**
(2) gas leak testing in accordance with **303. 3**
(3) testing of the viewports in accordance with **303. 4**
(4) vtesting of the doors, hatches and medical locks
(5) visual examination of the signs of corrosion on the shell of the PVHO and particularly the bottom part inside and outside
(6) vvisual examination of the shell penetrators. All penetrators are to be marked to show their function
(7) visual examination of the supporting structure
(8) visual examination of the windows
(9) visual examination of the markings
(10) visual examination of the insulation, if any
(11) visual examination of the doors, hatches and their locking mechanisms
(12) visual examination of the medical lock
(13) visual examination of the associated piping and fittings
(14) visual examination of the valves and flow fuses. All valves are to be marked to show their function
(15) visual examination of the connecting flanges between chambers
(16) visual examination of the bilge drain
(17) visual examination of the protectors on the outlet lines.

2. Pressure test

Hydraulic pressure test at 1.5 times the Maximum Allowable Working Pressure (MAWP) is to be conducted and witnessed by the Society.

3. Gas leak test

(1) Gas leak tests are to be conducted in accordance with an agreed procedure.
(2) Gas leak test are to be conducted at maximum working pressure for medical/equipment locks and all doors, hatches, valves, pipe work, fittings and penetrations on each compartment of the PVHO.
(3) The maximum allowable gas leak rate is 0.25% of the PVHO volume over a period of 6 hours, calculated at constant .temperature
(4) The PVHO is to be pressurized for a minimum of 6 hours. The pressure and the temperature are to be noted on a record chart every hour or less.
(5) All part of pressure vessel, door, window, piping, valve and fittings are to be sprayed with a snooper leak detection liquid.
(6) When a leak presents a risk of escalation (e.g. through a crack in a weld) it is deemed not to be acceptable.
(7) When helium is intended to be used in the breathing gas, the gas leak test is to be conducted with a gas mixture containing 10% Helium as a minimum.

4. Viewport

Viewports are to be tested at a pressure equal to 1,25 times Maximum Allowable Working Pressure.

304. Deck decompression chambers

1. The following inspection and tests are to be conducted on the DDC, as a minimum:
(1) testing of the PVHO in accordance with **303.**
(2) testing of the breathing gas system in accordance with **306. 2**
(3) testing of the sanitary systems (toilets, sewage and fresh water)
(4) testing of the fire safety systems
(5) testing of the gas regeneration system (CO2 removal)
(6) testing of the breathing gas reclaim system, if fitted
(7) testing of the environmental control unit in accordance with **306. 3**
(8) testing of the instrumentation
(9) testing of the communication
(10) testing of the BIBS in accordance with **306. 6**
(11) testing of the bilge drain system

305. Diving bell and wet bell

1. The following inspection and tests are to be conducted on the diving bell/basket as a minimum:
(1) weighing in air and in water
(2) testing of the PVHO in accordance with **303.**
(3) testing of the breathing gas system in accordance with **306. 2**
(4) testing of the ballast release system in water, when relevant
(5) testing of the emergency systems
(6) testing of the location and communication systems
(7) testing of the diving bell heating system
(8) testing of the gas regeneration system (CO2 removal)
(9) testing of the diver reclaim system, if fitted
(10) testing of the BIBS in accordance with **306. 6**

2. The following inspection and tests are to be conducted on the wet bell/basket as a minimum:
(1) weighing in air and in water
(2) testing of the breathing gas system in accordance with Article [9]
(3) testing of the ballast release system in water, when relevant
(4) testing of the emergency systems

306. Life support system

1. Control station

The following inspection and tests are to be conducted on the control stations, as a minimum:

(1) functional testing of the fire safety systems
(2) switching from main to emergency power source
(3) functional testing of the communication and CCTV systems
(4) functional testing of the gas distribution panel
(5) functional testing of the gas analyzers
(6) functional testing of the alarms
(7) verification of the markings and diagrams.

2. Breathing gas system

(1) Testing of piping systems carrying breathing gas is to comply with **Pt 5** as applicable for piping Class 1.
(2) An overpressure test at 1,5 times the design pressure is to be conducted on all piping systems carrying breathing gas.
(3) A gas leak test in accordance with **303. 3** be conducted on all pressure vessels and piping carrying breathing gas.
(4) Each supply source of breathing gas is to be tested separately.
(5) The breathing gas supply system is to be tested during commissioning on-board for pollutant content according to EN 12021.
(6) Breathing gas samples are to be taken at the gas cylinders, in relevant parts of the breathing gas piping, inside the chambers, at the BIBS supply line and at the gas reclaim unit.
(7) The cleanliness of the breathing gas piping system is to comply with a recognized standard such as **ASTM G93** or an equivalent standard.
(8) Safety features against overpressure and accidental decompression of the deck chambers (e.g. alarms, relief valves, bursting disks) are to be tested in accordance with an agreed program.

3. Environmental control unit

(1) Testing of the ECU is to be conducted in accordance with an approved testing program.
(2) The accuracy of heating/chilling system in the DDC is to be tested. A maximum difference of +/− 1°C between the setting value and the measured value is allowed.
(3) The 100% redundancy of the heating/chilling and humidity system is to be tested.

4. carbon dioxide removal system

(1) The carbon dioxide removal systems of the DDC and the diving bell are to be tested for performance and endurance according to an agreed program.
(2) The carbon dioxide levels are to be maintained under the partial pressure defined in **706. 1** (3).

5. breathing gas reclaim system

(1) The breathing gas reclaim system is to be tested for performance and endurance according to an agreed program.
(2) The alarms and pressure relief valve on the gas bag are to be tested.

6. Built-in breathing system (BIBS)

The BIBS in the DDC and diving bell are to be tested in accordance with an approved procedure.

7. Divers hot water unit

The divers' heating units are to be inspected and tested as per an approved procedure.

8. Sanitary systems inside deck chamber

The toilet flush is to be function tested.

307. Electrical installation

1. All electrical installations are to be tested in accordance with **Pt 6**.

2. The following inspection and tests are to be conducted on the electrical installations, as a minimum:

(1) functional test of each sub-system
(2) testing of main and emergency power supply
(3) insulation resistance test on every electrical circuit.

308. Launch and recovery system

1. General

(1) In addition to the inspection and testing defined in this section, launch and recovery systems are to be surveyed in compliance with **Ch 2** as applicable.
(2) If fitted, heave compensation systems are to be function tested in the presence of the surveyor.
(3) The static load test is to be carried out equal to design load.

2. Umbilical cable winch

(1) Functional testing of the winch umbilical is to be witnessed by the Society.
(2) Pressure testing of the swivel is to be witnessed by the Society.

309. Hyperbaric rescue unit

1. General

(1) The Hyperbaric Rescue Unit is to be inspected and tested in accordance with an agreed testing program.
(2) The following inspection and tests are to be conducted:
  (A) weighing in air
  (B) testing of the evacuation procedure
  (C) testing of the launching system
  (D) testing of the sanitary systems
  (E) testing of the fire safety systems
  (F) testing of the CO2 removal system
  (G) testing of the environmental control unit (heating / chilling)
  (H) testing of the instrumentation
  (I) testing of the communication system
  (J) sea trials including propulsion, steering and towing tests, as relevant
  (K) examination of the towing line
  (L) examination of the markings as defined in **Sec 11**.
  (M) inspection and testing applicable to lifeboats as per SOLAS/LSA requirements.
(3) The launching system of the HRU is to be inspected and tested in accordance with IMCA D004.
(4) An overload test at full outboard position is to be conducted.

310. On-board test and Commissioning

1. General

(1) The initial testing of the complete diving system and of each sub-system are to be carried out in accordance with the commissioning procedures agreed by the Society.
(2) The commissioning is to include at the minimum:
  (A) verification of the conformity of the installation with regard to the layout drawings and specification
  (B) verification of the certificates of the diving system components and the marking plates
  (C) verification of the cleanliness of the breathing gas piping in accordance with **306. 2** (7)
  (D) verification of the marking of the breathing gas piping in accordance with the colour code in **703. 4**
  (E) verification of the oxygen gas storage area, piping, valves and alarms
  (F) examination and testing of each sub-systems in accordance with the procedures listed in **310. 2**.
  (G) final diving test as described in **310. 3**.

2. On-board test

(1) PVHO pressure testing and gas leak testing (chamber complex, diving bell, HRU) as per **303.**
(2) Breathing gas system testing (piping, fittings and gas cylinders) as per **306.**
  (A) pressure testing
  (B) gas leak testing
  (C) purity and cleanliness testing
  (D) BIBS testing

(E) gas transfer system.
(3) diving control panel and life support control panel testing as per **306. 1** and including:
(A) gas distribution arrangement
(B) pressure rate
(C) pressure testing
(D) leak testing
(E) functional tests
(F) gas analyzers
(G) electrical, communication and video equipment.
(4) depth gauges calibration and testing
(5) sanitary system: toilets, sewage and fresh water
(6) gas regeneration testing (CO2 removal in chambers and diving bell) as per **306. 4**
(7) environmental control unit (temperature and humidity) as per **306. 3**
(8) gas reclaim system, if fitted, as per **306. 5**
(9) diver heating system as per **306. 7**
(10) launch and recovery system as per **308.**
(11) diving bell as per **305.**
(12) deck decompression chamber as per **304.**
(13) hyperbaric rescue Unit as per **309.**
(14) diving test procedure as per **310. 3**

3. Diving sea trial

(1) The final commissioning is to include a non-manned diving test with the diving bell/basket lowered to the rated depth.
(2) The bell/basket is to be weighted to its maximum rated weight.
(3) During the diving test, the bell is to be tested for:
(A) gas leakage by close visual inspection at depth
(B) function test of electrical and communication system including through-water communication at maximum depth
(C) function test of breathing gas supply.

Section 4 Design and Construction

401. General

1. This Section provides general requirements for the design and construction of diving systems.
2. HRU should comply with the requirements of IMO Guidelines.
3. Metallic materials are to comply with the requirements of **Pt 2** and **Pt 5** for materials and welding, unless otherwise specified.

402. General Design Requirements

1. General

(1) As far as reasonable and practicable, a diving system should be designed to minimize human error and constructed so that the failure of any single component.
(2) Diving systems and components thereof should be designed for the conditions under which they are certificated to operate.
(3) Materials for diving system components should be suitable for their intended use.
(4) All components in a diving system should be so designed, constructed and arranged as to permit easy cleaning, disinfection, inspection and maintenance.
(5) A diving system should include the control equipment necessary for safe performance of diving operations.
(6) The diving system should be capable of allowing the safe transfer of a person under pressure between the diving bell to the deck compression chambers.

2. General Layout

(1) The diving system is to be so arranged as to ensure that centralized control of the safe operation of the system can be maintained under all weather conditions.
(2) The control station is to provide control of diving operations and deck chambers, either in a unique location or in two distinct control stations with suitable means of communication.
(3) Requirements for the arrangements of the control stations are given in **Sec 8**.
(4) The foundations of the diving systems and their handling systems are to be strong enough to sustain the efforts arising from operating, emergency and stowage conditions.
(5) Provision should be made to ensure that the diving system and auxiliary equipment are securely fastened to the ship or floating structure and that adjacent equipment is similarly secured. Consideration should be given to the relative movement between the components of the system. In addition, the fastening arrangements should be able to meet any required survival conditions of the ship or floating structure.
(6) When bolts are used for load carrying connections, the bolts characteristics and the reference technical standard are to be submitted.

3. Failure Modes and Effects Analysis (FMEA)

(1) A FMEA is to be conducted at an early stage of the project.
(2) Reference is made to IMCA D039 - FMEA guide for diving systems, which is a recognized guidance to conduct FMEA.

4. Design conditions

(1) Any component of the diving system is to be designed to operate under the design conditions.
(2) Unless an hydrodynamic analysis of the diving support unit is performed to assess the maximum motions and accelerations, the rule values given **Table 9.7.1** are to be considered.
(3) Athwartships and fore-and-aft inclinations may occur simultaneously.
(4) Static inclination and dynamic inclination may occur independently.
(5) Any components and systems are to be available at all condition defined in **Annex 9-5**.

Table 9.7.1 Inclined position

Install location	Angle of Inclination (°)			
	Athwartships		For-and-aft	
	Static	Dynamic	Static	Dynamic
Compression chambers and other deck installation on ships	± 15	± 22.5	± 5	± 10
Mobile offshore units	± 15	-	± 15	-
Diving bells (Closed) or diving stage	± 22.5	± 45	-	-

(6) Unless otherwise specified, temperature and humidity conditions are given **Table 9.7.2**.

Table 9.7.2 Environmental conditions

Location	Temp (°C)	Humidity (%)	Other Condition
in chambers	5 ~ 55	100	Salty Air
outside chambers in air[1) 2)]	-10 ~ 55	100	
outside chambers in water	-2 ~ 32	-	Salt water containing 3.5% Salt
Control room	5 ~ 55	80	

NOTES :
1) In the case of facilities installed on the open deck, allowance is to be made for icing and temporary inundation with salt water and spray.
2) Other values may be permitted for installation in closed space

Section 5 PVHO

501. General

1. This section provides requirements for the design and construction of Pressure Vessels for Human Occupancy (PVHO) intended for diving systems.
2. For the design and construction of PVHO are to be followed ASME-PVHO or EN13445. Other recognized standard may be accepted subject to the approval of the Society.
3. Inspections and tests are in accordance with **Sec 2**.

502. Door, hatch and locking devices

1. General

(1) In the design of pressure vessels, including accessories such as doors, hinges, closing mechanisms and penetrators, the effects of rough handling and accidents should be considered in addition to design parameters such as pressure, temperature, vibration, operating and environmental conditions.
(2) The design of doors and hatches is to comply with the following:
(A) the clear opening diameter is to be at least 600 mm
(B) means of opening and closing is to be operable from both sides
(C) reverse over pressurization of the door is not to cause catastrophic failure of the locking device
(D) opening is not possible if the pressure is not equal on both sides
(E) means for securing the door in fully open position is to be provided
(F) a safety interlock system is to be fitted if pressure acts to open or unseat the hatch or door. This interlock system is not to allow pressurization of the door or hatch unless it is fully engaged.

2. Locking devices

(1) Locks should be designed to prevent accidental opening under pressure and, where necessary, interlocks should be provided for this purpose.
(2) The interlock system should have a safety device to prohibit the opening of the clamp when a pressure above atmospheric pressure remains in the trunk or the lock and to make it impossible to obtain a gas tight seal if the interlock is not properly closed.
(3) The locking device is to be fitted with an approved mechanical locking system.
(4) A safety device is to prevent un-locking if the internal pressure of the hub in not balanced with respect to ambient pressure.

3. Medical locks

(1) Pressure gauges on medical locks are to be so arranged that if the exhaust line of the medical lock is obstructed from the inside, the gauge will still indicate the correct pressure inside the lock.
(2) The size of the medical locks are to be adapted to the size of the equipment which may be transferred.
(3) Safety device is to be provided in accordance with the requirement **2** (2).

503. Piping system

1. Penetration

(1) Hull penetrations are not to create weak points in the pressure resistant shell. Requirements from a recognized standard regarding location of openings are to be complied with.
(2) All hull penetrators on chambers should be fitted with two shut off devices as close to the penetration as practicable. Where appropriate, one device should be a non-return valve.
(3) The valve of the penetrations are to be used other than screw-down valve. (ex. ball valve)
(4) These valves are to be mounted directly on each side of the chamber shell plating or close to the chamber shell provided that the piping between the valve and the shell complies with the

design standard of the PVHO.

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

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

(7) Requirements for electrical penetrators are given in **Sec 8**.

2. Piping and fittings

(1) Piping and fittings are to comply with applicable requirements of **Sec 7**.

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

(3) The use of flow-fuse or flow rate sensitive valve is to be considered to limit the exhaust rate.

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

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

3. Piping and fittings

(1) All PVHO are to be fitted with a pressure relief valve rated to the design pressure. As an alternative, overpressure alarm may be provided as allowed by (2).

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

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

504. Viewports

1. General

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

(2) The term viewport means both the window and its sealing.

(3) The certification process of the viewports includes:

(A) design review

(B) fabrication procedure

(C) material certification

(D) material testing

(E) pressure testing.(The pressure test may be done with the viewport installed on the chamber.)

(4) Operating limitations

The viewports are subject to the following operating limitations:

(A) Maximum pressure ratio for acrylic plastic viewports(or windows) : 10 bar/sec

(B) the number of pressure cycles is not to exceed 10,000 or the total duration is not to exceed 40,000 hours

(C) the minimum design temperature is −18°C and the maximum design temperature is +66°C.

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

2. Marking

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

(A) design pressure

(B) maximum and minimum operating temperatures

(C) referenced certification standard

(D) name or symbol of the certification body

(E) serial number or equivalent

(F) year and month of fabrication.

(2) The marking is to be performed by means of a stencil in a legible and indelible way, pref-

erably on the edge of the viewport and in accordance with ASME PVHO-1. The marking is not to cause any damage to the viewport which may cause a crack propagation.

(3) If the serial number or other identifying mark for each viewport is not visible when fitted in situ then it is to be prominently marked on the outside of the chamber adjacent to each viewport.

505. Material and Fabrication

1. The referenced standard is to be complied with regarding:
   (1) material
   (2) structural scantling
   (3) welders qualification
   (4) welding procedure and testing
   (5) testing
   (6) marking.

2. Material

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

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

3. Fabrication

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

Section 6 Deck Decompression Chambers and divers transfer system

601. General

1. This Section provides the requirements for the design and fabrication of Deck Decompression Chambers (DDC), closed diving bell and divers transfer system.
2. Inspections and tests are in accordance with **Sec 3**.
3. The pressure vessel forming the deck chamber should be designed as a pressure vessel for human occupancy according to **Sec 5**.
4. The requirements given in this Section are additional to the requirements given in relevant section.

602. Deck decompression chambers

1. General

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

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

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

ration diving are to have a minimum diameter of 1800 mm.

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

(5) Deck decompression chambers in surface diving are to comply with general provisions regarding deck chambers. Their conditions of use are as follow:
   (A) the filling gas is compressed air or mixed gas
   (B) the regeneration of the hyperbaric atmosphere is performed by ventilation
   (C) built-in Breathing Systems (BIBS) are available for breathing over oxygenated mixes and pure oxygen
   (D) an oxygen analyzer is to be available
   (E) if the chamber is not installed in a temperate room, it is to be fitted with a thermal protection and environmental control unit, as relevant.

(6) The supporting structure of the DDC is to be designed to withstand the motions and accelerations of the supporting unit as defined in **402. 4** and the loading conditions due to internal load.

(7) The volume of the deck chamber is to be accurately known to allow gas calculations to be carried out.

2. Medical lock

Each pressure compartment should have medical lock as defined **502. 3**.

3. Viewports

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

4. Protection against overpressure

(1) Penetrations for safety valves shall be provided with shut-off valves on both sides of the shell plating. These shut off valves shall be sealed in the open position.

(2) Visual and audible overpressure alarm alerting the operators at the control station shall be provided.

5. Transfer under pressure and Mating device

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

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

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

(4) Safety device for mating device or mating clamp is to be provided in accordance with the requirement **502. 2** (2).

(5) A display of the internal pressure of the hub is to be available at the control station of the opening.

6. Gas analysis

(1) Gas analyzers are to be provided in deck decompression chambers.

(2) Gas piping used for analysis purpose is to be kept to the minimum diameter.

7. Control system

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

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

(3) A secondary system is to be available for controlling the internal environment of the chamber.

8. Temperature and humidity control, Carbon dioxide removal and Breathing gas reclaim

(1) Regeneration system used for the removal of the carbon dioxide is to comply with **706. 1**.
(2) A secondary system is to be available for removing the carbon dioxide.
(3) Temperature and humidity control units are to comply with **708**.
(4) A secondary system is to be available for temperature and humidity control inside the deck chamber.
(5) The breathing gas reclaim system, when fitted, is to comply with the requirements of **706. 2**.

9. BIBS

(1) BIBS are to comply with requirements defined in **705.**.
(2) In each compartment of the chamber there is to be at least one BIBS (Built-in Breathing System) connection and mask for each intended occupant plus one spare.

10. Sanitary Equipment

(1) The sanitary equipment is to comply with **707.**.
(2) Deck decompression chambers used for saturation diving are to be provided with a sanitary room accessible by each diver in saturation.
(3) The toilet bowl is to be designed in order not to be sealed when a person is seated on it.
(4) Flush type toilet are to be fitted with sufficient interlocks to stop it being flushed while occupied.
(5) Hot and cold potable water are to be provided in each sanitary room with washing facilities including shower.
(6) An hyperbaric toilet is to be provided in each sanitary room.

11. Electrical installations and control systems

The electrical installations and control systems are to comply with the requirements of **Sec 8**.

12. Fire safety

Fire safety requirements inside the hyperbaric chambers are given in **Sec 9**.

603. Closed Diving Bell

1. General

(1) The diving bell should be provided with adequate protection against mechanical damage during handling operation.
(2) The diving bell should be equipped with means whereby each diver using the bell is able to enter and leave it safely as well as with means for taking an unconscious diver up into a dry bell.
(3) The diving bell should provide a suitable environment and facilities for the persons who use it, having regard to the type and duration of the diving operation.
(4) Diving bells should be so designed as to provide adequate space for the number of occupants envisaged, together with the equipment.
(5) A seat with safety belt is to be available for each occupant.
(6) Diving bells should have a volume of at least 1.5 m3 per diver.
(7) Volume of the bell is to be accurately known to allow breathing gas and stability calculations to be carried out.
(8) The diving bell is normally designed in order to have a resistance against external pressure at least equal to the one against internal operating pressure. If not, restrictive operational conditions are to be taken into account.‘
(9) The diving bell should be fitted with a manifold at a suitable point close to the main lifting attachment which should include connections for the following services:
(A) ¾ inch NPT (female) - for hot water
(B) ½ inch NPT (female) - for breathing mixture.
The manifold should be clearly marked and suitably protected
(10) The duration of working of all survival means embarked is to be at least 24 hours. The survival means should include at least:
(A) reserves of breathing gas
(B) beverage

(C) food
(D) breathing gas regeneration means
(E) thermal protection
(F) lighting
(G) emergency communications
(H) ultra-sonic pinger
(I) visual beacon.

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

(11) Locations are to be provided for the storage of the following safety equipment:
(A) emergency breathing equipment
(B) first aid kit
(C) sanitary bags
(D) reserve food and beverage
(E) appropriate thermal protection means
(F) adequate repair tools
(G) checks, instructions and safety procedures lists
(H) reserves of products for regeneration (soda lime/sorb)
(I) emergency lighting.

(12) When means to control the water level inside the bell are fitted, it is to automatically limit the upper level in order to protect the equipment which may be damaged when immersed. The valve actuating the water level is to be accessible to a diver inside the access hub.

(13) Means are to be provided to empty a tilted bell partially filled with water.

2. Viewports

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

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

3. Access doors

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

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

(3) The handling of doors of vertical accesses is to be assisted.

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

(5) The lower opening devoted to the going-out of divers should have a minimum passing through diameter of 800 mm.

(6) The lower outer hatch may be closed from the inside of the bell.

4. Protection against overpressure

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

5. Mating system

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

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

(3) Safety device for mating device or mating clamp is to be provided in accordance with the requirement **502. 2** (2).

6. Medical lock

Each pressure compartment should have medical lock as defined **502. 3**.

7. Breathing gas system

(1) There is to be a means by which the divers in the bell can analyze the atmosphere for O2 and CO2 independent of the surface.
(2) Consideration should be given to providing a means of monitoring the bell atmosphere for hydrocarbons and H2S.
(3) There is to be a powered scrubber unit to provide primary CO2 removal from the atmosphere.
(4) Each diver's gas supply is to be arranged so that if one line fails then this does not interfere with the gas supply to another diver.
(5) There should be an alarm fitted to alert the bellman if the diver(s) supply switches over to the on-board gas.
(6) The externally carried oxygen supply is to be fitted with a means whereby it is regulated to a low pressure before it enters the bell. High pressure oxygen is not to be available inside the bell.
(7) The oxygen coming into the bell is to be fitted with a system which limits either the rate of flow or the volume which can enter in order to minimize the risk of excess O2 building up in the bell.

8. Gas reserve

(1) The diving bell should be designed with a self-contained breathing gas system capable of maintaining a satisfactory concentration of breathing gas for the occupants for a period of at least 24 hours at its maximum operating depth.
(2) The reserves of breathing gas outside the bell are to be sufficient:
(A) to empty the bell filled with 50% of water at the maximum operating depth, or
(B) to support each working diver plus the bellman outside the bell for a minimum of 30 minutes at a breathing rate of 40 liters/minute at the maximum depth of the diving operation.
(3) The pressure of all on-board gases are to be reduced to a maximum of 30 bar over ambient pressure before it enters the bell interior.
(4) Sufficient oxygen is to be available for metabolic consumption by the maximum number of divers at 0.5 liters/minute per diver for at least 24 hours at the end of a bell run.

9. BIBS

(1) BIBS are to comply with requirements defined in **705.**.
(2) An oral/nasal or full face BIBS mask is to be supplied for each occupant of the bell. This should be capable of providing breathing gas either from the surface or from the on-board cylinders

10. Piping, valves, fitting and hoses

(1) Piping bringing fluids in the bell are to be fitted inside with isolating valves and outside with non-return valves.
(2) Wall penetrations devoted to the passage of hot sea water are to be protected against corrosion.
(3) Internal compression and decompression controls are to be made by means of “dead man” safety valves which close when the handle is released.
(4) The system of injection of pure oxygen is to be such that an unintentional addition may not induce an unacceptable rise of the partial pressure of oxygen.
(5) The piping of the safety valve is to be fitted, inside with an isolating valve sealed in open position.
(6) Valves are to be free of corrosion and should move freely through their full range of operation.
(7) Any open ended exhaust pipe work is to be fitted with guards to prevent suction hazard.
(8) Any gas inlet pipe work should be fitted with some form of diffuser.
(9) There should be a valve fitted to allow partial flooding of the bell by the bellman. This should be in an easily accessible position and clearly visible. This valve should be in addition to the internal hull stop valve.

11. Instrumentation

(1) General requirements regarding life support instrumentation are given in **Sec 7**.
(2) Valves, gauges and other fittings should be provided outside the bell as necessary to control and indicate the pressure and safe environment within the diving bell. The external pressure on the diving bell should also be indicated inside the bell.
(3) Gauges are to be provided inside the bell to let the divers know both the internal and external pressure.

(4) The relative pressure of gas supplies (normal and emergency) may be read inside the bell.
(5) The temperature (and possibly the flow rate) of hot water devoted to the heating of the diver may be read inside the bell.

12. Umbilical cable

(1) Diving bells are to be provided with a main supply umbilical for supplying breathing gases, hot water, electrical power, communication, etc., to the bell.
(2) Umbilicals are to be securely attached to the bell by means of a strength member or strain relief fitting so that the individual connections are not subjected to loads.

13. Temperature and humidity control, Carbon dioxide removal and Breathing gas reclaim

(1) Regeneration system used for the removal of the carbon dioxide is to comply with **706. 1**.
(2) A secondary system is to be available for removing the carbon dioxide.
(3) Temperature and humidity control units are to comply with **708**.
(4) As required in **603. 1**, there should be means to maintain the divers within the diving bell in thermal balance in an emergency for at least 24 hours. Such requirements may be satisfied by use of passive means carried in the bell.
(5) The breathing gas reclaim system, when fitted, is to comply with the requirements of **706. 2**.

14. Electrical installations and Communication

(1) The electrical installations and control systems are to comply with the requirements of **Sec 8**.
(2) An autonomous flashing light located on the emerged part of the diving bell when floating at the surface is to be provided.
(3) Sufficient internal lighting are to be provided to allow valves and controls to be operated safely.
(4) The diving bell is to be equipped with an emergency locating device with a frequency of 37.5 kHz designed to enable personnel on the surface to establish and maintain contact with the submerged diving bell if the umbilical to surface is served. The locating equipment must conform to the relevant requirements of the **IMO Res. A.831(19).**

15. Structure

(1) The structure of the diving bell is to be checked against lifting loads.
(2) The lifting rope attachment to the diving device is to be a properly designed lifting padeye.
(3) The diving bell should be equipped with one extra lifting point designed to take the entire dry weight of the bell including ballast and equipment as well as the weight of the divers staying on in the bell.
(4) There should be a secondary attachment point on the diving bell if the main one is damaged. This secondary point should also be a properly designed pad eye or similar (it may be a second hole in the same pad eye).
(5) The connection of the lifting rope to the padeye is to have two retaining means for the removable pin (eg: nut locked with a split spin).

16. Emergency recovery means

(1) In the event of single component failure of the main handling system, an alternative means should be provided whereby the bell can be returned to the deck decompression chamber.
(2) In addition, provisions should be made for emergency retrieval of the bell if the main and alternative means fail. If this involves buoyant ascent, the bell should have sufficient stability to maintain a substantially upright position and means should be provided to prevent accidental release of the ballast weights.
(3) Provisions are to be taken in order that it will be possible to release suspension ropes, guide ropes and umbilical from the inside of the bell. These systems are to be actuated through two voluntary actions from the personnel and are to be efficiently protected against undue actions. One of these systems is to be of mechanical type, for each release system.
(4) A ballast release system may be fitted and designated for use as an emergency recovery means.
(5) The release of the ballast weight is to work in a safe way in the most unfavorable attitudes specified for the bell.
(6) At least, one mechanical system is to be fitted. This release system may be actuated through two voluntary actions from the personnel and is to be efficiently protected from undue actuation.
(7) If the release mechanism is operated by means of pressurization (gas or hydraulic) then iso-

lations need to be in place such that they cannot be activated accidentally by external water pressure or internal gas pressure.
(8) The ballast weights are not to be capable of being shed accidentally, for example if the bell is inadvertently tilted.
(9) If the system uses only one weight then there is to be no single component whose failure could cause the weight to become detached. This requirement does not apply if there are two or more weights operating independently.
(10) The amount of positive buoyancy is to be carefully considered in case of ballast release in order that the bell is not moving up too fast.
(11) When buoyant ascent of the diving bell may be used as an emergency means of recovery, the bell ability to remain in upright position is to be checked.

604. Wet bell and diving basket

1. General

(1) Arrangements are to be in place to recover an injured or unconscious diver from the water to the deck.
(2) Wet bells /diver baskets should be designed for the carriage of at least two divers, including their equipment. The bells are to have suitable dimensions to carry the divers in an uncramped position.
(3) Wet bells /diver baskets are to be provided with internal handholds to support the divers.
(4) Each wet bell/ diving basket is to be provided with a handling system to ensure safe transportation between the subsea work location and the surface. Handling systems for wet bell/diving baskets are to meet the applicable requirements of **Sec 10**.
(5) There is to be a main lift point to attach the lift wire to the wet bell / diving basket. This can be a padeye, a shackle point or a captive ring. There is to be a suitable place to attach a secondary lift wire if the main lift point fails (the secondary lift does not need to be fitted).

2. Diving basket

(1) Diving baskets are to be fitted with a gate or chain to prevent divers from falling out.
(2) Diving baskets are to be fitted with protection at the top to prevent injury to the divers from dropped objects.
(3) There is to be at least one emergency air cylinder fitted in the basket, fitted with a content gauge and a first stage regulator.
(4) An individual diving equipment is to be provided including SCUBA mouthpiece and valved flexible hose connection for air supply.

3. Wet Bell

(1) Wet bells are to be provided with an enclosed upper section that provides an envelope capable of maintaining a bubble of breathing gases for the divers.
(2) Wet bells are to be fitted with a gate or chain to prevent divers from falling out.
(3) The wet bell is to be fitted with masks for each diver plus one spare.
(4) The wet-bell is to be fitted with an exhaust system operated by a spring-loaded valve that closes when the valve handle is released.
(5) In addition to the main umbilical supply, wet bells are to be provided with emergency supplies of breathing gas sufficient to supply the divers at nominal diving depth for a period covering the recovery of the divers including decompression (minimum two hours) and with an emergency breathing mask for each diver.
(6) There is to be at least two emergency air cylinder fitted in the wet bell, fitted with a content gauge and a first stage regulator.
(7) An individual diving equipment is to be provided including SCUBA mouthpiece and valved flexible hose connection for air supply.
(8) Wet bells are to be provided with a main supply umbilical for supplying breathing gases, hot water, electrical power, communication, etc., to the bell. The umbilical is to be securely attached to the bell by means of a strength member or strain relief fitting so that the individual connections are not subjected to loads.
(9) The wet bell is to be provided with a depth gauge.
(10) Main and emergency lighting are to be provided to allow the divers to see and operate all controls.

(11) A visual monitoring of the wet bell and the operating site by video system is recommended.
(12) An emergency communication system is to be fitted on the wet bell to communicate with the surface.

605. Rescue chambers (transportable)

1. General

(1) This article is to be applicable to transportable rescue chambers.
(2) Pressure vessels for human occupancy are to comply with the requirements specified **Sec 4**.

2. PVHO

(1) In addition to the diver the transport chamber shall be capable of accommodating an accompanying person.
(2) The main chamber shall be provided with a supply lock. The dimensions of the supply lock shall not be less than 200 mm in diameter and 300 mm in length. The means of closure of the supply lock shall be interlocked in such a way that they cannot be opened simultaneously. Pressure equalizing apertures shall be safeguarded to prevent them from being rendered ineffective by obstructions. The pressure in the supply lock shall be indicated by a pressure gauge or a suitable device mounted externally at the lock controls.
(3) All open penetrations for gas, measurements and analysis shall be protected by replaceable filters mounted on the inside of the pressure chamber.
(4) It shall be possible to lodge the diver in the transportable chamber securely enough to prevent injury due to motions during transfer. Suitable holding devices respectively belts shall be provided.
(5) Transportable chambers shall have an inside length of at least 2.0 m and shall have an access port with a clear diameter of at least 0.5 m.
(6) Transportable chambers shall regarding their total weight and dimensions be designed such that they can be carried or moved otherwise by helpers over short distances and loaded onto a transport vehicle without the assistance of a crane.
(7) Transportable chambers shall be equipped with lifting handles, at least two fastening eyes and the necessary hoisting sling.
(8) Transportable chambers shall be fitted with observation windows giving a good view to the head of the occupant in the chamber.

3. Mating system and medical lock

(1) Transportable chambers shall be fitted with a bayonet flange connection as per EN 14931 (NATO flange) to enable them to be coupled to a treatment chamber. It shall be secured that the bayonet flange connection cannot get under impermissible overpressure.
(2) The design has to ensure that, for operation according to instructions; the means of closure of the transportable chamber can only be opened until the closure is subjected to the same pressure from inside and outside.
(3) The main chamber shall be provided with a medical lock. The dimensions of the medical lock shall not be less than 200 mm in diameter and 300 mm in length. The size of the medical lock may smaller and shall be agreed with the Society.

4. Piping

(1) Chambers are to be equipped with a suitable safety device which automatically prevents the maximum permissible working pressure from being exceeded by more than 10 %. In addition, diver pressure chambers are to be equipped with a reliable safeguard against any inadmissible pressure drop.
(2) Safety valves are to be so designed that they respond only when the maximum permissible working pressure has been exceeded and close before the pressure drops below this level. Safety valves are to be mounted in such a way that they are protected from mechanical damage and accidental operation. The connection of safety valves on diver pressure chamber are to be so designed that they cannot be sealed off unintentionally.
(3) Instead of the pressure relief device, equipment may be fitted which automatically interrupts the pressure supply when the maximum permissible working pressure is exceeded and simultaneously trips a visual and audible alarm. The alarm signal shall be such that it is at all times clearly perceptible to the operating personnel.
(4) Each pressurized gas supply and exhaust line shall at least be fitted with a shut-off valve im-

mediately at the pressure chamber wall. This shut-off valve may be dispensed if the connection to the first valve is short and well protected.

5. Breathing gas supply

(1) Diver pressure chambers shall be so designed that a working pressure of at least 5 bar can be reached and maintained without fail. Provision shall be made for raising the working pressure from 0 bar to 5 bar within 6 minutes. A pressure reduction from 0.4 bar to 0.2 bar shall be possible within one minute.

(2) Transportable chambers shall be equipped with compressed air containers with at least 8000 litres (at atmospheric pressure) air supply. This supply of air is intended for the sole purpose of flushing the atmosphere in the event of an interruption of the normal air supply. Adequate flushing of the atmosphere means 25 litres per minute and person measured at the maximum pressure in the chamber.

(3) A flow of flushing air of at least 25 litres per minute and person (measured at the chamber pressure) shall be secured at each pressure stage.

(4) Each person to be accommodated shall be provided in the main chamber with a source of oxygen supplying at least 75 L/min at atmospheric pressure. The oxygen shall be supplied to the breathing connection via a demand breathing system at the pressure prevailing in the chamber. The exhaled gas shall not be introduced in the chamber atmosphere.

6. Electrical equipment and communication

(1) The electrical installations and communication are to comply with the requirements of **Sec 8**.

(2) A communication system with loudspeakers shall be provided between the inside of the transportation chamber and the outside controls. On the outside, the system shall be permanently switched to "receive", and reversal of the direction of communication shall only be possible by the operation of a self-resetting switch mounted on the outside. On the outside the communication system is also to be equipped with a head-set.

7. Control system and Instrumentation

(1) Transportable chambers shall be equipped with at least the following controls and monitoring instruments:
- (A) air inlet valve
- (B) exhaust air valve
- (C) flushing air valve
- (D) pressure gauge (class 0.25) for chamber pressure
- (E) pressure-reducing valve, with inlet and outlet pressure gauge, to which the compressed air containers called for in **5** (1) are connected
- (F) an additional means of connection, with shut-off device, comprising a suitable high-pressure hose at least 1.5 m in length for connecting the operational compressed air supply to the pressure-reducing valve
- (G) measuring instrument for monitoring of the oxygen volume concentration or partial pressure.

(2) When the transportable chamber is connected to the pressure chambre, the controls and indicating instruments shall be capable of being operated or observed. They shall be located close to a window in the vessel in such a way that the operating personnel can observe the persons in the transportable chamber without changing position.

Section 7 Life Support System

701. General

1. This Section provides requirements for the design and construction of the life support system intended for diving systems.

2. The life support system includes the following functions and installations:
- (1) breathing gas storage, mixture and distribution
- (2) oxygen installations
- (3) breathing gas analysis
- (4) breathing gas regeneration
- (5) pressure control

(6) temperature and humidity control
(7) fresh water installations
(8) sewage installations
(9) umbilicals from surface to diving bell
(10) gas cylinders
(11) piping, valves and fittings
(12) filters and compressors.

3. Inspection and test requirements are provided in **Sec 3**.

4. When relevant, the machinery and piping systems are to comply with the requirements of **Pt 5**, in addition to this Section.

702. Breathing gas supply

1. General

(1) Each deck decompression chamber and diving bell should be fitted with adequate equipment for supplying and maintaining the appropriate breathing mixtures to its occupants at all depths down to maximum operating depth. When adding pure oxygen to the chamber, a separate piping system should be provided.
(2) Piping systems containing gases with more than 25% oxygen should be treated as systems containing pure oxygen. Such piping systems are to comply with **710.** in addition to the present Article.
(3) Any diving bell or deck chamber is to be supplied with two independent sources of breathing gas.
(4) When automatic, the commutation from one gas source to the other is to trigger an alarm.
(5) On PVHO designed for operation in a continuous ventilation mode, means of indicating the rate of flow of ventilation gas are to be provided.
(6) The distribution is to be so arranged as to allow isolation of any filter, regulator and valve without interrupting gas supply.
(7) Inlet end inside the chambers Exhaust lines should be fitted with an anti-suction device on the inlet side. Anti-suction devices in deck chambers are to comply with requirements defined in **503. 2**.
(8) Gases vented from the diving system should be vented to the open air away from sources of ignition, personnel or any area where the presence of those gases could be hazardous.
(9) Every breathing gas piping system is to be provided with means for manually reducing the pressure.
(10) Minimum rate of gas supply is to be ensured in order to compensate for any leak.
(11) Decompression rate of the deck chamber is to be in accordance with specified decompression tables (e.g. US NAVY diving tables).

2. Protection against overpressure

(1) Piping systems which may be subjected to a higher pressure than designed for should be fitted with a pressure relief device.
(2) The flow rates of the safety valves or the discharge valves fitted to pumps and compressors are to be determined so that the pressures in these units are not exceeding by more than 10% the design pressure when operating with the discharge shut.

3. Gas mixing equipment

(1) Efficient ventilation of the breathing mixture is to be provided for in order to obtain a proper homogeneity of the breatheable mixture.
(2) The oxygen content at the gas mixing equipment location is to be measured in compliance with **704. 3** (6).
(3) In case of oxygen content failing to comply with the tolerances set, the gas supply is to be switched to a secondary source. This should be documented in the FMEA of the diving system.

703. Breathing gas storage

1. Location

Breathing gas storage and associated equipment should not be located in a machinery space not as-

sociated with the diving system.

2. Gas storage capacity

(1) It shall be ensured that there are enough spaces to store permanent or portable gas containers and the capacity of gas storage containers is enough to store breathing gas to supply to divers at maximum operating depth for both normal and emergency modes.
(2) As a minimum, the gas storage capacity should be sufficient to pressurize twice all the deck chambers and the HRU to the maximum rated pressure.

3. Protection against overpressure

(1) Pressure vessels and gas cylinders are to be fitted with relief valves and shut-off valves.
(2) Any relief valves or bursting discs should be piped to dump overboard and not in to the enclosed space.

4.Marking

For piping systems and gas storage bottles/pressure vessels, the colour codes defined in Tab 1 are to be used. In addition, each bottle/pressure vessel is to be marked with the name and symbol of the gases it contains. The marking and colour coding of the gas storage bottles is to be visible from the valve end.

Table 9.7.4 Marking of gas system

Gas	Chemical symbol	Colour
Oxygen	O_2	white
Nitrogen	N_2	gray
Air	-	black
Helium	He	brown
Oxygen/Helium gas mixture	O_2/He	white and brown

704. Control of pollutants

1. General

(1) The breathing gas delivered from compressors has to meet the requirements of EN 12021 Respiratory protective devices - Compressed air for breathing apparatus, or an equivalent standard.
(2) Deck decompression chambers should be equipped with such valves, gauges and other fittings as necessary to control and indicate the internal pressure and safe environment of each compartment from outside the chamber at a centralized position. (See Table 9.7.5)

Table 9.7.5 Operating parameters to be monitored

Parameter	Compression chamber compartment	Diving bell
Pressure or depth(1)	O	O(2)
Temperature(1)	O	
Humidity	O	
Oxygen partial pressure(1)	O	O
CO_2 partial pressure	O	O

(Note)
(1) These parameters are to be displayed continuously
(2) The pressure or depth inside and outside the diving bell are to be indicated

2. Pressure gauge

(1) Pressure gauges are to comply with a recognized standard.
(2) The scale of gauges used for depth indication or pressure in the deck chambers are to be appropriate to the duty and large enough to be read easily and accurately. Pressure gauges are to normally operate in the range 25 to 75% of full scale deflection and in the 0 to 25% range if used for decompression. If used for the final stages of decompression they are to have scale divisions of no more than 0.5msw. When pressure gauges are digital, reading is to be displayed with one decimal point.
(3) All pressure gauges are to have the same unit marking system (metric or imperial or both).

3. Breathing gas analysis

(1) The composition, pressure and temperature of the breathing mixture, especially where dangerous gases are likely to be emitted, are to be subject of the utmost attention.
(2) Suitable devices are to be provided to analyze the following content in the breathing gas:
  (A) oxygen content
  (B) carbon dioxide content
  (C) content of each dangerous gas likely to occur (eg: carbon monoxide)
  (D) An appropriate sensor, in the diving bells which contain batteries, and in working enclosures where explosive mixtures (hydrogen and hydrocarbons) are likely to originate.
(3) The following oxygen analyzers are to be provided:
  (A) 1 analyzer in the diving bell
  (B) 2 analyzers in each compartment of the deck decompression chamber
  (C) 1 analyzer on each gas distribution panel
  (D) 1 analyzer in the gas supply panel
  (E) 1 analyzer directly at the output of the gas reclaim system.
(4) The oxygen analyzer for the oxygen partial pressure (PPO2) is to have an accuracy of ± 0.015 bar of partial pressure (PPO2) of O2 or ± 1% in concentration of O2 at atmospheric pressure.
(5) In case of long missions (exceeding 24 hours), a calibration system of the checking devices by means of known and stables mixtures or a device of equivalent reliability is to be provided.
(6) Oxygen analyzers are to comply with a recognized standard(EU directive on marine equipment).
(7) The analyzer for the carbon dioxide partial pressure (PPCO2) is to have an accuracy of ± 0.001 bar of CO2 partial pressure.
(8) Carbon dioxide gas is to be provided for calibration purpose.

705. BIBS

1. General

(1) In addition to the main breathing gas system, each deck decompression chamber and diving bell should contain a separately controlled built-in breathing system (BIBS) for oxygen, therapeutic gas or bottom mix gas. Means are to be provided to prevent any dangerous accumulation of gases.
(2) BIBS are to be overboard dump type with exhausts piped outside the PVHO and also outside the compartment containing the PVHO.

706. CO2 Scrubber and Breathing gas reclaim system

1. CO2 Scrubber

(1) Closed diving bell and each compartment of the deck chambers are to be provided with carbon dioxide (CO2) removal systems.
(2) CO2 scrubber is to be redundant for each separately pressurized PVHO.
(3) CO2 removal systems are to have the capacity to maintain a CO2 partial pressure of less than 0,005 bar in the DDC and less than 0,02 bar in the diving bell, taking into account a production rate of 59 grammes per occupant per hour (or 30 litres/hour/occupant at standard temperature and pressure).

2. Breathing gas reclaim system

(1) A reclaim system may be fitted in order to recover the breathing gas from divers and / or deck chambers.
(2) When fitted, gas reclaim systems are to be designed to reduce the content of bacteria and con-

taminants in the reclaimed gas below the maximum allowable.
(3) When used, gas bag are to be fitted with an overpressure protection device.

707. Sanitary installations

1. General

(1) Sanitary installations are to be provided in deck decompression chambers intended to be occupied for more than 12 hours.
(A) When the DDC is intended to be occupied for less than 24 hours, hand washing facilities and handling sanitary waste are to be provided.
(B) When the DDC is intended to be occupied for more than 24 hours, the flushing toilet, shower, hand-washing sink and external holding tank is to be provided.

2. Fresh water

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

3. The sanitary and sewage installations

(1) The sanitary and sewage installations are to comply with ASME PVHO-1 or an equivalent standard.
(2) The toilet arrangement is to prevent flushing while somebody is sitting on the toilet.

708. Temperature and humidity control

1. General

(1) The diving system should include adequate plantand equipment to maintain the divers in safe thermal balance during normal operations.
(2) For saturation diving systems, the heating and cooling systems are to be 100% redundant in case of power failure.

2. Deck decompression chambers

(1) There is to be suitable means to provide heating/cooling and humidity control inside each deck chamber.
(2) Means for controlling the humidity content is to be provided in the deck chambers.
(3) External heating coils are to be fitted with 2 temperature indicators.

3. Divers and diving bell

(1) For saturation diving, means for heating the breathing gas of the divers are to be provided.
(2) Means for reading the heating medium temperature and its flow rate are to be provided inside the diving bell.
(3) The diver heating system is to include a low and high temperature level alarm at the diving control station.

709. Piping and fittings

1. General

(1) Piping arrangement and materials used for breathing gas is to comply with Class I of **Pt 5**.
(2) Protection against mechanical damage All high-pressure piping is to be protected against mechanical damage.
(3) Piping carrying breathing gas is to be kept away from electrical cables.
(4) Valves used on the breathing gas system are to comply with a recognized standard.
(5) Pressure regulators used on breathing gas systems are to meet the standard EN 738.

2. Material and welding

(1) The materials of the piping system is to comply with the relevant provisions of **Pt 2** and **Pt 5**.
(2) As a rule, ordinary bronze is not permitted for accessories where the design pressure exceeds 15 bars.

(3) Copper and copper alloy pipes are to be of a type without longitudinal seam.
(4) Welding material and welders qualification are to comply with the relevant requirements of the **Pt 2** and **Pt 5**.

3. Flexible hoses

(1) Flexible hoses are to be designed and constructed in accordance with **Pt 5** and a recognized standard.
(2) Flexible hoses, except for umbilicals, should be reduced to a minimum.
(3) Flexible hoses are to be kept as short as practically possible.
(4) Shut-off devices are to be provided to allow isolating the flexible hose.
(5) Provisions are to be taken in such a way that flexible hoses may not accidentally un-tie and whip in case of rupture.
(6) All flexible hoses other than charging whips are to be appropriately supported and secured at intervals not exceeding 2,0 m.
(7) When carrying oxygen, flexible hoses are to comply with the relevant requirements of **710**.
(8) Flexible hoses and associated couplings are to be selected with a minimum burst pressure the greatest of:

$PB = 4 \cdot DP + 5$
$PB = 20$
where:
PB : Minimum burst pressure, in bar
DP : Design Pressure, in bar

(9) As a rule, flexible hoses intended to carry breathing gas at a pressure greater than 10 bar, as well as those carrying oil, are to be metal braided. In addition to its mechanical strength, the function of the metal braid is to conduct heat in case of fire. The metal braid is to be made of stainless steel.
(10) The radius of curvature of the flexible hose is not to be less than the minimum recommended by the manufacturer.

710. Oxygen installations

1. General

(1) A recognized standard is to be applied for the design of the oxygen installation and submitted to the Society for approval.
(2) Special attention should be paid to the design and choice of material for the construction of pressure vessels containing oxygen.
(3) Breathing gas mixtures containing more than 25% of oxygen are to be considered like pure oxygen for installation purpose.

2. Oxygen supply

(1) Any material used in a plant which is intended to carry oxygen is to be compatible with oxygen at working pressure and flow rate.
(2) The use of high-pressure oxygen piping is to be minimized by the fitting of pressure reducing devices, as close as practicable to the storage cylinders.
(3) Ball valves should not be used for oxygen supply.
(4) Oxygen systems with pressure greater than 1,72 bar are to have slow-opening shutoff valves except pressure boundary shutoff valves.
(5) Hoses for oxygen are to be of fire-retardant construction and type approved.
(6) The partial pressure of oxygen on the breathing gas is to be maintained within physiologically acceptable limits taking into account the duration of the mission.

3. Oxygen storage

(1) Oxygen and gases with an oxygen volume percentage higher than 25 per cent should be stored in bottles or pressure vessels exclusively intended for such gases.
(2) Oxygen bottles should be installed in a well-ventilated location.
(3) Oxygen bottles are not to be stored near flammable substances.
(4) As far as practicable, oxygen should be stored on an open deck or in enclosed space specially intended for that purpose.
(5) A visual and audible high-low oxygen alarm is to be fitted when oxygen is stored in an en-

closed space in order that any personnel is warned before entering the space. This alarm is to be repeated on the ship command center.

(6) The pressure of oxygen or mixes containing over 25% oxygen should be regulated down at the quad or cylinder to a maximum of 40 bar for breathing gas or 60 bar for supplies to gas blenders.

4. Oxygen cleaning

(1) Any materials used in a plant which is intended to carry oxygen is to be cleaned of hydrocarbons and debris to avoid explosions.

(2) Reference is to be made to ASTM G93 - Oxygen cleaning method - or an equivalent standard.

(3) All valves and pipe work are to be cleaned for oxygen service when used for gas mixes containing more than 25% oxygen. This may be demonstrated by means of a suitable procedure to ensure cleanliness which is applied when any components are new or after there has been any significant alteration.

711. Gas cylinder

1. General

(1) Gas cylinders shall be designed, constructed and tested according to **Pt 5** or recognised international standards.

(2) Cylinders and quads are to be colour coded and marked with the name and chemical symbol of the contents, in accordance with **703. 4**.

(3) Gas cylinders intended for oxygen storage are to comply with **710.**.

(4) Thickness increment of the cylinder shell of typically 1 mm is to be considered for wastage allowance.

(5) Individual cylinders or multiple cylinders grouped together by means of a manifold, are to be provided with:

(A) an isolation valve rated for the maximum allowable working pressure of the cylinder

(B) a protective device to relieve excess pressure

(C) means for eliminating moisture when used for gas reclaim purpose.

712. Compressor

1. General

(1) Compressors are to comply with **Pt 5**.

(2) Diaphragm type compressors are to be fitted with a cracked plate detector which will automatically stop the compressor in the event of failure.

(3) Any compressor or pump intended for pumping oxygen or any gas mixture containing more than 25% oxygen are to be designed for that purpose.

(4) Any compressor used for gas transfer, and not intended for use with gases containing over 25% oxygen, should be fitted with a protective device which will shut the compressor down if the oxygen percentage entering the compressor exceeds 25%.

(5) Safety relief valves are to exhaust to a safe location.

(6) The intakes of all air compressors are to be sited in an area where they are not exposed to any pollution − particularly exhaust fumes.

2. Pollutant content

The breathing gas delivered from compressors has to meet the requirements of EN 12021 or an equivalent standard.

713. Umbilical cable

1. General

(1) As a rule, umbilicals are to be designed and constructed in accordance with a recognized standard(ISO 13628- 5, API 17E, ISO 15333).

(2) The following information are to be submitted to the Society:

(A) applied technical standard

(B) mechanical properties including minimum breaking strength

(C) design load envelope: maximum tension, bending etc.

(D) minimum Bending Radius (MBR) with respect to applied tensile load

(E) design life
(F) arrangement and diameter of sheaves and winch drum.
(3) Flexible hoses used in umbilicals are to comply with the provisions of **709. 3**.
(4) Electrical cables used in umbilicals are to comply with the provisions of **Sec 8**.
(5) Hoses and electrical cables used in umbilicals are not to have any intermediate connection.
(6) Sheathing is to be such that internal overpressure arising from the leakage of a hose be prevented from being built-up.

2. Main bell umbilical

(1) The main bell umbilical ensures the connection between the diving bell and the surface.
(2) The main bell umbilical is to be securely attached to the bell by means of a strength member or strain relief fitting so that neither the individual components or any bell penetrations are subject to load.
(3) The diving bell umbilical may include means for the transfer of:
(A) breathing gas
(B) hot water
(C) communication, video and controls
(D) electrical power.
(4) When the main bell umbilical is paid out manually, it is to be marked at regular intervals in order for the operator to know exactly the amount paid out at any time during the diving operation.

3. Diver's umbilical

(1) The diver's umbilical ensures the connection between the diving bell and the diver.
(2) Umbilicals are to be marked for length at least every 10 meters using a recognized system which allows easy visual identification of the length paid out.'
(3) Any hoses carrying concentration of oxygen greater than 25% are to be oxygen compatible.

Section 8 Electrical, Control and Communication Systems

801. General

1. This Section provides requirements for the design and construction of electrical installations and control systems, in addition to the requirements defined in the **Pt 6**.

802. General design requirements

1. Environment

(1) All electrical equipment and installations, including power supply arrangements, should be designed for the environment in which they will operate to minimize the risk of fire, explosion, electrical shock and emission of toxic gases to personnel, and galvanic corrosion of the deck decompression chamber or diving bell.
(2) Reference is made to IMCA D045 Code of practice of the safe use of electricity under water, as amended.

2. Electricity under water and inside hyperbaric chambers

(1) The use of electricity inside hyperbaric chambers is to be kept to a minimum. Equipment used is to be of adequate design and construction against hyperbaric and oxygen enriched environment.
(2) Electrical receptacles installed inside the deck chambers are to be waterproof.

3. Maximum voltages

(1) Inside the deck chambers, the voltage should not exceed:
(A) 30 V D.C for plugs, portable equipment and communication, monitoring and remote control
(B) 250 V A.C for power system: A.C Systems with voltage between 7,5 V and 250 V are to be protected against accidental touching and fitted with suitable earth leakage protection.

(C) Higher voltage may be allowed provided that effective protection is fitted and subject to agreement from the Society.

(2) Inside the bell, the voltage should not exceed 30 V D.C.

4. Lighting

(1) Main and emergency lighting is to be provided in spaces containing diving equipment.

(2) Each deck decompression chamber and diving bell should have adequate means of normal and emergency lighting to allow an occupant to read gauges and operate the system within each compartment.

(3) Lighting equipment installed inside PVHO are to be rated at a pressure equal to 1,5 times the MAWP.

(4) Illumination levels within the diving system are to be adequated for the tasks to be performed. Sufficient internal lighting are to be provided to allow valves and controls to be operated safely.

5. Electric motors

Electrical motors inside the deck chambers or diving bell are to be suitable for the intended use as required in **2**.

803. Power source

1. General

The electrical installations are to be supplied from two independent sources of electrical power, a main and an emergency source of power.

2. Emergency source of power

(1) In the event of failure of the main source of electrical power supply to the diving system, an independent source of electrical power is to be available for the safe termination of the diving operation. It is admissible to use the unit's emergency source of electrical power as an emergency source of electrical power if it has sufficient electrical power capacity to supply the diving system and the emergency load for the vessel at the same time.

(2) The emergency source of electrical power is to be located outside the machinery casings to ensure its functioning in the event of fire or other casualty causing failure to the main electrical installation.

(3) As a minimum, the emergency source of power is to be of sufficient capacity to supply the following emergency services:

(A) the breathing gas supply, analysis and regeneration systems

(B) the emergency communication system

(C) the emergency lighting in the deck decompression chambers, the diving bell and the control stations

(D) the launch and recovery system of the diving bell

(E) the handling system required for emergency launching of the HRU

(F) any emergency system necessary for life support.

(4) The emergency source of power is to be capable of supplying the emergency services for a minimum period in accordance with the intended procedure to decompress or evacuate the divers in a safe manner, and as defined in the operating manual.

(5) The emergency source of electrical power is to be self-contained and independent of the main electrical installation and may be either a generator or an accumulator battery.

(6) The following emergency services are to remain available during switching from main to emergency source of power:

(A) emergency lighting

(B) alarm systems (diving and life support system)

(C) emergency communication systems.

(7) Where the emergency source of electrical is a generator, it is to be started automatically upon failure of the main source of electrical power in order to supply the required emergency loads in less than 45s.

(8) A transitional source of emergency electrical power is to be provided, so arranged as to supply automatically and for half an hour the services referred to in (6) or for which a permanent or temporary degradation may occur during the switchover period.

(9) When an accumulator battery is used as the emergency source of power or as a transitional

source of power, it shall operate without recharging while maintaining the voltage of the battery throughout the discharge period within 12% above or below its nominal tension.

(10) When switching from the main source of power to the emergency source of power, an audible and visible alarm is to be actuated in the diving and life support control stations, with the indication of the source of power connected.

3. Accumulator batteries

(1) Storage batteries are not to be located inside the diving bells nor the deck decompression chambers.

(2) Any battery devoted to supply essential services is to be fitted with an indicator of the status of charging and a low level alarm.

(3) When batteries are used within an hyperbaric enclosure, reference is made to IMCA D002 Battery packs in pressure housings, as amended. In particular, the following is to be observed when using batteries in pressure housing:

(A) battery terminals/leads are to be adequately insulated to protect against short circuit

(B) periodic examination, testing and renewal of the cells as necessary should be included within the planned maintenance system

(C) as a general rule shunt diodes should be provided across each cell of a primary battery to avoid the possibility of polarity-reversal occurring in any cell under discharge conditions

(D) the battery housing is to be fitted with an appropriate pressure relief device

(E) the battery casing should not be opened in a confined space and should be fully vented

(F) lead acid batteries should not be used in a hyperbaric environment.

804. Distribution system

1. General

(1) The distribution system is to be of an insulated neutral type (IT).

(2) The structure or hull return distribution system is not permitted.

(3) The distribution system is to be such that the failure of a single circuit will not endanger or render any other circuit inoperative for longer periods.

(4) When the system is supplied through a distribution board, at least two sections of this board are to be supplied by two independent electrical power circuits.

(5) Every insulated distribution system for power, heating or lighting, shall be provided with a device capable of continuously monitoring the insulation level to earth (i.e. the values of electrical insulation to earth) and of giving an audible and visual indication of abnormally low insulation values.

2. Circuit protection

(1) Circuit breakers and fuses are to be provided on all conductors in order to protect the circuit against overload and short-circuit.

(2) Fuses and circuit breakers are not to be fitted within the bell or the deck decompression chambers.

3. Earthing

Deck chambers and bells are to be provided with earthing connection.

4. Distribution panel

(1) Distribution panels are to comply with the requirements of the **Pt 6**.

(2) The distribution panel is to be readily accessible from the control stations.

(3) It is to be possible to disconnect each deck decompression chamber separately.

5. Electrical penetrators for pressure vessels

(1) Electrical penetrators on the boundary of the pressure vessels are to be specially designed and manufactured for that purpose and approved by the Society.

(2) Electrical penetrators in pressure vessels are to remain gas tight and watertight under the design pressure of the vessel, even if the electrical cable passing through the penetrator is damaged.

6. Electrical cables

(1) Electrical cables and wiring are to comply with **Pt 6**.

(2) Electrical cables are to be separated from piping installations carrying breathing gas.

805. Diving control station and Life support control station

1. Diving control station

(1) The control station of the diving bell is to provide the diving supervisor with all information, controls, monitoring systems and means of communication needed for the command of the diving operation and the diving bell.
(2) When there are two diving bells, two diving control stands are to be provided.
(3) The control panel is to be provided with the diagram of the gas flow lines.
(4) The information on the control panel is to include:
  (A) internal pressure of the bell
  (B) depth of immersion of the bell: by measurement of the external pressure and by measurement of the paid-out suspension rope length
  (C) indications on the proper paying-out of the umbilical (information on the length paid-out, view on the pay-out device, information from the bell etc.)
  (D) depth of immersion of each divers working outside the bell
  (E) pressure of the gases supplied at the diving bell
  (F) pressure before and after all pressure reducers on the gas flow lines
  (G) pressure in the storage gas cylinders
  (H) results of the breathing gas analysis defined in Sec 3:
    (a) partial pressure of oxygen served out in umbilical
    (b) partial pressure of oxygen in the bell
    (c) partial pressure of carbon dioxide
    (d) partial pressure of helium (in case of 3 gases mix)
    (e) content of pollutants if any.
  (I) controls parameters of heating means: temperature of the hot water being supplied to the divers and flow rate.
  (J) alarms including:
    (a) low and high level alarm for the oxygen partial pressure of the breathing gas supplied to the divers
    (b) low and high level alarm for the oxygen partial pressure in the diving control station
    (c) alarm when the water temperature used as a diver heating medium moves outside the pre-set limits
    (d) alarm when main source of power is failing
    (e) alarm for electrical insulation fault with an indication of the concerned circuit
    (f) alarm for the failure of the station keeping system.
  (K) indication of the source of electrical power connected
  (L) communication and video watching of the diving bell.
(5) Provisions should be made within the bell for an independent means of monitoring oxygen and carbon dioxide levels.
(6) Any audio alarm is to be capable of being muted if it is so obtrusive that it does not allow to hear other means of communications.
(7) A monitoring system is to be provided to continuously record the oxygen and carbon dioxide content in the bell.
(8) The diving control station is to include the following direct and remote controls:
  (A) electrical controls of the bell (lighting, video, communication, gas reclaim systems, etc)
  (B) controls of the supply of the umbilical: breathing gas for each diver, hot water, etc.)
  (C) control of the sources of energy for the tools.
(9) When emergency source of power is to be manually actuated, the manual switch is to be provided in the control station.
(10) When fitted, cross-over valves on breathing gas supply or depth gauge lines are either be fixed in one position or to indicate very clearly which source they are connected to. In any event any gauge fitted with a cross-over valve is to indicate very clearly at all times exactly what it is reading.
(11) For surface diving, the diving control station where the diving supervisor operates is to gather:
  (A) the information needed for the control of the dive:
    (a) communication and video
    (b) measurement of the immersion of the wet bell/diving basket
    (c) Pressure of the breathing gas storage
    (d) partial pressure of oxygen (for surface mixed gas diving)

(e) clock.
(B) controls actuating:
(a) main and emergency supply
(b) pure oxygen supply (if needed).
(C) the input pressure of the umbilical of the wet bell/diver basket if the umbilical is independent from the supply of the divers.
(12) Indicators and analyzers are to comply with **Sec 7**.
(13) Oxygen analyzers are to be provided in control stations.

2. Life support control station

(1) The control station of the deck decompression chambers is to provide the operator with all information, controls and means of communication needed for the command of the life support operations.
(2) The control panel is to be provided with the diagram of the gas flow lines.
(3) The information on the control panel is to include:
(A) pressure in each compartment of the deck chambers including the trunks with at least one separate gauge for each compartment
(B) pressure inside the diving bell
(C) pressure of supply of the breathing gases into the deck chambers
(D) pressure of the storage gas cylinders
(E) pressure before and after all pressure reducers on the gas flow lines
(F) results of the breathing gas analysis defined in Sec 3:
(a) partial pressure of oxygen in each compartment
(b) partial pressure of carbon dioxide in each compartment
(c) partial pressure of oxygen served out at Built-in Breathing Apparatus (BIBS)
(d) content of pollutants if any.
(G) alarms including:
(a) low and high level alarm for the oxygen partial pressure
(b) alarm when main source of power is failing
(c) alarm for electrical insulation fault with an indication of the concerned circuit
(d) alarm for the failure of the station keeping system
(e) alarm for oxygen content in oxygen storage areas
(H) indication of the source of electrical power connected
(I) temperature and humidity content in each compartment of the deck chambers and indication whether each environmental control unit is running or not
(J) video watching of each compartment of the deck chambers.
(4) A monitoring system is to be provided to continuously record the oxygen, the carbon dioxide content, the helium content if a 3 gases mix is used, the temperature and humidity in each compartment.
(5) The life support control station is to include the following controls:
(A) compression and decompression of each compartment
(B) command of valves for each gas supply
(C) gas supply for the Built-in Breathing Apparatus (BIBS)
(D) switching on and off the electrical equipment of the chamber:
(a) lighting, video, communication
(b) regeneration
(c) addition of oxygen
(d) electrical sensor (pressure, ppO2…).
(E) switching on and off the electrical power (1 general electrical switch for each chamber)
(F) actuation of the fixed fire-fighting system in the deck chambers
(G) selection of the gas bank
(H) amount of oxygen supply for each compartment
(I) manual switching from main to emergency electrical power, when applicable
(J) control of the opening of the transfer from the bell to the deck chambers.
(6) Indicators and analyzers are to comply with **Sec 7**.
(7) Oxygen analyzers are to be provided in control stations.

806. Communication

1. General

(1) Communication means described in this Article are to be provided in control stations, diving bell and DDC. Direct two-way communication are to be provided in control station, diving bell and DDC.
(2) Alternative means of communication with divers in the deck decompression chamber and diving bell should be available in case of emergency.
(3) Each deck decompression chamber and diving bell should be connected to a speech unscrambler when used with gas systems, including helium.

2. Diving control station

(1) The communication system should be arranged for direct 2-way communication between the diving control station and:
(A) the diver in water
(B) the diving bell
(C) each compartment of the chambers
(D) diving system handling positions
(E) dynamic positioning room
(F) bridge, ship's command centre or drilling floor.
(2) The diving control station is also to include communication with the bell and divers through an ultra-sonic system in damaged condition.
(3) There is to be both primary and secondary means of communication between the diving control station and:
(A) the ship command centre
(B) the life support control station
The primary link is to be hard wired, immediately available and unable to be interrupted. One of these links is to be able to operate without the need for external power supply.
(4) A recording system is to be fitted to record all communications between divers and supervisor.

3. Life support system control station

(1) The life support control station is to include the following means of communication with:
(A) each compartment of the deck chambers, including interphone with unscrambler, when relevant
(B) the exterior of each medical lock fitted on the deck decompression chambers
(C) the diving control station
(D) the ship command centre
(E) the launching station of the hyperbaric rescue unit
(F) inside the hyperbaric rescue unit (inside and outside the PVHO).
(2) There is to be two-way communications between the divers inside each compartment of the chamber.
(3) A secondary (back up) communication system (such as a sound powered phone) should exist between the divers inside each compartment of the chamber and those outside at the life support control station.

4. Diving bell

A self-contained through-water communication system should be provided for emergency communication with diving bells when operating under water.

5. Visual control

(1) For saturation diving systems, means for visual control of the divers in the diving bell (e.g. CCTV) from the diving control stand are to be provided.
(2) All compartments of the deck chambers are to be provided with means for visual control.
(3) Means for visual control of the launch and recovery area from the diving control stand (directly or through CCTV) are to be provided.

Section 9 Fire Protection, Extinction and Detection

901. General

1. This Section provides design and construction requirements regarding the fire protection, detection and extinction applicable to diving systems.
2. Inspections and tests are in accordance with **Sec 2**.

902. Fire Protection

1. Material

(1) All materials and equipment used in connection with the diving system should be, as far as is reasonably practicable, of fire-retardant type in order to minimize the risk of fire and sources of ignition.
(2) All materials used in the diving system and especially in the inner area of the hyperbaric chambers, are to be selected so as to offer a minimum risk of combustion and a flame propagation velocity as slow as possible, particularly the wall coating, taking into account high partial pressure of oxygen.
(3) Where selecting materials, particularly plastics, the toxicity and the quantity of noxious gases likely to escape during combustion of the chosen materials is to be taken into account.
(4) Requirements regarding materials for oxygen installations are given in **Sec 7**.
(5) Lubricants are to be approved for use in over-oxygenated environment.
(6) The choice of materials is to be justified and submitted to the Society for approval; the Society reserves the right to call for tests.
(7) Requirements regarding the electrical equipment are given in **Sec 8**.
(8) Electrical equipment are to be selected so as to prevent static electricity to build up and the risk of spark.

2. Area of installation of diving system

(1) The ship or floating structure on which the diving system is installed is required to conform to the fire protection regulations of the classification society responsible and, where applicable, to the relevant requirement of **Pt 8**.
(2) Where pressure vessels are situated in enclosed spaces, a permanently installed water spray system having an application rate of $10\ l/m^2$ related to the horizontal projected area is to be provided for cooling in the event of fire. These water spray systems may be manually activated and operated. For pressure vessels installed on the open deck, cooling by means of fire hoses connected to the general fire extinguishing system is permitted.

903. Fire detection

1. Fire detection and alarm

(1) In outer spaces where no regular human supervision is ensured, a fire detection system allowing to signalize automatically any incipient fire and its location is to be provided for.
(2) In each compartment of the deck chambers, a fire detection and alarm system is to be provided.
(3) The alarm is to be audio and visual both locally and at the life support control station.

904. Fire extinction

1. General

(1) Each compartment in a deck decompression chamber should have suitable means of extinguishing a fire in the interior which would provide rapid and efficient distribution of the extinguishing agent to any part of the chamber.
(2) The fire extinguishers provided for are to be suitable for operation at the pressure prevailing within the enclosure.
(3) The fire-fighting equipment is to be permanently available.

2. Saturation diving system

(1) Each compartment of the deck chambers in a saturation diving system is to be provided with a fixed fire-extinguishing system.
(2) The fixed fire-fighting system is to be operable from both inside and outside of the deck chambers.
(3) The fire extinguishing agent is to be atomized water. The use of other product is to be submitted to the Society for approval.
(4) In addition to the fixed fire-fighting system, portable fire extinguishers are to be provided.
(5) Reference is made to NFPA 99 - Health care facilities code - for the fire-fighting system inside hyperbaric chambers. Other standard may be accepted subject to approval of the Society.

3. Surface diving system

Portable extinguishers may be sufficient in deck decompression chambers of surface diving systems.

905. Other fire protection equipment

Emergency breathing apparatus are to be available at diving and life support control stations.

Section 10 LAUNCH AND RECOVERY SYSTEM

1001. General

1. This Section provides requirements for the design and construction of launch and recovery systems of diving bells.
2. The requirements given in the present Section are additional to the requirements given in **Ch 2**.
3. Inspections and tests are in accordance with **Sec 3**.

1002. General design requirements

1. General

(1) A diving system should be equipped with a main handling system to ensure safe transportation of the diving device between the work location and the deck decompression chamber.
(2) The handling system should be designed with adequate safety factors considering the environmental and operating conditions, including the dynamic loads which are encountered while handling the diving bell through the air-water interface.
(3) The handling system should enable smooth and easily controllable handling of the diving bell.
(4) The lowering of diving devices under normal conditions should not be controlled by brakes, but by the drive system of the winches.
(5) The handling system is to be suitable for man riding.
(6) Handling systems should enable easy and firm connection or disconnection of a closed diving bell to a deck decompression chamber, even under conditions where the support ship or floating structure is rolling, pitching or listing to predetermined degrees.
(7) The SWL is to be clearly marked on every winch and on the A frame, trolley or similar.
(8) When the LARS is powered by hydraulics, the hoses used are to be suitably supported and secured at intervals not exceeding 2 m.
(9) If a heave compensation system is fitted, a warning (light) is to be visible at the dive control stand an d the LARS control stand when the system is in operation.

Calculations

1. The 'working load' of the handling system comprises the weight of the diving bell, the total weight of the fully equipped divers at 150 kgf each, the weight of the equipment and the ballast weights. The 'dead load' is the weight of the handling system.

2. Regardless of the tape of handling system and the size of the working load, the dimensional design of the handling system is to allow for a working load factor Y = 2,0 and a dead load factor F of 1.5. It is assumed here that the use of the system in a seaway will be limited to significant wave

heights of 2 m or less. Where it is proposed that handling operations should be performed in even more unfavourable conditions, previous agreement with the Society is necessary.

3. Calculations are to be based on the assumption that the angle of engagement of the hoisting and lowering strength member may be 12 off perpendicular in any direction.

4. The maximum static tensile stress imposed on steel wire ropes by the working load may not exceed 12.5 % of the proven rupture strength of the ropes.

5. Where ropes made of natural or synthetic fibres are used, the maximum static tensile stress imposed by the working load may not exceed 10 % of the proven rupture strength of the ropes.

6. The stress limits for components are specified in **Annex 9-5**.

7. Rope tension shall not exceed the design load below.
   (1) Wire rope's safety factor is 4 times design load factor. (Design load shall not exceed 1.5 times working weight.)
   (2) Synthetic fiber's safety factor is 5 times design load factor.

8. All interchangeable components such as blocks, hooks, shackles etc. are to be complied with the recognized standards and are to be designed for twice the working load.

1003. Machinery and electrical equipment

1. Winch

(1) The winch rated pull capacity is to take into account allowance for dynamic effects.
(2) The winch raise/lower control is to be designed to return to the neutral position when released by the operator.
(3) If any sort of clutch mechanism is fitted to the winch, there is to be a positive means of preventing it becoming disengaged during operation.
(4) The winch drum is to be able to accept the full length of wire being used. This means that there should be a clear space between the outside of the top layer of wire and the edge of the drum flange of at least 2,5 times the wire diameter.
(5) Any winch used to handle the diving bell is to have:
   (A) a second motor
   (B) means to ensure that the wire being recovered is correctly spooled
   (C) means by which the winch operator can see how much of the main bell lift wire and main bell umbilical have been paid out. This may be by line-out meters or at its simplest by marking the bell wire and umbilical at 10 metres intervals, using the same marking system.

2. Brake

(1) If the energy supply to the handling system fails or the operating lever is returned to neutral position, brakes should be engaged automatically.
(2) Winch for personnel hoisting is to be provided with double brakes.
(3) In addition to the normal brake, the winch shall be equipped with a mechanically and operationally independent secondary brake with separate control system.

3. Secondary means of recovery

(1) In the event of single component failure of the main handling system, an alternative means should be provided whereby the bell can be returned to the deck decompression chamber.
(2) In case of failure of the main handling system, there is to be a secondary means of recovering the diving device to the surface, bringing it on-board and mating it to the chamber system. This is to be independent of the main recovery system.
(3) The secondary recovery system is to have a certified SWL which is at least equal to the weight of the fully loaded diving device in air and in water, in addition to its main task when relevant.

4. Emergency power source

(1) An independent (secondary) power source is to be available in case of failure of the primary power.
(2) The emergency power source is to comply with the requirements provided in **Sec 8**.

1004. Ropes and padeyes and umbilical handling system

1. Lifting rope and guide wires

(1) The lifting rope is to be of non-rotating type.
(2) Operating the release system of the main lifting rope is to be dependent on 2 independent self-willed actions.
(3) The wire rope is to be adequately protected against corrosion.
(4) For saturation diving systems, a system is to be provided to restrict excessive lateral or rotational movement of the diving device in the water. Usually, this system consists in a pair of guide wires stabilized with a weight.
(6) This system may be used as an emergency means of recovery. In this case, the guide wires and their winch are to be suitable for man riding.
(7) The lifting rope attachment to the diving device is to be a properly designed lifting padeye.
(8) The connection of the lifting rope to the padeye is to have two retaining means for the removable pin (eg: nut locked with a split spin).

2. Umbilical handling system

(1) Provisions should be made in order that the handling system of the umbilical is not used to lift the diving device, unless it is designed for that function.
(2) The winding diameter (reel, sheave) should be at least 3 times the umbilical natural curvature radius.
(3) Umbilicals in surface diving systems are to be marked in order for the LARS operator to know the amount of umbilical paid out at any time during the diving operation.

Section 11 HYPERBARIC RESCUE UNIT

1101. General

1. This Section provides requirements for the design and construction of Hyperbaric Rescue Units (HRU) including:
   (A) self-propelled hyperbaric lifeboat (SPHL)
   (B) hyperbaric rescue chamber (HRC) non propelled.
2. Saturation diving systems are to be provided with an hyperbaric rescue unit.
3. Where the hyperbaric evacuation system permanently connected to the diving system is provided it is to be applied with the 'Guidelines and Specifications for Hyperbaric Evacuation Systems', **Res. A.692(17).** Other standard may be accepted subject to approval of the Society.
4. Inspections and tests are in accordance with **Sec 3**.

1102. Evacuation system

1. General

(1) An evacuation system should be provided having sufficient capacity to evacuate all divers under pressure, in the event of the ship having to be abandoned, and should be in accordance with the provisions of IMO Guidelines and specifications for hyperbaric evacuation systems Resolution A692.
(2) he design and construction of the hyperbaric evacuation system should be such that it is suitable for the environmental conditions envisaged, account being taken of the horizontal or vertical dynamic snatch loads that may be imposed on the system and its lifting points particularly during evacuation and recovery.
(3) On floating units intended for drilling, production or storage of hydrocarbon, the HRU is to have means of propulsion or other method to ensure it can rapidly move clear of the site.
(4) Arrangement is to be provided to enable an unconscious diver to be taken into the unit.
(5) Various methods are available for evacuating divers and the suitability of the various options depends on a number of factors including geographical area of operation, environmental conditions, and any available offshore or onshore medical and support facilities. Options available to diving system operators include:

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

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

2. Hyperbaric rescue chamber (HRC)

(1) The hyperbaric rescue chamber is a deck chamber specially fitted to be launched and to work continuously and passively during the specified minimum autonomy. This implies:
(A) an interface with handling means
(B) a stability study
(C) a protection against impact
(D) a specific thermal protection
(E) means of making vital and communication functions autonomous in flotation condition.
The set of drawings and calculations notes corresponding to these items are to be submitted to the Society for approval.

3. Self-Propelled hyperbaric lifeboat (SPHL)

(1) The SPHL is to comply with international regulations applicable to rescue craft (IMO LSA code).
(2) A non-pressurized steering and control station is to be provided for at least one sailor and one deck chamber operator.
(3) The deck chamber operator is to be able to watch inside the chamber from its control panel through a viewport.

1103. General design requirements

1. General

(1) The HRU is to be capable of maintaining the divers at the correct pressure and with life support for a minimum of 72 hours.
(2) Assessment of reserves in soda lime, heating/ refrigerating means, survival rations, reserves of gas, etc. is to be made considering the required autonomy.
(3) Breathing gas reserves and gas reclaim are to cover the consumption of the designed number of persons as well as the compensation of possible leaks. The embarked gas reserve is to allow at least to keep the chamber of the HRU at its operating pressure during the survival duration.
(4) Where hyperbaric rescue units are designed to be placed on board a rescue vessel, attachment points should be provided on the unit to enable it to be secured to the deck.
(5) Hyperbaric rescue units designed to float should be provided with adequate stability for all envisaged operating and environmental conditions and be self-righting. In determining the degree of stability to be provided, consideration should be given to the adverse effects of large righting moments on the divers. Consideration should also be given to the effect which equipment and rescue personnel, required to be placed on the top of the system to carry out a recovery from the sea, may have on the stability of the hyperbaric rescue unit.
(6) Towing attachment points should be so situated that there is no likelihood of the hyperbaric rescue unit being capsized as a result of the direction of the tow line. Where towing harnesses are provided they should be lightly clipped or secured to the unit and, so far as is possible, be free from snagging when pulled free.
(7) Hyperbaric rescue units designed to float should have sufficient reserves of buoyancy to enable the necessary rescue crew and equipment to be carried.
(8) The access trunk is to be part of the resistant structure. It should allow the personnel to easily pass through.
(9) There is to be emergency means of lighting of the access trunk.
(10) The evacuation route should be such that access for divers to the HRU is possible in all normal circumstances. This should include the possibility of an injured diver requiring evacuation by stretcher. If it is necessary to use a pulley type system to move the stretcher then the pulley is to be of a length that allows connection at the furthest extremity of the trunk. The attach-

ment point of the pulley(s) inside the HRU is to be submitted.

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

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

2. Marking

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

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

(3) Where applicable, the following instructions and equipment should be clearly visible and be kept readily available while the unit is afloat:
- (A) towing arrangements and buoyant towline
- (B) all external connections, particularly for the provision of emergency gas, hot/cold water and communications
- (C) maximum gross weight of unit in air
- (D) lifting points
- (E) name of the parent ship and port of registration and
- (F) emergency contact telephone.

(4) Where appropriate, the following instructions should be permanently displayed on every hyperbaric rescue unit in two separate locations so as to be clearly visible while the unit is afloat:
"Unless specialised diving assistance is available:
- (A) do not touch any valves or other controls
- (B) do not try to get occupants out
- (C) do not connect any gas, air, water or other supplies
- (D) do not attempt to give food, drinks or medical supplies to the occupants and
- (E) do not open any hatches".

3. Pressure vessel for human occupancy

(1) Pressure vessels for human occupancy used in HRU and access to HRU are to comply with the requirements specified Sec 5.

(2) Hyperbaric chambers used for hyperbaric evacuation are to have a minimum diameter of 1750 mm.

(3) A medical lock should be provided and be so designed as to prevent accidental opening while the HRU chamber is pressurized. Where necessary, interlock arrangements should be provided for this purpose. The dimensions of the medical lock should be adequate to enable essential supplies, including CO2 scrubber canisters, to be transferred into the HRU chamber, and be of such dimensions as to minimize the loss of gas when the lock is being used.

4. Life support system

(1) Life support systems are to comply with the relevant provisions of **Sec 7**.

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

(3) A Built-In Breathing System should be provided with a sufficient number of masks for all the occupants under pressure plus one spare. BIBS should be overboard dump type with exhausts piped both outside the chamber and outside the enclosed cockpit area in the case of lifeboat type.

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

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

(A) 3/4 in. NPT (female) - hot or cold water
(B) 1/2 in. NPT (female) - breathing mixture.
The connections are to be clearly and permanently marked and be suitably protected.

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

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

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

5. Electrical installations, control systems and Communication

(1) Communication means are to be provided between the HRU decompression chamber and:
(A) the HRU launching station
(B) the DDC control station.

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

(3) The HRU is to be fitted with: flashing light and radar deflector.
(A) radar deflector
(B) strobe light
(C) radio location devices (EPIRB or similar).

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

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

6. Fire safety

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

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

7. Launch and Recovery System

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

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

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

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

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

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

Amendments of the Rule / Guidance

(External review)

Pt. 9 Additional Installations

2020. 02.

Hull Rule Development Team

Present	Amendment	Note
Pt. 9 Additional Installations <Rule> ***Ch.2 CARGO HANDLING APPLIANCES*** ***Section 1 <omit>*** ***Section 2 Surveys*** ***<omit>*** ⚓	***Pt. 9 Additional Installations <Rule>*** ***Ch.2 CARGO HANDLING APPLIANCES*** ***Section 1 <same as current>'*** ***Section 2 Surveys*** ***201.~ 202. <same as current>*** **203. Registration Surveys** **1., 2. <same as current>** **3.** (1) (A) (B) Non-destructive test (When considered necessary by the Surveyor) (2) (3) **4.** ***<same as current>*** ⚓	<reference>
Pt. 9 Additional Installations <Guidance> <newly added>	***Pt. 9 Additional Installations <Guidance>*** **203. Registration Surveys** **1., 2. <same as current>** 3. In application to **203. 3. (1) (B)** of the **Rule**s, the term 'When considered necessary by the Surveyor' means the cases as specified in **Pt.1 Ch.1, 801. 2** of the **Guidance.** **<same as current>**	

Amended Guidance Relating to the Rules for the Classification of Steel Ships

Part 9 Additional Installations

Present	Amendment	Remark
CHAPTER 2 CARGO HANDLING APPLIANCES **Section 1 General** **101. General** **1. <same as the present Rules>** **2. Equivalency [See Rule]** In **101. 2** (2) of the Rules, the "any rules or standards recognized by the Society" means the rules of any Society which is subject to verification of compliance with QSCS(Quality System Certification Scheme) of IACS and International Standard(ISO) or equivalent standards and "Tests and inspection required by the Society" means the Design Examination specified in **203. 1** of the Rules and the Work Examination specified in **203. 2** of the Rules thereof. However, the Society may dispense with part of the plan investigation and examination for the machinery and gear which passed the plan investigation and examination of the official or third-party organizations considered appropriate by the Society and were certified by them. <hereafter, same as the present Rules> **Section 2 Surveys** **203. Registration Surveys** **1., 2. <same as current>** **3. <newly added>**	**CHAPTER 2 CARGO HANDLING APPLIANCES** **Section 1 General** **101. General** **1. <same as the present Rules>** **2. Equivalency [See Rule]** In addition to the requirements of **101. 2** of the Rules, any existing cargo gear, cargo ramps and loose gear designed and manufactured not under the requirements of the Rules may be deemed by the Society to comply with the Rules, provided that they have passed the tests and inspection required by the Society. The expression Tests and inspection required by the Society means the Design Examination specified in **203. 1** of the Rules and the Work Examination specified in **203. 2** of the Rules thereof. However, the Society may dispense with part of the plan investigation and examination for the machinery and gear which passed the plan investigation and examination of the official or third-party organizations considered appropriate by the Society and were certified by them. *(2020)* <hereafter, same as the present Rules> **Section 2 Surveys** **203. Registration Surveys** **1., 2. <same as current>** **3.** In application to **203. 3. (1) (B)** of the **Rule**s, the term 'When considered necessary by the Surveyor' means the cases as specified in **Pt.1 Ch.1, 801. 2** of the **Guidance.**	* amendment due to reorganization of rules related to equivalency

Effective Date : 1 January 2020

(The contract date for ship construction)

◉ The requirement for equivalence has been amended in accordance with the amendment to Part 1 of the Rules.

Present	Amendment	Remark
CHAPTER 3 AUTOMATIC AND REMOTE CONTROL SYSTEMS	**CHAPTER 3 AUTOMATIC AND REMOTE CONTROL SYSTEMS**	
Section 2 Surveys of Automatic and Remote Control Systems	**Section 2 Surveys of Automatic and Remote Control Systems**	(Amended) - The article number has been amended in accordance with the amendment to Part 1 of the Guidance that incorporates the requirements for equivalence.
201. General	**201. General**	
1. Preparation for surveys and others **[See Rule]** In application to **201. 3** (1) of the Rules, the term "a standard deemed appropriate by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance.	**1. Preparation for surveys and others** **[See Rule]** In application to **201. 3** (1) of the Rules, the term "a standard deemed appropriate by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or~~ **105.** of the ~~Guidance.~~ Rules.	
202. <same as the present Rules>	**202. <same as the present Rules>**	
203. Shop tests	**203. Shop tests**	
1. <same as the present Rules>	**1. <same as the present Rules>**	
2. Shop tests of automatic systems **[See Rule]** In application to **203. 2** (1) (E) of the Rules, the term "Other tests considered necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance.	**2. Shop tests of automatic systems** **[See Rule]** In application to **203. 2** (1) (E) of the Rules, the term "Other tests considered necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or~~ **105.** of the ~~Guidance.~~ Rules.	
204. - 208. <same as the present Rules>	**204. - 208. <same as the present Rules>**	

Present	Amendment	Remark
Section 3 Centralized Monitoring and Control Systems for Main Propulsion and Essential Auxiliary Machinery	**Section 3 Centralized Monitoring and Control Systems for Main Propulsion and Essential Auxiliary Machinery**	
302. System design	**302. System design**	
1. Control systems 【See Rule】 In application to **302. 4** (7) of the Rules, the term "other measures considered appropriate by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance.	**1. Control systems** 【See Rule】 In application to **302. 4** (7) of the Rules, the term "other measures considered appropriate by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or~~ **105.** of the ~~Guidance.~~ Rules.	(Amended) - The article number has been amended in accordance with the amendment to Part 1 of the Guidance that incorporates the requirements for equivalence.
2. <same as the present Rules>	**2. <same as the present Rules>**	
303. - 305. <same as the present Rules>	**303. - 305. <same as the present Rules>**	
306. Automatic and remote control of boilers	**306. Automatic and remote control of boilers**	
1. General 【See Rule】 In application to **306. 1** (3) of the Rules, the term "deemed appropriate by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance.	**1. General** 【See Rule】 In application to **306. 1** (3) of the Rules, the term "deemed appropriate by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or~~ **105.** of the ~~Guidance.~~ Rules.	
2. Automatic combustion control systems (1) In application to **306. 2** (2) (F) of the Rules, the term "as deemed appropriate by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance. 【See Rule】 (2) In application to **306. 2** (4) of the Rules, the term "deemed appropriate by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance. 【See Rule】	**2. Automatic combustion control systems** (1) In application to **306. 2** (2) (F) of the Rules, the term "as deemed appropriate by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or~~ **105.** of the ~~Guidance.~~ Rules. 【See Rule】 (2) In application to **306. 2** (4) of the Rules, the term "deemed appropriate by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or~~ **105.** of the ~~Guidance.~~ Rules. 【See Rule】	

Present	Amendment	Remark
Section 5 Specific Automatic Equipment	**Section 5 Specific Automatic Equipment**	
502. Class 1 specific automation equipment	**502. Class 1 specific automation equipment**	
1. - 2. <same as the present Rules>	**1. - 2. <same as the present Rules>**	(Amended) - The article number has been amended in accordance with the amendment to Part 1 of the Guidance that incorporates the requirements for equivalence.
3. Automatic steering system [See Rule] In application to **502. 2** (11) of the Rules, the term "Any other items considered necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance.	**3. Automatic steering system [See Rule]** In application to **502. 2** (11) of the Rules, the term "Any other items considered necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the ~~Guidance.~~ Rules.	
4. - 7. <same as the present Rules>	**4. - 7. <same as the present Rules>**	
503. - 504. <same as the present Rules>	**503. - 504. <same as the present Rules>**	

Present	Amendment	Remark
CHAPTER 5 NAVIGATION BRIDGE SYSTEMS	**CHAPTER 5 NAVIGATION BRIDGE SYSTEMS**	
Section 2 Surveys of Navigation Bridge Systems	**Section 2 Surveys of Navigation Bridge Systems**	
202. Classification Survey	**202. Classification Survey**	
1. Drawings and data **[See Rule]**	**1. Drawings and data** **[See Rule]**	(Amended) - The article number has been amended in accordance with the amendment to Part 1 of the Guidance that incorporates the requirements for equivalence.
In application to **202. 1** (1) (E) of the Rules, the term "Other drawings and data deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance.	In application to **202. 1** (1) (E) of the Rules, the term "Other drawings and data deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or~~ **105.** of the ~~Guidance.~~ Rules.	
2. Shop tests **[See Rule]**	**2. Shop tests** **[See Rule]**	
In application to **202. 2** (J) of the Rules, the term "Other equipment deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance.	In application to **202. 2** (J) of the Rules, the term "Other equipment deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or~~ **105.** of the ~~Guidance.~~ Rules.	
203. Survey Assigned to Maintain Classification	**203. Survey Assigned to Maintain Classification**	
1. Annual survey **[See Rule]**	**1. Annual survey** **[See Rule]**	
In application to **203. 2** (1) (B) (f) of the Rules, the term "Other equipment deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance.	In application to **203. 2** (1) (B) (f) of the Rules, the term "Other equipment deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or~~ **105.** of the ~~Guidance.~~ Rules.	
Section 5 <same as the present Rules>	**Section 5 <same as the present Rules>**	

Present	Amendment	Remark
Section 6 Bridge Work Assist Systems **602. Bridge Work Assist Systems** **1. <same as the present Rules>** **2. Bridge information system [See Rule]** In application to **602. 2** (E) of the Rules, the term "Other functions deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance. **3. <same as the present Rules>** **4. Auto tracking system [See Rule]** In application to **602. 4** (G) of the Rules, the term "Other functions deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance.	**Section 6 Bridge Work Assist Systems** **602. Bridge Work Assist Systems** **1. <same as the present Rules>** **2. Bridge information system [See Rule]** In application to **602. 2** (E) of the Rules, the term "Other functions deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or~~ **105.** of the ~~Guidance.~~ Rules. **3. <same as the present Rules>** **4. Auto tracking system [See Rule]** In application to **602. 4** (G) of the Rules, the term "Other functions deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or~~ **105.** of the ~~Guidance.~~ Rules.	(Amended) - The article number has been amended in accordance with the amendment to Part 1 of the Guidance that incorporates the requirements for equivalence.

Effective Date : 1 July 2020

(The contract date for ship construction)

Present	Amendment	Remark
CHAPTER 4 DYNAMIC POSITIONING SYSTEMS	**CHAPTER 4 DYNAMIC POSITIONING SYSTEMS(DP SYSTEMS)**	
Section 2 Requirements of Dynamic Positioning Systems	**Section 2 Requirements of ~~Dynamic Positioning~~ DP Systems**	(Amended) - The term "Dynamic positioning systems" has been amended to use the term "DP system" within the requirements. Accordingly, the guidance was also revised.
<Newly added>	**201. General** **1.** In application to **201. 6** of the Rules, for vessels that carry out DP operations where the DP operator's view of the working area is not considered necessary, the view from the backup DP control station may not be similar to the view from the main DP control station. For such vessels(e.g. drilling units) it may be accepted that the view from the backup DP control station is provided by closed circuit television (CCTV) system. *(2020)* **【See Rule】**	
203. Additional requirements for dynamic positioning systems **1. DPS(2)** (1) - (2) <same as the present Rules>	**203. Additional requirements for ~~dynamic positioning~~ DP systems** **1. DPS(2)** (1) - (2) <same as the present Rules>	

Present	Amendment	Remark
CHAPTER 5 NAVIGATION BRIDGE SYSTEMS	**CHAPTER 5 NAVIGATION BRIDGE SYSTEMS**	
Section 2 - 5 <same as the present Rules>	**Section 2 - 5 <same as the present Rules>**	
Section 6 Bridge Work Assist Systems	**Section 6 Bridge Work Assist Systems**	
602. Bridge Work Assist Systems	**602. Bridge Work Assist Systems**	
1. <same as the present Rules>	**1. <same as the present Rules>**	
2. Bridge information system [See Rule]	**2. Bridge information system** [See Rule]	(Amended) - The requirement has been newly added to clarify the alarms and warnings which requires the navigator response in 602. 2 (D) of the Rules.
	(1) In application to **602. 2** (D) of the Rules, "alarms and warnings which requires the navigator response" means alarm and warning described in **Appendix 5, Table 1** of **IMO Res.MSC.252(83)**. *(2020)* [See Rule]	
In application to **602. 2** (E) of the Rules, the term "Other functions deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance.	(2) In application to **602. 2** (E) of the Rules, the term "Other functions deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance. [See Rule]	
3. - 4. <same as the present Rules>	**3. - 4. <same as the present Rules>**	

Present	Amendment	Remark
CHAPTER 8 HIGH VOLTAGE SHORE CONNECTION SYSTEMS **Section 1 General** **101. General** [See Rule] **1. Class notation** In application to **101. 4** of the Rules, ships installed a part of high voltage shore connection systems in accordance with the requirements of **Ch 8** of the Rules may be assigned with the class notation HVSC-Partial.	**CHAPTER 8 HIGH VOLTAGE SHORE CONNECTION SYSTEMS** **Section 1 General** **101. General** [See Rule] **1. Class notation** In application to **101. 4** of the Rules, ships permanently installed ~~a part of~~ high voltage shore connection systems in accordance with the requirements of **Ch 8** of the Rules may be assigned with the class notation HVSC and ships installed a part of the systems may be assigned with the class notation HVSC-Partial. *(2020)*	(Amended) - The requirement has been amended to clarify assignment for additional installations notations of high voltage shore connection systems.

-Main Amendments-

(1) Effective Date : 1 July 2020(Date of which contracts for construction are signed)

◉ CHAPTER 7 DIVING SYSTEMS
- Complete revision

◉ Ch 9 CARGO VAPOUR EMISSION CONTROL SYSTEMS
- Application has been amended.
- Overfill control system and high level alarm system has been amended.

CHAPTER 7 DIVING SYSTEMS *(2020)*

Section 1 Classification

101. General

1. In applying

Equipment	Saturation Diving (SUR)	Bounce Diving (BOU)	Surface Diving (SUR)
Diving bell (closed)	○	Choose either diving bell or wet bell	X
Wet bell	X		Choose either wet bell or diving stage
Diving stage	X	X	
Umbilical cable	○	○	○
diving control system	○	○	○
Launch and recovery system	○	○	○
Deck decompression chamber	○	○	○
Life support control system	○		
Life support system - breathing gas storage, mixture and distribution - CO2 scrubber - Breathing gas reclaim system - Environmental - Divers hot water unit - Sanitary installations	 ○ ○ ○(if fitted) ○ ○ ○ ○	 ○ ○ X ○(if fitted) ○(if fitted) X	 ○ ○ X ○(if fitted) ○(if fitted) X
Hyperbaric evacuation system	○		
Launch and recovery system of hyperbaric evacuation system	○		

Section 2 Surveys

201. General

1. Application

The requirements apply to periodical surveys for the equipment in **Ch 7, 101. 1**.

2. Followings are to be examined during periodical surveys.

(1) diving operations log
(2) valve shut-off checklists
(3) operational procedures
(4) emergency procedures
(5) dive log, duly signed off
(6) data sheet for diving system
(7) layout drawing for diving system
(8) PMS. records

3. Survey planning document

(1) Survey planning document shall be part of the documentation on board for the lifetime of the Diving System. The Survey Planning Document shall be written by the owners representatives in accordance with the principles laid out in this Annex, but shall be suited to their particular diving system. For transferable diving systems, the Survey Planning Document shall specify scopes for surveys when the system is installed and for surveys when the system is in storage (laidup).

(2) The Survey Planning Document shall be written in English, or translated into English, and approved by the Society prior to the survey taking place. Checklists shall be included as attachments. It shall have the following information printed on the front page:
(A) "DSV survey planning document"
(B) name of support vessel or installation given in the classification register
(C) Id. number given in the classification register
(D) IMO number (for statutory surveys)
(E) name of company
(F) revision number and date.

(3) Checklists shall be made available for the surveyor to fill out and endorse at each survey. The checklists shall include the following information at the top of each page:
(A) name of support vessel or installation given in the classification register
(B) Id. number given in the classification register
(C) name of company
(D) scope of survey (annual, intermediate, renewal or otherwise)
(E) in columns: survey item, condition, action, comment
(F) place, date, surveyor, signature, and stamp.

202. Survey items

1. Diving bell

(1) Testing of the gas cylinders
(2) Testing of the piping system
(3) Testing of the ballast release system, if any
(4) Testing of the emergency systems
(5) Testing of the location and communication systems
(6) Testing of the diving bell heating system
(7) Testing of the electrical installations
(8) Visual examination of the batteries packs and their watertight seals, if any
(9) Visual examination of the connectors of the piping lines
(10) Visual examination of the BIBS, if any
(11) Visual examination of the anodes, if any
(12) Visual examination of the structure framework
(13) Visual examination of the seals on mating faces

2. Wet bell/Diving stage

(1) Testing of the gas cylinders
(2) Testing of the piping system
(3) Testing of the ballast release system, if any
(4) Testing of the emergency systems
(5) Testing of the electrical installations
(6) Visual examination of the batteries packs and their watertight seals, if any
(7) Visual examination of the connectors of the piping lines
(8) Visual examination of the BIBS, if any
(9) Visual examination of the anodes, if any
(10) Visual examination of the structure framework

3. Deck decompression chamber

(1) Testing of the PVHO in accordance with **4**
(2) Testing of the piping system
(3) Testing of the sanitary systems

(4) Testing of the fire safety systems
(5) Testing of the gas regeneration system (CO2 removal)
(6) Testing of the environmental control unit
(7) Testing of the breathing gas reclaim system, if any
(8) Testing of the instrumentation
(9) Testing of the communication system
(10) Testing of the electrical installations

4. PVHO

(1) Visual examination of the signs of corrosion on the shell of the PVHO and particularly the bottom part inside and outside
(2) Visual examination of the shell penetrators
(3) Visual examination of the supporting structure
(4) Visual examination of the markings
(5) Visual examination of the insulation, if any
(6) Visual examination of the doors, hatches and their locking mechanisms
(7) Visual examination of the medical lock
(8) Visual examination of the associated piping and fittings
(9) Visual examination of the connecting flanges between chambers
(10) Visual examination of the seals on mating faces which are to be cleaned, undamaged and covered lightly in silicone grease.
(11) Gas leak test at maximum working pressure
(12) Hydraulic pressure test at 1.5 times the Maximum Allowable Working Pressure. On a cases-by-case basis and when deemed acceptable by the Society, alternative to in-service hydraulic testing may be granted (e.g. pressure testing with acoustic emission monitoring).
(13) Testing of the viewports in accordance with ASME PVHO

5. Electrical installations

(1) Confirmation that no modifications have been performed on electrical installations and that they are found in satisfactory condition.

6. Launch and recovery system

(1) Wire lubrication
(2) If fitted, heave compensation system is to be function tested.

7. Hyperbaric evacuation system

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

203. Periodical Survey

Equipment	Survey item	Annual Survey	Interme diate Survey	Special Survey
Gas analyzers	◦Inspection and functional test of pump, Validity of tube (if disposal type tube fitted, had pump is to be included.) ◦Visual inspection and functional test ◦Calibration test to agreed specifications	○ ○ ○		
Diving bells (main framework, lowering device)	◦Visual inspection for damage and corrosion of main framework and lowering device) ◦Load test at 1.5 times safety working load 1.5. Non-destructive test of the lifting point or pad eye before and after the load test	○ ○		
Built-in breathing system (BIBS)	◦ Visual inspection and functional test (if fitted, communication equipment is to be included) ◦Inspection and test in accordance with the manufacturer's criteria (in case of underwater unit)	○ ○		
Communication and Video	◦ Inspection and functional test ◦ Test of battery (where practicable)	○ ○		
Compressors, boosters and filters	◦ Visual inspection and functional test (safety devices are to be included except PRV) ◦ Test of flow rate and delivery pressure ◦ Gas purity test (where practicable)	○ ○ ○		
Pressure vessels	◦Visual inspection (external)	○		
	◦ Visual inspection for details of outside and inside ◦ Gas leak test at maximum working pressure ◦ Pressure test at 1.5 times maximum allowable working pressure. (if necessary, non-destructive test is to be carried out)		○ ○	
	◦ Pressure test at 1.5 times maximum allowable working pressure			○
	The frequency and pressure of pressure tests may be in accordance with the flag administration's domestic laws.			
Electrical equipment	◦ Visual inspection ◦ Functional test of equipment (including protectors) ◦ Electrical continuity and insulation resistance test	○ ○		
Emergency locating device of diving bell	◦ Inspection of symptoms of damage or deterioration ◦ Functional test including battery condition check	○ ○		
Environmental control unit	◦ Visual inspection and functional test	○		
Fixed fire-fighting system	◦ Visual inspection of nozzles, valves, piping and fittings ◦ Functional test or simulation test using air or gas ◦ Functional test of automatic detection /automatic operation system (if fitted)	○ ○ ○		
Portable fire-fighting system	◦ Visual inspection(external) and test that the indicating device is within the acceptable range	○		

Divers breathing gas reclaim system and gas blender	◦Visual inspection and functional test (safety devices are to be included except PRV) ◦ Disinfection Check of gas bag	○ ○		
Depth gauge	◦ ± 0.25 % accuracy of full scale reading ◦ Visual inspection and functional test	○ ○		
Divers' heating units	◦ Visual inspection and functional test ◦ Insulation resistance test when electricity is supplied	○ ○		
	◦ Overpressure test			○
Launch and recovery system	◦ Visual inspection of symptoms of damage or deterioration ◦ Static load test at 1.5 times safety working load(SWL) for each brake system ◦ Functional test of heave compensation systems (if fitted) ◦ Functional test of secondary recovery system ◦Dynamic load test at 1.25 times safety working load(SWL) (to be performed NDT after test if necessary)	○ ○ ○ ○ ○		
hydraulic power system	◦Visual inspection and functional test for essential components of the tensioning device ◦ Functional test and check flow rate of intercooler/heater(if fitted) ◦Hydraulic fluid and oil analysis (replace hydraulic fluid and oil, if necessary)	○ ○ ○		
Piping and fittings	◦ Visual inspection ◦ Internal cleanliness verification	○ ○		
	◦ Gas leak test at maximum working pressure		○	
Oxygen piping	◦ Visual inspection	○		
	◦ Gas leak test at maximum working pressure		○	
Pressure relief valve	◦ Visual inspection	○		
	◦Functional test at setting pressure and gas leak test at maximum working pressure		○	
	◦ Bursting disk is to be replaced every ten(10) years.			
PVHO	◦ Visual inspection	○		
	◦ Visual inspection for details of outside and inside ◦ Gas leak test at maximum working pressure		○ ○	
	◦ Internal pressure test			○
Viewport	◦ Visual inspection	○		
	◦ Gas leak test including viewport		○	
	◦ Pressure test			○
	◦ Viewport is to be replaced every ten(10) years.			
Sanitary equipment	◦ Visual inspection and functional test	○		

Umbilical cable	◦ Visual inspection and functional test	○		
	◦ Gas leak test at maximum working pressure		○	
Wire rope	◦ Visual inspection ◦ Cut the wire rope of appropriate length and perform the destruction test of the wire rope -If it is lower than MBL value at the time of initial production, the result falls 10% below the base value adopted following the test carried out when the rope was first put into service, it is to be discarded. ◦ Static load test at 1.5 times maximum safety load after end termination details	○ ○ ○		
Diving bell ballast	◦ Visual inspection for all framework ◦ Static load test at 1.5 times ballast weight ◦ Non-destructive test for main components ◦ Functional test for ballast release system ◦ Positive buoyancy test of diving bell	○ ○ ○ ○ ○		
	◦ Ballast release test			○
Hyperbaric Rescue Unit and launch system	◦ Visual inspection ◦ Functional test including emergency launch system	○ ○		
	◦ Replace the wire for launch system (except stainless steel wire)			○
Hyperbaric Rescue Unit	◦ Visual inspection and functional test ◦ Visual inspection of towing line	○ ○		
Umbilical cable winch	◦ Functional test	○		
	◦ Pressure test at 1.25 times maximum allowable pressure of the swivel			○
Diving bell	◦ Visual Inspection and functional test	○		
	◦ Weighing in air and in water			○
	◦ Testing of the PVHO			
Commissioning	◦Commissioning at rated maximum depth			○

Section 3 Testing

301. General

1. In application to **301. 1** (4) of the Rules, "in accordance with separately provided" means **Guidance for Approval of Manufacturing Process and Type Approval, Etc.** and recognized standard which deemed appropriate by the Society.

302. Tests at the manufacturers works

1. In application to **302. 1** of the Rules, the penetrators are to be tested as specified below.

(1) Test process of compression chamber wall penetrations and underwater plug connections is as follow:

(A) Hydraulic pressure test, in which the test pressure must equal twice the design pressure. The test is to be conducted in accordance with the test pressure/time curve shown in **Fig 9.7.1** the changes in pressure being applied as quickly as possible

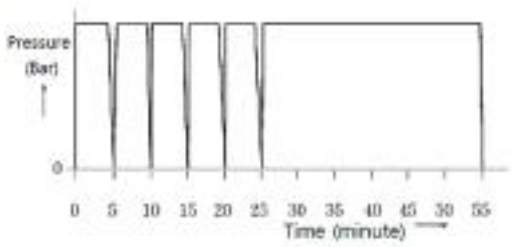


Fig 9.7.1 Test pressure/time curve

(B) Gas tightness test with shorn, open cable ends.
This test may be performed alternatively under air or helium pressure. If compressed air is used, the test pressure must be equal twice the design pressure; if helium is used, 1.5 times.
In all pressure and tightness tests on compression chamber wall penetrations, the pressure must in each case be applied from the pressure side of the wall penetration.

(C) High voltage test at an AC voltage of 1000 V plus twice the rated voltage.
This test is performed at the rated frequency and is to be tried out for 1 minute in each case between all the conductors mutually and between the conductors and the casing. The test is performed in the disconnected state. The connection side of the compression chamber wall penetration may be fully wired for the high voltage test. The sealing of the connector shells and the like is permitted where this is stipulated by the manufacturer in the relevant data sheet. The test voltage for plug connections rated at more than 500 V is to be agreed with the Society.

(D) Measurement of insulation resistance
The minimum value of the insulation resistance between the conductors mutually and between the conductors and the casing shall be 5 $M\Omega$. The insulation resistance is to be measured with an instrument using 500 V DC. With wet plug connections, the minimum insulation resistance is also to be measured after the connection has been made once in salt water.

(E) Visual check against manufacturer's documentation.

(2) All electrical penetrations in compression chamber walls and all plug connections are to be sub-possible. Subjected to individual inspection by the manufacturer. A Works Test Certificate is to be issued by the manufacturer in respect of this inspection.

(3) The necessary test conditions applicable to plug connections in medium voltage systems are to be agreed with the Society in each case.

310. On-board test and Commissioning

1. In application to **310. 3** of the Rules, "in accordance with the discretion of this Society" are those defined in **101. 2** of the Rules.

Section 5 PVHO

503. Piping system

1. In application to **503. 1** (2) of the Rules, where non-return valve is installed, non-return valve is to be installed inside the PVHO and shut-off valve is to be external.

Section 6 Deck Decompression Chambers and divers transfer system

603. Closed Diving Bell

1. In application to **603. 1** (10) of the Rules, means independent from surface supplies are to be provided to maintain the diver's body temperature and reduce CO2 for a minimum period of 24 hours in an emergency. This will normally be by means of survival bags and emergency individual scrubbers.

605. Rescue chambers (transportable)

1. In application to **605. 4** (2) of the Rules, setting values of safety valves are as follows.

	Minimum pressure	Maximum pressure
Response pressure	Maximum Allowable Working Pressure (MAWP)	Maximum Allowable Working Pressure (MAWP) * 1.1
Maximum opening pressure (Maximum Supply)	-	Maximum Allowable Working Pressure (MAWP) * 1.1
Closing pressure	≥Working Pressure (generally MAWP/1.1)	-

Section 7 Life Support System

703. Breathing gas storage

1. In application to **703. 2** of the Rules, the quantities of breathing gas and pure oxygen to carry on-board is to be assessed for each diving campaign and justified by a risk analysis. Minimum requirements are provided by IMCA D050.

Section 10 Launch and Recovery System

1002. General design requirements

The dynamic load of launch and recovery system of diving bell are as follows.

1. General

The estimated dynamic loads during the operation of cursors and diving bells, which are connected to stationary support vessel at designed sea condition and propelling support vessel heading in the main direction of incoming waves, are given in clause **3** and **4.**
The specified methods for calculation of hydrodynamic forces are limited to the cases in which the vertical motions of the suspended bell may be taken equal to the corresponding motions of the support vessel. The conditions permitting such assumptions are specified in Clause **3**, 3.1, (2). Other methods deemed appropriate by the Society.

2. Definitions

(1) Parameters applied for calculation of the forces.
m : mass of bell in air corresponding to its working weight including trapped water (kg).
ρ : mass density of seawater
V : volume of displaced water (m^3).

A : cross sectional area of bell with appendices projected on a horizontal plane (m^2).

C_m : coefficient for added mass (water). (For typical diving bells with appendages such as gas containers, bumper structure etc. the coefficient may be taken as C_m = 1.0). Above water C_m = 0.

C_d : drag coefficient. (For typical diving bells with appendages the coefficient may be taken as C_d = 1.5).

a : maximum expected vertical acceleration of the bell (m/s^2).

a_r : maximum expected vertical relative acceleration between bell and water particles (m/s^2).

v : maximum expected vertical velocity of the bell (m/s).

v_r : maximum expected vertical relative velocity between bell and water particles (m/s).

f_w : reduction factor for the wave action on the bell, depending on the submerged depth z of the bell, given by:

$$f_w = e^{\left(-0.32\frac{z}{h_s}\right)}$$

z : submerged depth of the bell (m) when larger than h_s.

h_s : significant wave height (m).
significant wave height : When selecting the third of the number of waves with the highest wave height, the significant wave height is calculated as the mean of the selection.

e = 2.72

f_a and f_v : reduction factors due to wave action under the heading "Motions of ship shaped support vessels".

k : stiffness of the handling system (N/m).

C_B : block coefficient of vessel.

R_P : horizontal distance from centre of mass (i.e. bell) to the axis of rotation, which may be taken at 0.45 L from the after perpendicular of the vessel (m).

A_w : cross sectional area of moon pool.

s_r : maximum expected relative amplitude (+/-) of motion between sea surface and support vessel in way of moon pool (m).

g : acceleration of gravity

d : draught of vessel at bottom of opening for moon- pool for $d > h_s$ (m)

(2) Parameters applied for correction of units in empirical formulae:
h1 = 1 m^{-1}
L1 = 1 m^{-1}
u1 = 1 m/s
u2 = 1 m

3. Loads on Negative(-) Buoyant Bell

(1) Loads on bell clear of support vessel
(A) In a free flow field the maximum vertical hydrodynamic load Fn acting on a negative buoyant bell in the design sea-state may be taken as the smaller of the values obtained from the two following formulae:

$$F_n = \pm \sqrt{F_{aW}^2 + F_V^2} \quad \text{(N)}$$

$$F_n = \pm \sqrt{F_a^2 + F_W^2 + F_V^2} \quad \text{(N)}$$

F_{aW} : force due to the combined acceleration of bell and water particles, given by:

$$F_{aW} = (m - \rho V)a + \rho V(1 + C_m) f_a a_r \quad \text{(N)}$$

F_v : force due to the relative velocity between bell and water particles, given by:

$$F_v = 0.5 \rho A C_d (f_v v_r)^2 \quad \text{(N)}$$

F_a : force due to acceleration of bell, given by:

$$F_a = (m + C_m \rho V)a \quad \text{(N)}$$

F_w : force due to acceleration of water particles in the deepest wave, given by:

$$F_w = 0.4(1 + C_m) f_w \rho V g \quad \text{(N)}$$

The parameters and principles applied for calculation of the forces are given in (B) of the Rules.

(B) Motions of ship shaped support vessels

The vertical motions of the bell may be taken equal to those of the support vessel when the natural oscillating period of the handling system is less than 3 seconds, as given by:

$$2\pi \sqrt{\frac{m + \rho V C_m}{k}} < 3$$

For calculation of the forces from the formulae given in 3.1 (1) of the Rules, the launching or retrieval velocities are to be added to v and v_r.

The estimation method for a and a_r as well as V and V_r given in the following may be used for vessels with length between perpendiculars L (m) in the range:

50 < L < 150

operating in sea-states with significant wave heights h_s (m) of magnitude: : $2 < h_s < 8$

The heave acceleration az of the support vessel is given by the smaller of:

$$a_z = \frac{(5 h_1 h_s - 0.02 h_1 h_s L_1 L + 1) \times g}{100} \quad (\mathrm{m/s^2})$$

or a_z as obtained from the Rules. The pitch acceleration a_p of the support vessel is given by:

$$a_p = \frac{3.5}{C_B} \times \frac{R_p}{L} \times a_z \quad (\mathrm{m/s^2})$$

The combined vertical acceleration from heave, pitch and roll is given by:

$$a = \sqrt{(r a_z)^2 + a_p^2} \quad (\mathrm{m/s^2})$$

r : coefficient of roll
: 1.0 at centreline of vessel
: 1.2 at sides of vessel

The relative acceleration ar between vessel and water particles at surface is given by:

$$a_r = \left(0.15q\sqrt{h_1 \times h_s}\right) \times g \quad (\mathrm{m/s^2})$$

q : coefficient for position of bell.
: 1.3 at stern.
: 1.1 at sides amidship.
: 1.0 at vessel's centreline amidship.
The vertical velocity of the vessel may be taken as:

$$v = \left(14 - 4.5\frac{R_p}{L}\right)\frac{a \times u_1}{g} \quad (\mathrm{m/s^2})$$

The relative vertical velocity between vessel and water particles at surface is given by:

$$v_r = \left(0.04 \times L_1 \times L + 6\right)\frac{a_r \times u_1}{g} \quad (\mathrm{m/s^2})$$

f_a = reduction factor for vertical relative acceleration of bell due to wave action, given by:

$$f_a = \frac{a + (a_r - a)f_w}{a_r}$$

f_v = reduction factor for vertical relative velocity of bell, given by:

$$f_v = \frac{v + (v_r - v)f_w}{v_r}$$

(2) Hydrodynamic Loads on bell in moon pool

(A) In the flow field of a moon pool (narrow well) the maximum vertical hydrodynamic load F_m acting on a negative buoyant bell may be taken as derived from Clause (1), when C_m and C_d are substituted by $f_m \cdot C_m$ and $f_d \cdot C_d$ respectively, where:

$$f_m = 1 + 1.9(A/A_w)2.25$$
$$f_d = \frac{1 - 0.5A/A_w}{(1 - A/A_w)^2}$$

The factors f_m and f_d obtained from the above apply to moon pools of constant cross section and for the ratio $A/A_w < 0.8$. The relative accelerations a_r and velocities v_r refer to the flow field above the bell.
When A/A_w approaches 1, the hydrodynamic load on the bell approaches the dynamic part of the bottom pressure, and may be taken as:

$$F_m = \pm As_r\rho \geq {}^{\left(-0.32\frac{d}{h_s}\right)} \quad \text{(N)}$$

For a moon pool at the centreline of the support vessel s_r may be taken as:

$$s_r = \left(0.064L + 1.6u_2\right)\frac{a_r}{g}$$

(3) Impulse Loads

(A) Impulse loads F_i caused by sudden velocity changes in the handling system by start, stop and snatch loads in hoisting ropes may be taken as :

$$F_i = v_i\sqrt{k(m + \rho VC_m)} \quad \text{(N)}$$

v_i : impulse velocity (m/s) obtained from Clause **3**, 3.3, (2) or Clause **3**, 3.3, (3)

(B) Impulse velocity
The impulse velocity v_i during start and stop may be taken as the maximum normal transportation velocity.

(C) Slack
Slack hoisting rope may be expected when

$$|F_n| = (m - \rho V)g7$$

When F_n obtained from 3.1 is mainly wave induced and a snatch load is of short duration relative to the wave period i.e. when the natural oscillating period of the handling system is less than 3 seconds as given in 3.1, (2), then the impact velocity v_i may be taken as:

$$v_i = v_1 + v_2 C_i$$

v_i = free fall velocity (m/s) in calm water

$$v_1 = \sqrt{\frac{2(m-\rho V)g}{\rho A C_d}}$$

$v_2 = v_r f_v$ as obtained from 3.1, (2) for tight hoisting ropes
C_i = probability coefficient obtained from the table below

$\frac{v_1}{v_2}$	C_i
$\frac{v_1}{v_2} \leq 0.2$	1
$0.2 < \frac{v_1}{v_2} < 0.7$	$\cos\left(\pi\frac{v_1}{v_2} - 0.2\pi\right)$
$\frac{v_1}{v_2} \geq 0.7$	0

4. Loads on a Positive(+) Buoyant Bell

(1) Impulse loads

(A) Impulse loads F_i caused by sudden velocity changes in the handling system by start, stop and snatch loads in hoisting ropes may be taken as follows:

$$F_i = v_i\sqrt{k(m+\rho V_e 0.6 C_m)} \quad \text{(M)}$$

V_e = volume of displaced water of the floating bell
v_i = impulse velocity obtained from Clause (B)

(B) Impulse velocity is taken to be as follows:

$$V_i = V_r + V_{hoist}$$

V_r : from **3** (1) (B) (m/s)
V_{hoist} : normal transportation speed.

5. Design loads

(1) Maximum load

(A) The maximum load P in the vertical direction may be taken as follows:

In water : $P = (m-\rho V)g + F$

F : where F is the larger of F_n and F_i obtained from 3.1, 3.2 and 3.3.

In air : $P = mg + \sqrt{(ma)^2 + F_i^2}$

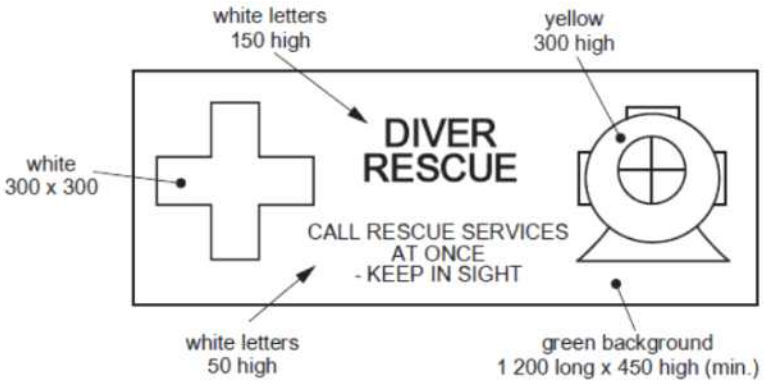
(B) The design load in the vertical direction may be obtained from the following table.

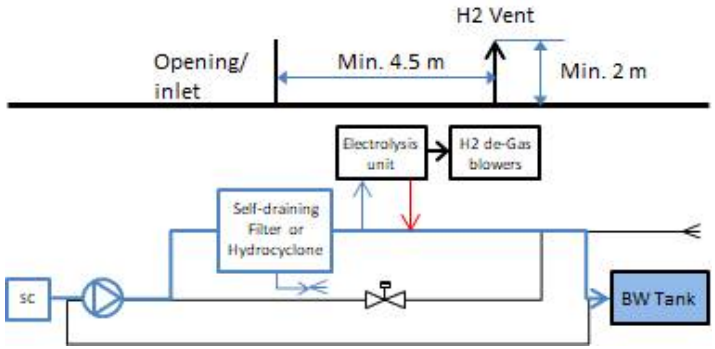
$\frac{P}{mg}$	Design load
$\frac{P}{mg} \leq 2$	P
$2 < \frac{P}{mg} < 3$	$\left(1.5 - 0.25\frac{P}{mg}\right)P$
$\frac{P}{mg} \geq 3$	$0.75\ P$

Section 11 Hyperbaric Rescue Unit

1103. General design requirements

1. In application to **1103. 2** (2) of the Rules, marking follows as figure below. ⚓



Present	Amendment	Reason
CHAPTER 9 CARGO VAPOUR EMISSION CONTROL SYSTEMS	~~**CHAPTER 9 CARGO VAPOUR EMISSION CONTROL SYSTEMS**~~	(Amended) - IMO MSC./Circ.585 & USCG CFR 46 Part 39
Section 3 Requirements for VEC2 Notation	~~**Section 3 Requirements for VEC2 Notation**~~	
302. Overfill Alarm [See Rule]	~~**302. Overfill Alarm**~~ [See Rule]	
1. In applying **302. 1** (1) & (3) of the Rules, the sensor of cargo gauging system and the sensor of high level alarm can be used in common. *(2019)*	**1.** ~~In applying **302. 1** (1) & (3) of the Rules, the sensor of cargo gauging system and the sensor of high level alarm can be used in common. *(2019)*~~	
2. In applying **302. 1** (5) of the Rules, visible and audible alarms are to be provided where the operator readily recognizable from the cargo areas. *(2018)* ⚓	**2.** ~~In applying **302. 1** (5) of the Rules, visible and audible alarms are to be provided where the operator readily recognizable from the cargo areas. *(2018)* ⚓~~	
CHAPTER 10 BALLAST WATER MANAGEMENT	**CHAPTER 10 BALLAST WATER MANAGEMENT**	
Section 3 Ballast Water Management Systems	**Section 3 Ballast Water Management Systems**	
303. Arrangement of BWMS *(2018)* [See Rule]	**303. Arrangement of BWMS *(2018)*** [See Rule]	
1. In applying **303. 1** (3) of the Rules, the area within 3 m around the open end of degas equipment venting dangerous gas is to be considered a hazardous area.⚓	**1.** In applying **303. 1** (3) of the Rules, the area within 3 m around the open end of degas equipment venting dangerous gas is to be considered a hazardous area.	
2. <newly added>	**2.** In applying **303. 1** (3) of the Rules, pipes leading to open deck should be routed to 2 m above deck away from and at least 4.5 m horizontal distance from ventilation inlets, openings to accommodation and service spaces. Other methods deemed appropriate by the Society.  	- Reflected KJE4800-85-2019 request for revision of Guidance.

Amended Guidance Relating to the Rules for the Classification of Steel Ships

Part 9 Additional Installations

(CHAPTER 2 CARGO HANDLING APPLIANCE)

Present	Amendment	Remark
CHAPTER 2 CARGO HANDLING APPLIANCES **Section 1 General** **101. General** **1. <same as the present Rules>** **2. Equivalency** [See Rule] In **101. 2** (2) of the Rules, the "any rules or standards recognized by the Society" means the rules of any Society which is subject to verification of compliance with QSCS(Quality System Certification Scheme) of IACS and International Standard(ISO) or equivalent standards and "Tests and inspection required by the Society" means the Design Examination specified in **203. 1** of the Rules and the Work Examination specified in **203. 2** of the Rules thereof. However, the Society may dispense with part of the plan investigation and examination for the machinery and gear which passed the plan investigation and examination of the official or third-party organizations considered appropriate by the Society and were certified by them. <hereafter, same as the present Rules>	**CHAPTER 2 CARGO HANDLING APPLIANCES** **Section 1 General** **101. General** **1. <same as the present Rules>** **2. Equivalency** [See Rule] In addition to the requirements of **101. 2** of the Rules, any existing cargo gear, cargo ramps and loose gear designed and manufactured not under the requirements of the Rules may be deemed by the Society to comply with the Rules, provided that they have passed the tests and inspection required by the Society. The expression Tests and inspection required by the Society means the Design Examination specified in **203. 1** of the Rules and the Work Examination specified in **203. 2** of the Rules thereof. However, the Society may dispense with part of the plan investigation and examination for the machinery and gear which passed the plan investigation and examination of the official or third-party organizations considered appropriate by the Society and were certified by them. *(2020)* <hereafter, same as the present Rules>	* amendment due to reorganization of rules related to equivalency

Revised Guidance Relating to the Rules for the Classification of Steel Ships

(Final)

Part 9 Additional Installations

- Chapter 3 Automatic and Remote Control Systems
- Chapter 4 Dynamic Positioning Systems
- Chapter 5 Navigation Bridge Systems

2020. 1.

Machinery Rule Development Team

Effective Date : 1 January 2020

(The contract date for ship construction)

◉ The requirement for equivalence has been amended in accordance with the amendment to Part 1 of the Rules.

Present	Amendment	Remark
CHAPTER 3 AUTOMATIC AND REMOTE CONTROL SYSTEMS	**CHAPTER 3 AUTOMATIC AND REMOTE CONTROL SYSTEMS**	
Section 2 Surveys of Automatic and Remote Control Systems	**Section 2 Surveys of Automatic and Remote Control Systems**	(Amended) - The article number has been amended in accordance with the amendment to Part 1 of the Guidance that incorporates the requirements for equivalence.
201. General	**201. General**	
1. Preparation for surveys and others 【See Rule】 In application to **201. 3** (1) of the Rules, the term "a standard deemed appropriate by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance.	**1. Preparation for surveys and others** 【See Rule】 In application to **201. 3** (1) of the Rules, the term "a standard deemed appropriate by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or **105.**~~ of the ~~Guidance.~~ Rules.	
202. <same as the present Rules>	**202. <same as the present Rules>**	
203. Shop tests	**203. Shop tests**	
1. <same as the present Rules>	**1. <same as the present Rules>**	
2. Shop tests of automatic systems 【See Rule】 In application to **203. 2** (1) (E) of the Rules, the term "Other tests considered necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance.	**2. Shop tests of automatic systems** 【See Rule】 In application to **203. 2** (1) (E) of the Rules, the term "Other tests considered necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or **105.**~~ of the ~~Guidance.~~ Rules.	
204. - 208. <same as the present Rules>	**204. - 208. <same as the present Rules>**	

Present	Amendment	Remark
Section 3 Centralized Monitoring and Control Systems for Main Propulsion and Essential Auxiliary Machinery	**Section 3 Centralized Monitoring and Control Systems for Main Propulsion and Essential Auxiliary Machinery**	
302. System design	**302. System design**	
1. Control systems **[See Rule]** In application to **302. 4** (7) of the Rules, the term "other measures considered appropriate by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance.	**1. Control systems** **[See Rule]** In application to **302. 4** (7) of the Rules, the term "other measures considered appropriate by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or **105.**~~ of the ~~Guidance.~~ Rules.	(Amended) - The article number has been amended in accordance with the amendment to Part 1 of the Guidance that incorporates the requirements for equivalence.
2. <same as the present Rules>	**2. <same as the present Rules>**	
303. - 305. <same as the present Rules>	**303. - 305. <same as the present Rules>**	
306. Automatic and remote control of boilers	**306. Automatic and remote control of boilers**	
1. General **[See Rule]** In application to **306. 1** (3) of the Rules, the term "deemed appropriate by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance.	**1. General** **[See Rule]** In application to **306. 1** (3) of the Rules, the term "deemed appropriate by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or **105.**~~ of the ~~Guidance.~~ Rules.	
2. Automatic combustion control systems (1) In application to **306. 2** (2) (F) of the Rules, the term "as deemed appropriate by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance. **[See Rule]** (2) In application to **306. 2** (4) of the Rules, the term "deemed appropriate by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance. **[See Rule]**	**2. Automatic combustion control systems** (1) In application to **306. 2** (2) (F) of the Rules, the term "as deemed appropriate by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or **105.**~~ of the ~~Guidance.~~ Rules. **[See Rule]** (2) In application to **306. 2** (4) of the Rules, the term "deemed appropriate by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or **105.**~~ of the ~~Guidance.~~ Rules. **[See Rule]**	

Present	Amendment	Remark
Section 5 Specific Automatic Equipment **502. Class 1 specific automation equipment** **1. - 2. <same as the present Rules>** **3. Automatic steering system 【See Rule】** In application to **502. 2** (11) of the Rules, the term "Any other items considered necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance. **4. - 7. <same as the present Rules>** **503. - 504. <same as the present Rules>**	**Section 5 Specific Automatic Equipment** **502. Class 1 specific automation equipment** **1. - 2. <same as the present Rules>** **3. Automatic steering system 【See Rule】** In application to **502. 2** (11) of the Rules, the term "Any other items considered necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the ~~Guidance.~~ Rules. **4. - 7. <same as the present Rules>** **503. - 504. <same as the present Rules>**	(Amended) - The article number has been amended in accordance with the amendment to Part 1 of the Guidance that incorporates the requirements for equivalence.

Present	Amendment	Remark
CHAPTER 5 NAVIGATION BRIDGE SYSTEMS **Section 2 Surveys of Navigation Bridge Systems** **202. Classification Survey** **1. Drawings and data** 【See Rule】 In application to **202. 1** (1) (E) of the Rules, the term "Other drawings and data deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance. **2. Shop tests** 【See Rule】 In application to **202. 2** (J) of the Rules, the term "Other equipment deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance. **203. Survey Assigned to Maintain Classification** **1. Annual survey** 【See Rule】 In application to **203. 2** (1) (B) (f) of the Rules, the term "Other equipment deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance. **Section 5 <same as the present Rules>**	**CHAPTER 5 NAVIGATION BRIDGE SYSTEMS** **Section 2 Surveys of Navigation Bridge Systems** **202. Classification Survey** **1. Drawings and data** 【See Rule】 In application to **202. 1** (1) (E) of the Rules, the term "Other drawings and data deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or **105.**~~ of the ~~Guidance.~~ Rules. **2. Shop tests** 【See Rule】 In application to **202. 2** (J) of the Rules, the term "Other equipment deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or **105.**~~ of the ~~Guidance.~~ Rules. **203. Survey Assigned to Maintain Classification** **1. Annual survey** 【See Rule】 In application to **203. 2** (1) (B) (f) of the Rules, the term "Other equipment deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or **105.**~~ of the ~~Guidance.~~ Rules. **Section 5 <same as the present Rules>**	(Amended) - The article number has been amended in accordance with the amendment to Part 1 of the Guidance that incorporates the requirements for equivalence.

Present	Amendment	Remark
Section 6 Bridge Work Assist Systems **602. Bridge Work Assist Systems** **1. <same as the present Rules>** **2. Bridge information system** **[See Rule]** In application to **602. 2** (E) of the Rules, the term "Other functions deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance. **3. <same as the present Rules>** **4. Auto tracking system** **[See Rule]** In application to **602. 4** (G) of the Rules, the term "Other functions deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance.	**Section 6 Bridge Work Assist Systems** **602. Bridge Work Assist Systems** **1. <same as the present Rules>** **2. Bridge information system** **[See Rule]** In application to **602. 2** (E) of the Rules, the term "Other functions deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or **105.**~~ of the ~~Guidance.~~ Rules. **3. <same as the present Rules>** **4. Auto tracking system** **[See Rule]** In application to **602. 4** (G) of the Rules, the term "Other functions deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** ~~or **105.**~~ of the ~~Guidance.~~ Rules.	(Amended) - The article number has been amended in accordance with the amendment to Part 1 of the Guidance that incorporates the requirements for equivalence.

Effective Date : 1 July 2020

(The contract date for ship construction)

Present	Amendment	Remark
CHAPTER 4 DYNAMIC POSITIONING SYSTEMS	**CHAPTER 4 DYNAMIC POSITIONING SYSTEMS(DP SYSTEMS)**	
Section 2 Requirements of Dynamic Positioning Systems	**Section 2 Requirements of ~~Dynamic Positioning~~ DP Systems**	(Amended) - The term "Dynamic positioning systems" has been amended to use the term "DP system" within the requirements. Accordingly, the guidance was also revised.
203. Additional requirements for dynamic positioning systems	**203. Additional requirements for ~~dynamic positioning~~ DP systems**	
1. DPS(2)	**1. DPS(2)**	
(1) - (2) <same as the present Rules>	(1) - (2) <same as the present Rules>	

Revised Guidance Relating to the Rules for the Classification of Steel Ships

(Development Review : For external opinion inquiry)

Part 9 Additional Installations

- Chapter 4 Dynamic Positioning Systems
- Chapter 5 Navigation Bridge Systems
- Chapter 8 High Voltage Shore Connection Systems

2020. 1.

Machinery Rule Development Team

Effective Date : 1 July 2020

(The contract date for ship construction)

Present	Amendment	Remark
CHAPTER 4 DYNAMIC POSITIONING SYSTEMS	**CHAPTER 4 DYNAMIC POSITIONING SYSTEMS(DP SYSTEMS)**	
Section 2 Requirements of Dynamic Positioning Systems	**Section 2 Requirements of ~~Dynamic Positioning~~ DP Systems**	(Amended) - For dilling units, etc. where view of the backup DP control station may not be similar to the view form the main DP control station, the requirement has been newly added to enable visibility through CCTV.
<Newly added>	**201. General** **1.** In application to **201. 6** of the Rules, for vessels that carry out DP operations where the DP operator's view of the working area is not considered necessary, the view from the backup DP control station may not be similar to the view from the main DP control station. For such vessels(e.g. drilling units) it may be accepted that the view from the backup DP control station is provided by closed circuit television (CCTV) system. *(2020)* **[See Rule]**	

Present	Amendment	Remark
CHAPTER 5 NAVIGATION BRIDGE SYSTEMS **Section 2 - 5 <same as the present Rules>** **Section 6 Bridge Work Assist Systems** **602. Bridge Work Assist Systems** **1. <same as the present Rules>** **2. Bridge information system** 【See Rule】 In application to **602. 2** (E) of the Rules, the term "Other functions deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance. **3. - 4. <same as the present Rules>**	**CHAPTER 5 NAVIGATION BRIDGE SYSTEMS** **Section 2 - 5 <same as the present Rules>** **Section 6 Bridge Work Assist Systems** **602. Bridge Work Assist Systems** **1. <same as the present Rules>** **2. Bridge information system** ~~【See Rule】~~ (1) In application to **602. 2** (D) of the Rules, "alarms and warnings which requires the navigator response" means alarm and warning described in **Appendix 5, Table 1** of **IMO Res.MSC.252(83)**. *(2020)* 【See Rule】 (2) In application to **602. 2** (E) of the Rules, the term "Other functions deemed necessary by the Society" means the acceptance in accordance with **Pt 1, Ch 1, 104.** or **105.** of the Guidance. 【See Rule】 **3. - 4. <same as the present Rules>**	(Amended) - The requirement has been newly added to clarify the alarms and warnings which requires the navigator response in 602. 2 (D) of the Rules.

Present	Amendment	Remark
CHAPTER 8 HIGH VOLTAGE SHORE CONNECTION SYSTEMS **Section 1 General** **101. General** [See Rule] **1. Class notation** In application to **101. 4** of the Rules, ships installed a part of high voltage shore connection systems in accordance with the requirements of **Ch 8** of the Rules may be assigned with the class notation HVSC-Partial.	**CHAPTER 8 HIGH VOLTAGE SHORE CONNECTION SYSTEMS** **Section 1 General** **101. General** [See Rule] **1. Class notation** In application to **101. 4** of the Rules, ships permanently installed ~~a part of~~ high voltage shore connection systems in accordance with the requirements of **Ch 8** of the Rules may be assigned with the class notation HVSC and ships installed a part of the systems may be assigned with the class notation HVSC-Partial. *(2020)*	(Amended) - The requirement has been amended to clarify assignment for additional installations notations of high voltage shore connection systems.

GUIDANCE RELATING TO THE RULES FOR THE CLASSIFICATION OF STEEL SHIPS

(Development Review : For external opinion inquiry)

Part 9 ADDITIONAL INSTALLATIONS

2020. 01.

-Main Amendments-

(1) Effective Date : 1 July 2020(Date of which contracts for construction are signed)

◉ CHAPTER 7 DIVING SYSTEMS
- Complete revision

◉ Ch 9 CARGO VAPOUR EMISSION CONTROL SYSTEMS
- Application has been amended.
- Overfill control system and high level alarm system has been amended.

CHAPTER 7 DIVING SYSTEMS *(2020)*

Section 1 Classification

101. General

1. In applying

Equipment	Saturation Diving (SUR)	Bounce Diving (BOU)	Surface Diving (SUR)
Diving bell (closed)	○	Choose either diving bell or wet bell	X
Wet bell	X		Choose either wet bell or diving stage
Diving stage	X	X	
Umbilical cable	○	○	○
diving control system	○	○	○
Launch and recovery system	○	○	○
Deck decompression chamber	○	○	○
Life support control system	○		
Life support system - breathing gas storage, mixture and distribution - CO_2 scrubber - Breathing gas reclaim system - Environmental - Divers hot water unit - Sanitary installations	 ○ ○ ○(if fitted) ○ ○ ○	 ○ ○ X ○(if fitted) ○(if fitted) X	 ○ ○ X ○(if fitted) ○(if fitted) X
Hyperbaric evacuation system	○		
Launch and recovery system of hyperbaric evacuation system	○		

Section 2 Surveys

201. General

1. Application

The requirements apply to periodical surveys for the equipment in **Ch 7, 101. 1**.

2. Followings are to be examined during periodical surveys.

(1) diving operations log
(2) valve shut-off checklists
(3) operational procedures
(4) emergency procedures
(5) dive log, duly signed off
(6) data sheet for diving system
(7) layout drawing for diving system
(8) PMS. records

3. Survey planning document

(1) Survey planning document shall be part of the documentation on board for the lifetime of the Diving System. The Survey Planning Document shall be written by the owners representatives in accordance with the principles laid out in this Annex, but shall be suited to their particular diving system. For transferable diving systems, the Survey Planning Document shall specify scopes for surveys when the system is installed and for surveys when the system is in storage (laidup).

(2) The Survey Planning Document shall be written in English, or translated into English, and approved by the Society prior to the survey taking place. Checklists shall be included as attachments. It shall have the following information printed on the front page:
(A) "DSV survey planning document"
(B) name of support vessel or installation given in the classification register
(C) Id. number given in the classification register
(D) IMO number (for statutory surveys)
(E) name of company
(F) revision number and date.

(3) Checklists shall be made available for the surveyor to fill out and endorse at each survey. The checklists shall include the following information at the top of each page:
(A) name of support vessel or installation given in the classification register
(B) Id. number given in the classification register
(C) name of company
(D) scope of survey (annual, intermediate, renewal or otherwise)
(E) in columns: survey item, condition, action, comment
(F) place, date, surveyor, signature, and stamp.

202. Survey items

1. Diving bell

(1) Testing of the gas cylinders
(2) Testing of the piping system
(3) Testing of the ballast release system, if any
(4) Testing of the emergency systems
(5) Testing of the location and communication systems
(6) Testing of the diving bell heating system
(7) Testing of the electrical installations
(8) Visual examination of the batteries packs and their watertight seals, if any
(9) Visual examination of the connectors of the piping lines
(10) Visual examination of the BIBS, if any
(11) Visual examination of the anodes, if any
(12) Visual examination of the structure framework
(13) Visual examination of the seals on mating faces

2. Wet bell/Diving stage

(1) Testing of the gas cylinders
(2) Testing of the piping system
(3) Testing of the ballast release system, if any
(4) Testing of the emergency systems
(5) Testing of the electrical installations
(6) Visual examination of the batteries packs and their watertight seals, if any
(7) Visual examination of the connectors of the piping lines
(8) Visual examination of the BIBS, if any
(9) Visual examination of the anodes, if any
(10) Visual examination of the structure framework

3. Deck decompression chamber

(1) Testing of the PVHO in accordance with **4**
(2) Testing of the piping system
(3) Testing of the sanitary systems

(4) Testing of the fire safety systems
(5) Testing of the gas regeneration system (CO2 removal)
(6) Testing of the environmental control unit
(7) Testing of the breathing gas reclaim system, if any
(8) Testing of the instrumentation
(9) Testing of the communication system
(10) Testing of the electrical installations

4. PVHO

(1) Visual examination of the signs of corrosion on the shell of the PVHO and particularly the bottom part inside and outside
(2) Visual examination of the shell penetrators
(3) Visual examination of the supporting structure
(4) Visual examination of the markings
(5) Visual examination of the insulation, if any
(6) Visual examination of the doors, hatches and their locking mechanisms
(7) Visual examination of the medical lock
(8) Visual examination of the associated piping and fittings
(9) Visual examination of the connecting flanges between chambers
(10) Visual examination of the seals on mating faces which are to be cleaned, undamaged and covered lightly in silicone grease.
(11) Gas leak test at maximum working pressure
(12) Hydraulic pressure test at 1.5 times the Maximum Allowable Working Pressure. On a cases-by-case basis and when deemed acceptable by the Society, alternative to in-service hydraulic testing may be granted (e.g. pressure testing with acoustic emission monitoring).
(13) Testing of the viewports in accordance with ASME PVHO

5. Electrical installations

(1) Confirmation that no modifications have been performed on electrical installations and that they are found in satisfactory condition.

6. Launch and recovery system

(1) Wire lubrication
(2) If fitted, heave compensation system is to be function tested.

7. Hyperbaric evacuation system

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

203. Periodical Survey

Equipment	Survey item	Annual Survey	Interme diate Survey	Special Survey
Gas analyzers	◦Inspection and functional test of pump, Validity of tube (if disposal type tube fitted, had pump is to be included.) ◦Visual inspection and functional test ◦Calibration test to agreed specifications	○ ○ ○		
Diving bells (main framework, lowering device)	◦Visual inspection for damage and corrosion of main framework and lowering device) ◦Load test at 1.5 times safety working load 1.5. Non-destructive test of the lifting point or pad eye before and after the load test	○ ○		
Built-in breathing system (BIBS)	◦ Visual inspection and functional test (if fitted, communication equipment is to be included) ◦Inspection and test in accordance with the manufacturer's criteria (in case of underwater unit)	○ ○		
Communication and Video	◦ Inspection and functional test ◦ Test of battery (where practicable)	○ ○		
Compressors, boosters and filters	◦ Visual inspection and functional test (safety devices are to be included except PRV) ◦ Test of flow rate and delivery pressure ◦ Gas purity test (where practicable)	○ ○ ○		
Pressure vessels	◦Visual inspection (external)	○		
	◦ Visual inspection for details of outside and inside ◦ Gas leak test at maximum working pressure ◦ Pressure test at 1.5 times maximum allowable working pressure. (if necessary, non-destructive test is to be carried out)		○ ○	
	◦ Pressure test at 1.5 times maximum allowable working pressure			○
	The frequency and pressure of pressure tests may be in accordance with the flag administration's domestic laws.			
Electrical equipment	◦ Visual inspection ◦ Functional test of equipment (including protectors) ◦ Electrical continuity and insulation resistance test	○ ○		
Emergency locating device of diving bell	◦ Inspection of symptoms of damage or deterioration ◦ Functional test including battery condition check	○ ○		
Environmental control unit	◦ Visual inspection and functional test	○		
Fixed fire-fighting system	◦ Visual inspection of nozzles, valves, piping and fittings ◦ Functional test or simulation test using air or gas ◦ Functional test of automatic detection /automatic operation system (if fitted)	○ ○ ○		
Portable fire-fighting system	◦ Visual inspection(external) and test that the indicating device is within the acceptable range	○		

Divers breathing gas reclaim system and gas blender	◦Visual inspection and functional test (safety devices are to be included except PRV) ◦ Disinfection Check of gas bag	○ ○		
Depth gauge	◦ ± 0.25 % accuracy of full scale reading ◦ Visual inspection and functional test	○ ○		
Divers' heating units	◦ Visual inspection and functional test ◦ Insulation resistance test when electricity is supplied	○ ○		
	◦ Overpressure test			○
Launch and recovery system	◦ Visual inspection of symptoms of damage or deterioration ◦ Static load test at 1.5 times safety working load(SWL) for each brake system ◦ Functional test of heave compensation systems (if fitted) ◦ Functional test of secondary recovery system ◦Dynamic load test at 1.25 times safety working load(SWL) (to be performed NDT after test if necessary)	○ ○ ○ ○ ○		
hydraulic power system	◦Visual inspection and functional test for essential components of the tensioning device ◦ Functional test and check flow rate of intercooler/heater(if fitted) ◦Hydraulic fluid and oil analysis (replace hydraulic fluid and oil, if necessary)	○ ○ ○		
Piping and fittings	◦ Visual inspection ◦ Internal cleanliness verification	○ ○		
	◦ Gas leak test at maximum working pressure		○	
Oxygen piping	◦ Visual inspection	○		
	◦ Gas leak test at maximum working pressure		○	
Pressure relief valve	◦ Visual inspection	○		
	◦Functional test at setting pressure and gas leak test at maximum working pressure		○	
	◦ Bursting disk is to be replaced every ten(10) years.			
PVHO	◦ Visual inspection	○		
	◦ Visual inspection for details of outside and inside ◦ Gas leak test at maximum working pressure		○ ○	
	◦ Internal pressure test			○
Viewport	◦ Visual inspection	○		
	◦ Gas leak test including viewport		○	
	◦ Pressure test			○
	◦ Viewport is to be replaced every ten(10) years.			
Sanitary equipment	◦ Visual inspection and functional test	○		
Umbilical cable	◦ Visual inspection and functional test	○		
	◦ Gas leak test at maximum working pressure		○	

Wire rope	◦ Visual inspection ◦ Cut the wire rope of appropriate length and perform the destruction test of the wire rope -If it is lower than MBL value at the time of initial production, the result falls 10% below the base value adopted following the test carried out when the rope was first put into service, it is to be discarded. ◦ Static load test at 1.5 times maximum safety load after end termination details	○ ○ ○		
Diving bell ballast	◦ Visual inspection for all framework ◦ Static load test at 1.5 times ballast weight ◦ Non-destructive test for main components ◦ Functional test for ballast release system ◦ Positive buoyancy test of diving bell	○ ○ ○ ○ ○		
	◦ Ballast release test			○
Hyperbaric Rescue Unit and launch system	◦ Visual inspection ◦ Functional test including emergency launch system	○ ○		
	◦ Replace the wire for launch system (except stainless steel wire)			○
Hyperbaric Rescue Unit	◦ Visual inspection and functional test ◦ Visual inspection of towing line	○ ○		
Umbilical cable winch	◦ Functional test	○		
	◦ Pressure test at 1.25 times maximum allowable pressure of the swivel			○
Diving bell	◦ Visual Inspection and functional test	○		
	◦ Weighing in air and in water			○
	◦ Testing of the PVHO			
Commissioning	◦Commissioning at rated maximum depth			○

Section 3 Testing

301. General

1. In application to **301. 1** (4) of the Rules, "in accordance with separately provided" means **Guidance for Approval of Manufacturing Process and Type Approval, Etc.** and recognized standard which deemed appropriate by the Society.

302. Tests at the manufacturers works

1. In application to **302. 1** of the Rules, the penetrators are to be tested as specified below.

(1) Test process of compression chamber wall penetrations and underwater plug connections is as follow:

(A) Hydraulic pressure test, in which the test pressure must equal twice the design pressure. The test is to be conducted in accordance with the test pressure/time curve shown in **Fig 9.7.1** the changes in pressure being applied as quickly as possible

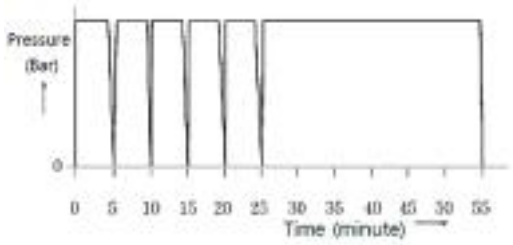


Fig 9.7.1 Test pressure/time curve

(B) Gas tightness test with shorn, open cable ends.
This test may be performed alternatively under air or helium pressure. If compressed air is used, the test pressure must be equal twice the design pressure; if helium is used, 1.5 times.
In all pressure and tightness tests on compression chamber wall penetrations, the pressure must in each case be applied from the pressure side of the wall penetration.

(C) High voltage test at an AC voltage of 1000 V plus twice the rated voltage.
This test is performed at the rated frequency and is to be tried out for 1 minute in each case between all the conductors mutually and between the conductors and the casing. The test is performed in the disconnected state. The connection side of the compression chamber wall penetration may be fully wired for the high voltage test. The sealing of the connector shells and the like is permitted where this is stipulated by the manufacturer in the relevant data sheet. The test voltage for plug connections rated at more than 500 V is to be agreed with the Society.

(D) Measurement of insulation resistance
The minimum value of the insulation resistance between the conductors mutually and between the conductors and the casing shall be 5 MΩ. The insulation resistance is to be measured with an instrument using 500 V DC. With wet plug connections, the minimum insulation resistance is also to be measured after the connection has been made once in salt water.

(E) Visual check against manufacturer's documentation.

(2) All electrical penetrations in compression chamber walls and all plug connections are to be sub-possible. Subjected to individual inspection by the manufacturer. A Works Test Certificate is to be issued by the manufacturer in respect of this inspection.

(3) The necessary test conditions applicable to plug connections in medium voltage systems are to be agreed with the Society in each case.

310. On-board test and Commissioning

1. In application to **310. 3** of the Rules, "in accordance with the discretion of this Society" are those defined in **101. 2** of the Rules.

Section 5 PVHO

503. Piping system

1. In application to **503. 1** (2) of the Rules, where non-return valve is installed, non-return valve is to be installed inside the PVHO and shut-off valve is to be external.

Section 6 Deck Decompression Chambers and divers transfer system

603. Closed Diving Bell

1. In application to **603. 1** (10) of the Rules, means independent from surface supplies are to be provided to maintain the diver's body temperature and reduce CO2 for a minimum period of 24 hours

in an emergency. This will normally be by means of survival bags and emergency individual scrubbers.

605. Rescue chambers (transportable)

1. In application to **605. 4** (2) of the Rules, setting values of safety valves are as follows.

	Minimum pressure	Maximum pressure
Response pressure	Maximum Allowable Working Pressure (MAWP)	Maximum Allowable Working Pressure (MAWP) * 1.1
Maximum opening pressure (Maximum Supply)	-	Maximum Allowable Working Pressure (MAWP) * 1.1
Closing pressure	≥Working Pressure (generally MAWP/1.1)	-

Section 7 Life Support System

703. Breathing gas storage

1. In application to **703. 2** of the Rules, the quantities of breathing gas and pure oxygen to carry on-board is to be assessed for each diving campaign and justified by a risk analysis. Minimum requirements are provided by IMCA D050.

Section 10 Launch and Recovery System

1002. General design requirements

The dynamic load of launch and recovery system of diving bell are as follows.

1. General

The estimated dynamic loads during the operation of cursors and diving bells, which are connected to stationary support vessel at designed sea condition and propelling support vessel heading in the main direction of incoming waves, are given in clause **3** and **4.**
The specified methods for calculation of hydrodynamic forces are limited to the cases in which the vertical motions of the suspended bell may be taken equal to the corresponding motions of the support vessel. The conditions permitting such assumptions are specified in Clause **3**, 3.1, (2). Other methods deemed appropriate by the Society.

2. Definitions

(1) Parameters applied for calculation of the forces.

m : mass of bell in air corresponding to its working weight including trapped water (kg).

ρ : mass density of seawater

V : volume of displaced water (m^3).

A : cross sectional area of bell with appendices projected on a horizontal plane (m^2).

C_m : coefficient for added mass (water). (For typical diving bells with appendages such as gas containers, bumper structure etc. the coefficient may be taken as C_m = 1.0). Above water C_m = 0.

C_d : drag coefficient. (For typical diving bells with appendages the coefficient may be taken as C_d = 1.5).

a : maximum expected vertical acceleration of the bell ($\mathrm{m/s}^2$).

a_r : maximum expected vertical relative acceleration between bell and water particles ($\mathrm{m/s}^2$).

v : maximum expected vertical velocity of the bell (m/s).

v_r : maximum expected vertical relative velocity between bell and water particles (m/s).

f_w : reduction factor for the wave action on the bell, depending on the submerged depth z of the bell, given by:

$$f_w = e^{\left(-0.32\frac{z}{h_s}\right)}$$

z : submerged depth of the bell (m) when larger than h_s.

h_s : significant wave height (m).
significant wave height : When selecting the third of the number of waves with the highest wave height, the significant wave height is calculated as the mean of the selection.

e = 2.72

f_a and f_v : reduction factors due to wave action under the heading "Motions of ship shaped support vessels".

k : stiffness of the handling system (N/m).

C_B : block coefficient of vessel.

R_P : horizontal distance from centre of mass (i.e. bell) to the axis of rotation, which may be taken at 0.45 L from the after perpendicular of the vessel (m).

A_w : cross sectional area of moon pool.

s_r : maximum expected relative amplitude (+/-) of motion between sea surface and support vessel in way of moon pool (m).

g : acceleration of gravity

d : draught of vessel at bottom of opening for moon- pool for $d > h_s$ (m)

(2) Parameters applied for correction of units in empirical formulae:
h1 = 1 m^{-1}
L1 = 1 m^{-1}
u1 = 1 m/s
u2 = 1 m

3. Loads on Negative(-) Buoyant Bell

(1) Loads on bell clear of support vessel

(A) In a free flow field the maximum vertical hydrodynamic load Fn acting on a negative buoyant bell in the design sea-state may be taken as the smaller of the values obtained from the two following formulae:

$$F_n = \pm \sqrt{F_{aW}^2 + F_V^2} \quad \text{(N)}$$

$$F_n = \pm \sqrt{F_a^2 + F_W^2 + F_V^2} \quad \text{(N)}$$

F_{aW} : force due to the combined acceleration of bell and water particles, given by:

$$F_{aW} = (m - \rho V)a + \rho V(1 + C_m) f_a a_r \quad \text{(N)}$$

F_v : force due to the relative velocity between bell and water particles, given by:

$$F_v = 0.5\rho A C_d (f_v v_r)^2 \quad \text{(N)}$$

F_a : force due to acceleration of bell, given by:

$$F_a = (m + C_m \rho V) a \quad \text{(N)}$$

F_w : force due to acceleration of water particles in the deepest wave, given by:

$$F_w = 0.4(1 + C_m) f_w \rho V g \quad \text{(N)}$$

The parameters and principles applied for calculation of the forces are given in (B) of the Rules.

(B) Motions of ship shaped support vessels

The vertical motions of the bell may be taken equal to those of the support vessel when the natural oscillating period of the handling system is less than 3 seconds, as given by:

$$2\pi\sqrt{\frac{m + \rho V C_m}{k}} < 3$$

For calculation of the forces from the formulae given in 3.1 (1) of the Rules, the launching or retrieval velocities are to be added to v and v_r.

The estimation method for a and a_r as well as V and V_r given in the following may be used for vessels with length between perpendiculars L (m) in the range:

50 < L < 150

operating in sea-states with significant wave heights h_s (m) of magnitude: : 2 < h_s < 8

The heave acceleration az of the support vessel is given by the smaller of:

$$a_z = \frac{(5h_1 h_s - 0.02 h_1 h_s L_1 L + 1) \times g}{100} \quad (\mathrm{m/s^2})$$

or a_z as obtained from the Rules. The pitch acceleration a_p of the support vessel is given by:

$$a_p = \frac{3.5}{C_B} \times \frac{R_p}{L} \times a_z \quad (\mathrm{m/s^2})$$

The combined vertical acceleration from heave, pitch and roll is given by:

$$a = \sqrt{(r a_z)^2 + a_p^2} \quad (\mathrm{m/s^2})$$

r : coefficient of roll
: 1.0 at centreline of vessel
: 1.2 at sides of vessel

The relative acceleration ar between vessel and water particles at surface is given by:

$$a_r = (0.15 q \sqrt{h_1 \times h_s}) \times g \quad (\mathrm{m/s^2})$$

q : coefficient for position of bell.
: 1.3 at stern.
: 1.1 at sides amidship.
: 1.0 at vessel's centreline amidship.

The vertical velocity of the vessel may be taken as:

$$v = \left(14 - 4.5\frac{R_p}{L}\right)\frac{a \times u_1}{g} \quad (\mathrm{m/s^2})$$

The relative vertical velocity between vessel and water particles at surface is given by:

$$v_r = (0.04 \times L_1 \times L + 6)\frac{a_r \times u_1}{g} \quad (\mathrm{m/s^2})$$

f_a = reduction factor for vertical relative acceleration of bell due to wave action, given by:

$$f_a = \frac{a + (a_r - a)f_w}{a_r}$$

f_v = reduction factor for vertical relative velocity of bell, given by:

$$f_v = \frac{v + (v_r - v)f_w}{v_r}$$

(2) Hydrodynamic Loads on bell in moon pool

(A) In the flow field of a moon pool (narrow well) the maximum vertical hydrodynamic load F_m acting on a negative buoyant bell may be taken as derived from Clause (1), when C_m and C_d are substituted by $f_m \cdot C_m$ and $f_d \cdot C_d$ respectively, where:

$$f_m = 1 + 1.9(A/A_w)2.25$$
$$f_d = \frac{1 - 0.5A/A_w}{(1 - A/A_w)^2}$$

The factors f_m and f_d obtained from the above apply to moon pools of constant cross section and for the ratio $A/A_w < 0.8$. The relative accelerations a_r and velocities v_r refer to the flow field above the bell.

When A/A_w approaches 1, the hydrodynamic load on the bell approaches the dynamic part of the bottom pressure, and may be taken as:

$$F_m = \pm A s_r \rho \geq^{\left(-0.32\frac{d}{h_s}\right)} \quad \text{(N)}$$

For a moon pool at the centreline of the support vessel s_r may be taken as:

$$s_r = (0.064L + 1.6u_2)\frac{a_r}{g}$$

(3) Impulse Loads

(A) Impulse loads F_i caused by sudden velocity changes in the handling system by start, stop and snatch loads in hoisting ropes may be taken as :

$$F_i = v_i\sqrt{k(m + \rho V C_m)} \quad \text{(N)}$$

v_i : impulse velocity (m/s) obtained from Clause **3**, 3.3, (2) or Clause **3**, 3.3, (3)

(B) Impulse velocity

The impulse velocity v_i during start and stop may be taken as the maximum normal transportation velocity.

(C) Slack

Slack hoisting rope may be expected when

$$|F_n| = (m - \rho V)g7$$

When F_n obtained from 3.1 is mainly wave induced and a snatch load is of short duration relative to the wave period i.e. when the natural oscillating period of the handling system is less than 3 seconds as given in 3.1, (2), then the impact velocity v_i may be taken as:

$$v_i = v_1 + v_2 C_i$$

v_i = free fall velocity (m/s) in calm water

$$v_1 = \sqrt{\frac{2(m-\rho V)g}{\rho A C_d}}$$

v_2 = $v_r f_v$ as obtained from 3.1, (2) for tight hoisting ropes
C_i = probability coefficient obtained from the table below

$\frac{v_1}{v_2}$	C_i
$\frac{v_1}{v_2} \leq 0.2$	1
$0.2 < \frac{v_1}{v_2} < 0.7$	$\cos\left(\pi\frac{v_1}{v_2} - 0.2\pi\right)$
$\frac{v_1}{v_2} \geq 0.7$	0

4. Loads on a Positive(+) Buoyant Bell

(1) Impulse loads
(A) Impulse loads F_i caused by sudden velocity changes in the handling system by start, stop and snatch loads in hoisting ropes may be taken as follows:

$$F_i = v_i\sqrt{k(m+\rho V_e 0.6 C_m)} \quad \text{(M)}$$

V_e = volume of displaced water of the floating bell
v_i = impulse velocity obtained from Clause (B)

(B) Impulse velocity is taken to be as follows:

$$V_i = V_r + V_{hoist}$$

V_r : from **3** (1) (B) (m/s)
V_{hoist} : normal transportation speed.

5. Design loads

(1) Maximum load
(A) The maximum load P in the vertical direction may be taken as follows:

In water : $P = (m-\rho V)g + F$
F : where F is the larger of F_n and F_i obtained from 3.1, 3.2 and 3.3.
In air : $P = mg + \sqrt{(ma)^2 + F_i^2}$

(B) The design load in the vertical direction may be obtained from the following table.

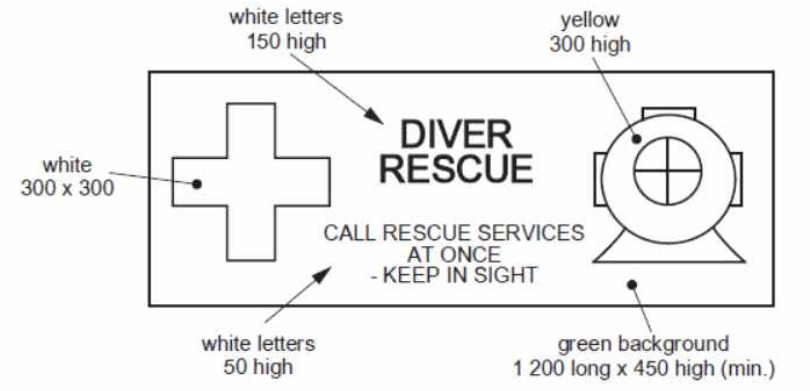
$\frac{P}{mg}$	Design load
$\frac{P}{mg} \leq 2$	P

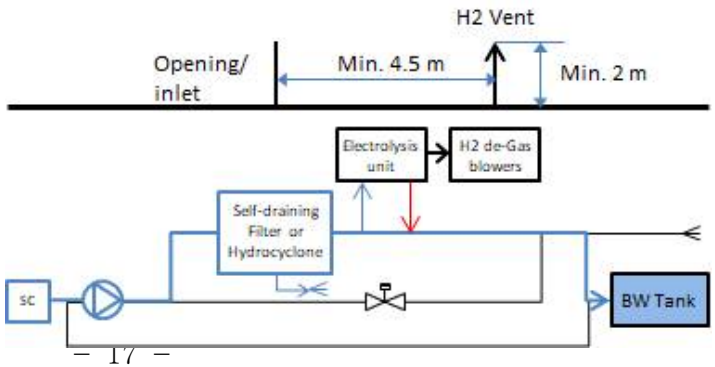
$2 < \frac{P}{mg} < 3$	$\left(1.5 - 0.25\frac{P}{mg}\right)P$
$\frac{P}{mg} \geq 3$	$0.75\ P$

Section 11 Hyperbaric Rescue Unit

1103. General design requirements

1. In application to **1103. 2** (2) of the Rules, marking follows as figure below. ⚓



Present	Amendment	Reason
CHAPTER 9 CARGO VAPOUR EMISSION CONTROL SYSTEMS **Section 3 Requirements for VEC2 Notation** **302. Overfill Alarm [See Rule]** **1.** In applying **302. 1** (1) & (3) of the Rules, the sensor of cargo gauging system and the sensor of high level alarm can be used in common. *(2019)* **2.** In applying **302. 1** (5) of the Rules, visible and audible alarms are to be provided where the operator readily recognizable from the cargo areas. *(2018)* ⚓ **CHAPTER 10 BALLAST WATER MANAGEMENT** **Section 3 Ballast Water Management Systems** **303. Arrangement of BWMS *(2018)* [See Rule]** **1.** In applying **303. 1** (3) of the Rules, the area within 3 m around the open end of degas equipment venting dangerous gas is to be considered a hazardous area.⚓ **2.** <newly added>	~~**CHAPTER 9 CARGO VAPOUR EMISSION CONTROL SYSTEMS**~~ ~~**Section 3 Requirements for VEC2 Notation**~~ ~~**302. Overfill Alarm [See Rule]**~~ ~~**1.** In applying **302. 1** (1) & (3) of the Rules, the sensor of cargo gauging system and the sensor of high level alarm can be used in common. *(2019)*~~ ~~**2.** In applying **302. 1** (5) of the Rules, visible and audible alarms are to be provided where the operator readily recognizable from the cargo areas. *(2018)* ⚓~~ **CHAPTER 10 BALLAST WATER MANAGEMENT** **Section 3 Ballast Water Management Systems** **303. Arrangement of BWMS *(2018)* [See Rule]** **1.** In applying **303. 1** (3) of the Rules, the area within 3 m around the open end of degas equipment venting dangerous gas is to be considered a hazardous area. **2.** In applying **303. 1** (3) of the Rules, pipes leading to open deck should be routed to 2 m above deck away from and at least 4.5 m horizontal distance from ventilation inlets, openings to accommodation and service spaces. Other methods deemed appropriate by the Society.  ⚓	(Amended) - IMO MSC./Circ.585 & USCG CFR 46 Part 39 - Reflected KJE4800-85-2019 request for revision of Guidance.