RECOMMENDED PRACTICE
DNV-RP-E401

SURVEY OF DIVING SYSTEMS

APRIL 2007

DET NORSKE VERITAS

FOREWORD

DET NORSKE VERITAS (DNV) is an autonomous and independent foundation with the objectives of safeguarding life, property and the environment, at sea and onshore. DNV undertakes classification, certification, and other verification and consultancy services relating to quality of ships, offshore units and installations, and onshore industries worldwide, and carries out research in relation to these functions.

DNV Offshore Codes consist of a three level hierarchy of documents:

— *Offshore Service Specifications.* Provide principles and procedures of DNV classification, certification, verification and consultancy services.
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A) Qualification, Quality and Safety Methodology

B) Materials Technology

C) Structures

D) Systems

E) Special Facilities

F) Pipelines and Risers

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H) Marine Operations

J) Wind Turbines

Amendments and Corrections

This document is valid until superseded by a new revision. Minor amendments and corrections will be published in a separate document normally updated twice per year (April and October).

For a complete listing of the changes, see the “Amendments and Corrections” document located at: http://webshop.dnv.com/global/, under category “Offshore Codes”.

The electronic web-versions of the DNV Offshore Codes will be regularly updated to include these amendments and corrections.

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Introduction

During the last 30 years, Det Norske Veritas (DNV) has been gaining experience from classification of Diving Support Vessels (DSVs) and experience from resolving a number of detailed problems associated with the design, construction and operation of diving systems.

In an effort both to share this knowledge with the industry, and also to improve the working relationship between the operator and surveyor, this Recommended Practice (RP) has now been developed, primarily based on the existing, relevant Offshore Standard, and the Service Specification for "Certification and Issue of Class notation DSV".Although the RP is primarily intended for systems in operation, it may also be used for the evaluation of new constructions and conversions.

Scope of the Recommended Practice

This RP provides technical guidance for the planning and executing of surveys for:

— diving systems
— their support systems, and
— interfaces with the support vessel.

A "Survey planning document" is to be prepared for each vessel and submitted for approval. The extent necessary meeting with the requirements of this proposal shall be decided on a case by case basis, taking the variables e.g. diving system design and statutory criteria, into consideration.

A satisfactory "Survey planning document" should meet the requirements for the retention of the class notations **DSV-SAT**, **DSV-BOUNCE** or **DSV-SURFACE**.

It is recognised that satisfactory in-service performance of the system relies on quality workmanship during fabrication and maintenance. It is important to note that the Recommended Practice cannot provide any assurance on or for systems built outside a recognised classification or certification regime. The operator shall, therefore, follow acceptable practices and ensure that the applied acceptance criteria, including fabrication tolerances, are consistent with these practices.

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SECTION 1
INTRODUCTION

A. Introduction

A 100 General

101 This Recommended Practice (RP) gives instructions, criteria and guidance on survey of diving systems.
In the case of diving systems that are certified or classified by DNV, it shall act as a set of requirements applied to the *Survey Planning Document* required by DNV to be kept onboard for the lifetime of the diving system. (See Sec.2 A300)

A 200 Organisation of this Recommended Practice

201 This document is divided into 10 sections as follows:

— Introduction
— Principles for surveys relating to DNV Certification and Classification
— Semi-annual (6 monthly) survey of systems in operation (sA)
— Annual survey (1 yearly) survey of systems in operation (A)
— Intermediate survey (2 or 3 yearly) (I)
— Renewal survey (5 yearly) (R)
— Survey of new manufacture, assembly and installations (NB)
— Statutory surveys for national authorities (STA)
— Appendix A - Pressure containing equipment summary
— Appendix B - Hyperbaric evacuation systems
— Appendix C - Example checklists.

A 300 Objectives

301 The objectives of this section shall outline the functionality of the RP and its related codes, standards and Recommended Practices.

302 General guidance is provided as to the use and interpretation of the RP.

303 These instructions do not apply to submersibles or Atmospheric Diving Systems (ADS such as “JIM” and “NEWT Suit”).

304 Surveys may be carried out with the vessel on location or in port as long as the diving system is not under pressure at the time. Pressure vessels requiring internal inspection should be depressurised, opened up, cleaned and made ready for survey.

305 Internal inspections of gas storage bottles should be carried out in accordance with an approved procedure by an approved service supplier. Consult the register of approved manufacturers for approved service suppliers.

306 The relevant ship history file (DNV exchange survey status report) should be consulted to decide which survey is required for the diving system. Please note the memorandums to owners placed in the diving system register records in the case of diving systems classed with DNV.

307 The following report forms should be completed:

— semi-annual reports to the Planned Maintenance System (PMS) – 6 monthly
— annual survey checklist - yearly
— intermediate survey checklist - 2 or 3 yearly
— renewal survey checklist - 5 yearly
— narrative reports – at each survey
— damage reports if applicable.
— upgrades/modifications history, incl. approvals.

Additional checklists may apply.

A 400 Application and scope

401 This RP applies to diving systems for any fixed location. The diving system may thus be located on and operated from a ship, barge, mobile offshore platform, fixed offshore installation or an onshore site (in the latter case e.g. for training and research purposes).

402 The RP also applies to transferable diving systems.

403 This RP is primarily written for diving systems used in the petroleum and natural gas industries. For application in other industries, special considerations may need to be agreed by the parties to the contract and or involved statutory regulators.

404 This section bears impact on all other sections.

A 500 Other codes

501 In case of conflict between requirements of this RP and a reference document, the requirements of DNV Rules should prevail in the case of inspections for DNV Classification.

502 Where reference is made to codes other than DNV documents, the valid revision should be taken as the latest revision.

503 This RP is intended to comply with the inspection requirements given in:

— IMO Code of Safety for Diving systems, 1995 Resolution A.831(19)
— IMO Guidelines and Specifications for Hyperbaric Evacuation Systems, 1991 Resolution A.692(17).

504 The requirements in this RP are based on requirements given in DNV Rules for Classification and principles outlined in DNV Offshore Standards applicable to diving systems.

Guidance note:

Additional requirements for the diving system may be applicable due to the statutory requirements given in certain geographic areas, or onboard ships flying certain flags.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

B. Normative References

B 100 Offshore Service Specifications

101 The latest revision of the following documents apply:

102 DNV-OSS-305 "Rules for Certification and Verification of Diving Systems"

103 DNV-OSS-101 “Rules for Classification of Offshore Drilling and Support Units”.

B 200 Offshore Standards

201 The latest revisions of the following documents apply:

— DNV-OS-E402 "Diving Systems".

B 300 Recommended Practices

301 The latest revisions of the following documents apply:

(Void)

B 400 Rules

401 The latest revisions of the following documents apply:

— DNV Rules for Classification of Ships (January 2007).

B 500 Certification Notes and Classification Notes

The latest revisions of the following documents apply:

(Void)

B 600 Guidelines

The latest revisions of the following documents apply:

(Void)

B 700 Other normative references

The latest revisions of the following documents apply:

(Void)

C. Informative References

C 100 General

The following references may be used as guidance for conducting surveys:

a) For DNV Offshore Standards, see references given in DNV-OS-E402 “Diving Systems”.

b) Diving Safety Memorandum issued by the Health and Safety Executive in the U.K.

c) DNV Rules for Certification of Diving Systems, 1988.

d) DNV Rules for Classification of Ships, in particular Pt.7 Ch.1 Sec.6 I - Diving Systems and Pt.6 Ch.1 Sec.4 - Diving Systems.

e) DNV Rules for Classification of Mobile Offshore Units.

f) International Marine Contractors Association, IMCA/AODC, Guidance notes, especially D 018 and D 024.

g) IMO Code of Safety for Diving Systems adopted by IMO by res. A.831(19) on 23. November 1995.

h) IMO Guidelines for Hyperbaric Evacuation (IMO Guidelines Res. A.692(17)).

i) Instructions to Classification Societies by Maritime Authorities.

j) Merchant Shipping Notices, issued by the Department of Transport in the U.K.

k) Newfoundland Offshore Area Petroleum Diving Regulations (C-7.5 – SOR/88-601).

l) NORSOK U-100 Manned underwater operations.

m) Norwegian Maritime Directorate Regulation Nr. 940 of 10 April 1984.

n) Nova Scotia Offshore Area Petroleum Diving Regulations SOR95/189.

o) Regulations Pertaining to Manned Underwater Operations in the Petroleum Activity, by NPD.

p) SI 1981:399 Diving Operations at Work Regulations, 1981 and Relevant Guidance Notes.

D. Verbal Forms and Definitions

D 100 Auxiliary verbal forms

101 *“Shall”*: Indicates requirements strictly to be followed in order to conform to this RP and from which no deviation is permitted.

NOTE:
This document is issued as a RP and may therefore be used for surveys outside the scope of DNV class. Consequently, *should* is frequently used instead of *shall*. However, in relation to mandatory inspections and testing for DNV class or Statutory requirements, *should* will in most cases be interpreted as *shall*.

102 *“Should”*: Indicates that among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required. Other possibilities may be applied subject to agreement. See **NOTE** above.

103 *“May”*: Verbal form used to indicate a course of action permissible within the limits of the RP.

104 *“Agreement”*, *“by agreement”*: Unless otherwise indicated, this means agreed in writing between manufacturer, contractor and purchaser.

D 200 Definitions

201 See DNV-OS-E402 "Diving Systems".

202 *Competent body/Competent person* is in this context defined as a company, organisation or person recognised as fit to carry out specified inspections or tests. The recognition may be by DNV or by a statutory agency.

E. Abbreviations and Symbols (Guidance)

E 100 Abbreviations

101 See DNV-OS-E402 "Diving Systems".

E 200 Symbols

201 Latin characters.

See DNV-OS-E402 “Diving Systems”.

SECTION 2
PRINCIPLES FOR SURVEYS RELATING TO DNV CERTIFICATION AND CLASSIFICATION

A. The Classification Concept

A 100 Introduction

101 This section applies to the scope of this Recommended Practice (RP) with respect to surveys in connection with DNV Certification and Classification of Diving Systems and their components as described in DNV Rules for Classification of Ships Pt.7 Ch.1 Sec.6 I. The Classification concept is given in DNV-OSS-101 "Rules for Classification of Offshore Drilling and Support Units" Ch.1 Sec.2 A and in DNV Rules for Classification of Ships Pt.6 Ch.1 Sec.4.

102 DNV Rules for Classification of Ships state in Pt.7 Ch.1 Sec.6 I100 General.

(quote)

"101 The requirements apply to ships with class notations:

— **DSV-SURFACE** or
— **DSV-BOUNCE** or
— **DSV-SAT**.

102 The requirements also apply to transferable diving systems, where the regular periodical surveys are carried out when such systems are in service. When transferable diving systems are out of commission, annual surveys as described in Pt.7 Ch.1 Sec.6 I500 are carried out.

103 Survey requirements by a recognised classification society apply to all diving systems on DNV classed vessels."
(unquote).

A 200 Basis for assignment and maintenance of class

201 In the basis for assignment and maintenance of class, a set of requirements relating to surveys of the diving system is given. This RP shall in such cases, act as requirements to such surveys against which the *survey planning document* may be verified.

A 300 Survey planning document - Tailored to each individual diving system

301 A *survey planning document* gives owners and surveyors a chance to tailor the instructions to fit each individual system or component and thereby avoid misunderstandings often encountered with respect to the application of generic requirements. This may also streamline the surveys in consideration of the operational situations in each case.

302 A *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 RP, 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 (laid-up).

303 The *Survey Planning Document* shall be written in English, or translated into English, and approved by DNV prior to the survey taking place. Checklists shall be included as attachments. It shall have the following information printed on the front page:

— "DSV survey planning document "
— name of support vessel or installation given in the classification register
— DNV Id. number given in the classification register
— IMO number (for statutory surveys)
— name of company
— revision number and date.

304 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:

— name of support vessel or installation given in the classification register
— DNV Id. number given in the classification register (for units in class with DNV)
— IMO number (for statutory surveys)
— page number
— name of company
— scope of survey (annual, intermediate, renewal or otherwise)
— in columns: survey item, condition, action, comment
— place, date, surveyor, signature, and stamp.

B. Documentation

B 100 General

101 Rules and documentation should be available, including:

— emergency procedures for each work site to cover all foreseeable situations
— diving operations log
— valve shut-off checklists
— operational procedures
— emergency procedures
— dive log, duly signed off
— data sheet for diving system form 20.201a
— layout drawing for diving system
— P.M.S. records.

B 200 Documentation in dive control

201 Also a diagram of the thruster configuration should be provided showing the bell and thrusters locations at 10m depth intervals, with relative distances marked between the two. The diagram can be referenced to indicate umbilical lengths used relative to working depth.

202 A copy of relevant parts of the emergency procedures (preferably plasticized/sealed) should be kept in the bell for diver guidance. A duplicate copy should be kept in dive control.

C. Positioning Systems

C 100 Dynamic positioning

101 DP surveys are normally carried out on a two (2) yearly basis and should accompany the DSV survey when this is appropriate. However, when diving from a vessel on DP, a confirmation that the DP system is functioning satisfactorily should be carried out during the DSV survey on an annual basis.

102 The diver access to the water should be in an area that is a suitable distance away from any thruster or other object

likely to cause problems.

C 200 Mooring systems

201 When diving from a vessel on mooring systems, a **POS-MOOR** survey should accompany the DSV survey.

D. Stability and Floatability

D 100 SF class notation

101 Diving support vessels should be verified to comply with the **SF** class notation prior to starting diving operations.

SECTION 3
SEMI-ANNUAL (6 MONTHS) SURVEY OF SYSTEMS IN OPERATION

A. General (sA)

A 100 General

101 Semi-annual surveys should be carried out by the owners and reported to the Planned Maintenance System (PMS). The planned maintenance system shall include a list of the systems and components that are included in the diving system being examined, and should conform with requirements in DNV Rules for Classification of Ships, Pt.7 Ch.1 Sec.8 C.

A 200 Cleanliness of the system

201 Cleanliness should be ensured at all times and should be verified and reported semi-annually. An internal and external visual survey is required to assure cleanliness of the system. Particular attention should be paid to contamination by hydrocarbons such as grease, (other than silicone grease) oil, hydraulic oil etc. This is especially important in the oxygen compressor room and oxygen distribution room, but is also important in gas storage rooms and divers living areas.

A 300 Permanent marking of equipment

301 Examine permanent marking of equipment, electrical cables, strips, valves and of fittings in control rooms, chambers, and bells and on launch and recovery system. The marked equipment should be traceable through the PMS. Certain essential markings should be fluorescent in case of a blackout situation. See DNV-OS-E402 Sec.2 K or Rules for Certification of Diving Systems, 1988. Sec.1 E.

302 Gas containers should be legibly marked, including standard colour coding, with the name and the chemical formula of its contents. Gas piping is to be permanently marked with its content.

303 Examine the various safety notices that are posted.

304 The AODC (IMCA) emergency bell tapping code defining communications between divers in an enclosed bell and rescue divers should be kept in the bell and HEU.

B. Pressure Containing Equipment (sA)

B 100 Pressure vessels for human occupancy (chambers/ bells) (sA)

101 Pressure vessels for human occupancy should be visually examined externally for signs of damage or corrosion.

B 200 Gas storage (seamless gas cylinders – welded pressure vessels) (sA)

201 Cylinders should be visually examined externally for signs of damage or corrosion.

B 300 Pressure vessels in supply and return lines (sA)

301 Other pressure vessels should be visually examined externally for signs of damage or corrosion.

B 400 Pumps and compressors (sA)

401 Pumps and compressors should be visually examined whilst running to ensure that there are no signs of leakage or excessive vibration. Further inspections should be carried out according to the manufacturer's manual.

B 500 Piping/ hoses/ valves/ fittings /filters/ driers/ umbilicals (sA)

501 Piping systems, including hoses and components, should be visually examined externally for damage, corrosion or leakage.

C. Environment and Breathing Gas Controls (Supply and Return) (sA)

C 100 Gas supply control (sA)

101 Controls and instrumentation for gas supply should be examined for trouble free operation. Examination of PMS and operational reports may be necessary.

C 200 Depth/pressure control (sA)

201 Calibration of essential gauges and clocks should be carried out on a 6 monthly basis by a competent person and verified by marking on the gauge. Inspect the gauges and indicators critical for the life support system. Ensure oxygen gauges are of a correct type. (For definition of "Competent person" reference may be given to IMCA D 024 February 2001, Sec.2. For inspection of gauges reference to IMCA D018 sheet 20 may be appropriate.)

202 Date of calibration should be recorded in on the gauges and in a register.

A register of gauges and clocks should be maintained.

C 300 Temperature and humidity control (body and breathing) (sA)

301 Visual examination should be carried out to ensure that the temperature and humidity control systems are functioning correctly. Manufacturer's instructions should be followed.

C 400 O2/ CO2 / contamination analysis (sA)

401 Visual examination should be carried out to ensure that the oxygen, carbon dioxide and contamination control systems are functioning correctly. Manufacturer's instructions should be followed.

C 500 Sanitary (sA)

501 Visually examine the sanitary systems to ensure that there is no leakage and that the safety systems are functioning correctly. Look for signs of damage and corrosion.

C 600 Auxiliary services to life support equipment (electrical/ hydraulic/pneumatic) (sA)

601 Visually examine the power systems supplying the life support systems to ensure that the consumers are supplied and not causing peak loads.

602 Visually examine Auxiliary services to support equipment according to a written list included in the planned maintenance system.

D. Communication (sA)

D 100 Primary (sA)

101 Ensure that the primary communication systems are functioning by testing them. Tests should be carried out according to a written procedure.

D 200 Secondary (sA)

201 Ensure that the secondary communication systems are functioning by testing them. Tests should be carried out

according to a written procedure.

D 300 Emergency (sA)

301 Ensure that the emergency communication systems are functioning by testing them. Tests should be carried out according to a written procedure.

D 400 Alarms

401 Ensure that the alarms are functioning by testing them. Tests should be carried out according to a written procedure.

E. Launch and Recovery System (sA)

E 100 Submergence launch and recovery (primary/ secondary/ emergency) (sA)

101 Visually examine submergence launch and recovery systems for functionality.

E 200 Surface and interface launch and recovery (primary/ secondary/ emergency) (sA)

201 Visually examine submergence launch and recovery systems for functionality.

E 300 Control functions (electrical/ pressure) (sA)

301 Visually examine submergence launch and recovery systems for functionality.

E 400 Auxiliary services to launch and recovery system (umbilical handling/ blocks and tackles/ power supplies – electrical/ hydraulic/pneumatic) (sA)

401 Visually examine the power systems supplying the lifting appliances to ensure that the consumers are supplied and not causing peak loads.

402 Visually examine for possible damage and corrosion.

F. Safety Equipment (sA)

F 100 Fire safety (sA)

101 Visually examine fire doors, alarms, fixed fire fighting systems and portable fire extinguishers.

F 200 Hyperbaric evacuation systems (sA)

201 Visually examine the evacuation system to ensure that there is no damage to the system.

F 300 Personal protective equipment (including personal diving equipment) (sA)

301 Visually examine portable breathing apparatus, fireman's outfit (if fitted) and personal diving equipment.

Follow manufacturer's instructions.

SECTION 4
ANNUAL SURVEY OF SYSTEMS IN OPERATION (A)

A. General (A)

A 100 General

101 The scope for the semi annual survey is included in the following scope for the annual survey.

A 200 Diving system operational status

201 Record the date when the diving system was last used and the extent of use since the last survey.

202 Examine for, and record, any alterations that have been made since the last periodic survey.

A 300 Operations manuals

301 Review the Certification manuals and examine any alterations that may have been carried out.
Examine the Data Sheet, Form 20.201a and alter if necessary. It is the owner's responsibility to ensure that the Data Sheet is updated prior to the periodical surveys. The class surveyor will endorse the Data sheet along with the owner to confirm the scope of the certification.

B. Pressure Containing Equipment (A)

B 100 Pressure vessels for human occupancy (chambers/ bells) (A)

101 Examine the attachments, framework and supporting steelwork for chambers and system. Ensure that bolts are secure and that steelwork supporting launch and recovery frame is in good order. Tap gently the bolts on critical structures.

Certain attachments if moved or newly installed may require sea fastening calculations and a load test with NDE carried out. See DNV-OS-E402 Sec.2 E400, 500 and 600 or DNV Rules for Certification of Diving Systems, 1988 Sec.2 A200.

102 Examine to see that bunks are firmly supported.

103 Verify that identification plates are fitted to the welded pressure vessels requiring certification.

104 Examine if paintwork is clean, in good condition, and free from corrosion. Insulation should be clean, substantially free of damage and free from signs of corrosion underneath.

105 The windows should satisfy the requirements as laid down in DNV-OS-E402 Sec.3 F (or DNV Rules for Certification of Diving Systems, 1988, Sec.3 F) and latest ASME/ANSI PVHO-1/PVHO-2. This is in regard to size, sealing arrangement and design.

106 Window and light port integrity is of utmost importance in diving systems, and they need to be examined closely. Windows should have a protective shield, clear plastic is suitable on the internally and externally.

107 List the windows with date of manufacture. Certification shall be examined. Windows exceeding 10 years of age should normally be replaced.
Windows should be clear, without discolouring (e.g. yellowing due to acid formation), crazing, cracks or scratches. (Ref. ASME-PVHO-2). Provided the window thickness is sufficient according to the Rules, areas with scratches may be ground and polished before annealing and reinstallation. Maximum allowable depth of scratches on low pressure side: 0.3 mm and on high pressure side: 0.8 mm. See DNV-OS-E402 Sec.3 F or DNV Rules for Certification of Diving Systems, 1988, Sec.3 F and ASME/ANSI PVHO-1 and PVHO-2.

Guidance note:

The above requirements originate from ASME PVHO-1, Article 5 in particular 2-5.5 and 2-7.7.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

108 The windows on the upper half of the bell should be protected against falling objects, as should the bottom, windows internally.

109 If damage control plugs are provided to enable divers to quickly seal off windows in the event of serious leakage, one plug for each size of window is sufficient and should be examined for intact seals.

110 Examine the hatch and medical lock sealing surfaces and o-rings. Particular attention should be paid to the Bell/TUP connecting flanges, the medical locks and equipment locks, and the bell bottom door flanges. Examine sealing surfaces, o-rings and hinges on the chambers.

111 Safety locking mechanisms shall be present on all hatches to prevent opening under pressure and these shall be function tested with the relevant chamber under pressure. Particular attention should be paid to medical / equipment locks with nut and bolt type doors. The locking mechanisms for these doors shall comply with the requirements given in the rules, both for preventing opening under pressure and preventing pressurisation when the locking arrangements are not in place. Ref. DNV-OS-E402 Sec.3 B300 or Rules for certification of Diving Systems, 1988 Sec.3 B. "Design of Chambers and Bells".

112 Ensure that doors that can be opened from both sides, can be secured "open" and have equalising valve where appropriate. Chamber doors should be numbered.

113 Locking mechanisms should be fitted where appropriate. i.e. on food lock and equipment lock.

114 Examine the safety locking mechanism fitted between the bell and the transfer chamber preventing the mating clamp of the transfer chamber from being opened while there is pressure in the transfer trunk. Verify compliance with the requirements as given in DNV-OS-E402 "Offshore Standard for Diving Systems" Sec.9 A1800.

115 Examine the structural integrity and corrosion status of chambers and bell with internal and external survey as applicable. Pay attention to bilges, equipment locks battery packs, maintenance, possible damage and serious corrosion. Examine with NDE if necessary. Examine chamber shell under deck plates for corrosion. Ultrasonic thickness tests if necessary.

116 The bilges in the bells should be inspected including the lower section of the bell where the floor plating is in contact with the shell. Attachments to the bell(s), e.g. battery pack, gas containers, buoyancy blocks, should be examined.

117 Examine the shell penetrations, especially the hot water penetrations on the bell where severe corrosion is frequently found. This is especially found in un-sleeved penetrators. Oxygen and bilge penetrations in the chambers should also be inspected. Penetrators should be withdrawn if necessary. Threads should be examined. Examine areas around penetrators with regard to corrosion.

Examine the bilge drains, supply and exhaust valves in bell(s) and chambers. Attention should be paid to the entry / equipment locks where there is a high level of moisture. At the discretion of the surveyor, penetrators should be withdrawn, if necessary. A thread gauge should be used to examine the threads.

118 Ensure that the hollow penetrations are fitted with protection valves or other device to prevent catastrophic loss of pressure. Valves should be free of corrosion, should move freely through their full range of operations, and be clearly marked. The electrical penetrations should be certified and suitable for use on a pressure chamber.
Open ended exhaust pipe work should be fitted with guards to protect fingers and avoid blockage. Open ended inlet pipe work should be fitted with some form of diffuser.

119 The penetrations should be clearly marked to show their function.

120 A partial-flooding system should be fitted to allow the bell to be flooded to a pre-set level, which will assist the stand-by diver in re-entering the bell and recovering an unconscious diver. Make sure this is not clogged, fitted with a guard and that it is located bellow electrical equipment.

121 Ensure that the bell and chambers are fitted with an over pressure relief valve or alarm. See DNV-OS-E402 Sec.4 B200 or DNV Rules for Certification of Diving Systems (1988) Sec.4 D200. Verify calibration.

122 Ensure that the following connections are provided for on the bell and HES:

— ¾" NPT (female) for hot water, and
— ½" NPT (female) for breathing mixture.

Quick connectors for these may be required to satisfy Norwegian regulations.

123 Shut-off valves should be inspected on chambers and bells to comply with DNV-OS-E402 Sec.4 B200 or DNV Rules for Certification of Diving Systems, 1988, Sec.4 D301.

Flow fuses should be tested by simulating that piping is suddenly opened to the atmosphere.

Guidance note:

Flow fuses can be tested by doing the following: Pressurise chamber to ~20 m. (this can vary depending on specification of fuse). The ECU inlet and outlet valves should be shut. The ECU piping should be open to the environment.

Open each valve (inlet/outlet) in turn quickly and a short blast of gas should come out, but shut off immediately confirming the flow fuse works correctly.

The valve can be shut and the flow fuse can be heard opening again.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

124 Verify that supply valves have silencers fitted. Examine outlet valves to ensure that they have protection to prevent possible suction. Ensure that bilge drain valves are spring loaded to shut.

125 Ensure that there are sufficient BIBS connections and masks for the designated number of occupants, plus one spare, in each chamber. BIBS exhaust gases should be dumped outside the chamber.
Functions test the BIBS in chambers, bells and HES. Function test distribution panels. Applicable breathing gas should be available in HP storage for this. See DNV-OS-E402 Sec.4 B or Diving Rules, Sec.4 B. Therapeutic gas supplies should be available to BIBS.

126 A method should be available whereby the stand-by diver can recover an unconscious diver into the bell single-handed. This will normally consist of a self-locking hoist, used in conjunction with a pelvic lift type body harness worn by the diver. The diver can be lifted sufficiently for the bell doors to be closed. Make sure this is not tangled or frayed, and that it runs smoothly.

127 Verify that there are means available of securing each diver in the bell during descent and ascent in order to minimise the possibility of injury. There should be one seat fitted with a restraining harness provided in the bell for the stand-by diver.

128 For the medical lock fitted on the bell, locking mechanisms and gauge should be tested. If external anodes are fitted, examine their general condition.

B 200 Gas storage (seamless gas cylinders – welded pressure vessels) (A)

201 Verify that cylinders are colour coded and marked with the name and chemical symbol of the gases they contain in accordance with AODC 016 Rev.1 (Ref. A3).

202 Verify that cylinders have been examined, tested and marked according to requirements in the design code to which they were originally manufactured and certified. Ensure that gas containers are within their respective test dates. The last test date stamp on the cylinders should be painted over with a small patch of distinctive colour, to facilitate location.

203 Verify that hazard warning signs are provided.

204 Examine the attachments and the framework. Inspect supporting steelwork for racks including the bolts.

205 Examine the structural integrity and corrosion status of gas containers. Examine externally and pay attention to maintenance, possible damage and serious corrosion. Examine by NDE if necessary.

206 Verify that where bulk gas is stored in an enclosed compartment an O_2 hi/low alarms are fitted external to the door with a sensor located inside with either the alarm repeated in life support control, or audible from the point of access into the gas storage compartment.

B 300 Pressure vessels in supply and return lines (A)

301 Verify that pressure vessels are coded and marked with the name and chemical symbol of the gases they contain in accordance with AODC 016 Rev 1 (Ref. A3).

302 Verify that pressure vessels have been examined and tested. Ensure that the pressure vessels are within their respective test dates. The last test date stamp on the pressure vessel should be painted over with a small patch of distinctive colour, to facilitate location. (Ref. DNV-OS-E402 Sec.3 C)

303 Verify that hazard warning signs are provided.

304 Examine the attachments and the framework. Inspect supporting steelwork, including the bolts.

305 Examine the structural integrity and corrosion status of pressure vessels. Examine externally and pay attention to maintenance, possible damage and serious corrosion. Examine by NDE if necessary.

B 400 Pumps and compressors (A)

401 Examine the attachments and the framework. Inspect supporting steelwork for machinery with bolts.

402 Verify that the compressors are fitted with solenoid switches, which will automatically stop the compressor if it begins to overheat.

403 Except where oxygen-compatible oil is used, diaphragm type compressors should be fitted with cracked plate detectors, which will automatically stop the compressor in the event of diaphragm failure.

404 Verify that where appropriate, there are warning signs on each compressor stating that it may be started up automatically and that care should be taken.

405 Verify that there are audio/visual indications in dive control to warn of gas reclaim compressor malfunction.

406 Verify that the equipment is maintained in accordance with the manufacturer's instructions. Particular attention should be paid to the regular changing of filters. Maintenance records should be kept in the PMS.

407 Breathing air and gas delivered by compressors should be examined for signs of contamination. A competent com-

pany should carry this out. Acceptance criteria for contaminant limits are given in DNV-OS-E402 Sec.8 E100 or Diving Rules, Sec.8 E100.

B 500 Piping/ hoses/ valves/ fittings /filters/ driers/ umbilicals (A)

501 Examine the cleanliness of the system by visual examination as required. Pay attention to contamination by hydrocarbons like grease, oil, hydraulic fluids.

502 Examine that the gas pipe work, particularly at connections and in distribution control panels, is readily accessible for maintenance and repair of leaks. Proof should be available of examination and test.

503 Examine that O2 make up discharge point are provided, and that they are led to a location where hazard is not created.

504 Ensure that external ECU gas flow-lines are fitted with a flow fuse and non-return valve

505 Examine the leads of the umbilical and connecting tails to ensure they are arranged so as to avoid chafing and kinking.

C. Environment and Breathing Gas Controls (Supply and Return) (A)

C 100 Gas supply control (A)

101 Examine the cleanliness of system by visual survey as required. Pay attention to contamination by hydrocarbons like grease, oil, hydraulic fluids.

102 Verify that the bulk storage of oxygen is in the open and well clear of fire hazard areas. Hazard warning signs should be displayed. Oxygen systems are pure oxygen or gas mixes with an oxygen content of 25% or more.

C 200 Gas distribution system (A)

201 Examine the connections of the piping system to the surrounding structure. The system should be clean. Permanent marking of equipment is very important. See DNV-OS-E402 Sec.2 K or Rules for Certification of Diving Systems, 1988, Sec.1 E101.

202 Function tests the life support systems including the following:

— heating and cooling arrangements
— compressors; boosters
— panels and piping systems, inclusive of flexible hoses for gas management
— regeneration units
— in addition to the tests carried out during the semi annual survey
— depth/pressure control.

203 Examine with respect to modifications to approved system and arrangement for preventing damage of unattached flexible hoses. Pay attention to the O2 system valves.

204 Examine the oxygen make-up system. Visually examine and function test the system. Cleanliness of the system is vital. Oxygen should normally be regulated at the storage quad down to 40 bars, with the exception of the on-board charging connection to the bell. Oxygen and O2 mixtures should not be pumped unless the system is so designed.

205 Verify that oxygen lines are fitted with needle valves. The high pressure oxygen control system should not be fitted with quarter turn valves except where permitted in DNV-OS-E402 Sec.8 C104 or Diving Rules, Sec.8 C104. Pipe work should be examined to ensure segregation of the gas reclaim and the O2 System from the remaining system.

206 Verify that where O2 levels are controlled manually there is a flow indicator situated in life support control, on the downstream side of the chamber O2 make-up line, to indicate when O2 is flowing into the chamber. Where automatic O2 injection systems are used there should be a control mechanism in place to ensure that the system cannot fail in the "on" position. The indicators should be function tested.

207 Ensure that the oxygen make-up systems are arranged so that the oxygen is dispersed around the chamber. Where scrubber or internal environmental control units are used to disperse oxygen, the oxygen pipe outlet should be placed at the outlet point of the unit. The oxygen make-up system should not be capable of significantly exceeding the rate of metabolic consumption of the divers. Oxygen injection orifices should be fitted with a means, which will close in the event of a power failure and prevent potential harmful or explosive build up of oxygen levels within the reclamation unit.

208 Examine if pressure is regulated at the storage quad down to a maximum of 50 bar (750 psi) for breathing gas supplies, or 60 bar (900 psi) for supplies to gas blenders.

209 Verify that pipe work is hard plumbed wherever possible. Flexible hoses (oxygen compatible where required) should be kept to an absolute minimum. Visually inspect the piping to the chambers.

210 Examine gas regeneration units and ECUs. Function test O2 solenoids if possible. Examine piping and valves.

211 Examine if the Gas Reclaim panel is mounted within easy reach of the diving supervisor where the gauges can be clearly seen. An audio/visual alarm should be incorporated into the topside control panel to warn of reclaim compressor malfunction. The alarms shall be tested.

212 Examine if a means of monitoring the gas bag is available. This may be by means of an audio/visual over inflation alarm fitted to the gas bag. This alarm should operate in the gas bag area, the compressor room, dive control and chamber control.

213 Verify that the gas bags are fitted with a relief valve or bursting disc, with overboard dump, to prevent rupture of the bags. Where system discharge exceeds gas bag capacity, such as in the case of exceptionally deep dives, suitable precautions should be in place. This may take the form of a solenoid-operated three-way valve which will discharge exhaust gases directly over the side instead of to the chamber gas reclaim system.

214 Verify that there is sufficient room to allow for full expansion of the gas bag.

215 Examine if there is a management system to monitor bacterial growth in the bag.

216 Verify that reclaimed chamber gases is analysed for oxygen and carbon dioxide content prior to their re-use.

217 Verify that indicator lights showing compressor cycling function, are installed in dive control room and chamber control room.

218 Examine the arrangements made for preventing damage caused by discharging unattached flexible hoses.

Hoses should be as short as possible. They should be tested by the diving team and registered in the certification manual for the system.

219 Test manual and automatic control valves and reduction valves by varying the set point of the control parameters, to ensure correct pressure/power delivery.

220 Verify that the gas reclaim water trap (where applicable) is readily accessible by the bell-man.

221 Ensure that each diver's gas supply line is arranged so that if one line fails the failure does not interfere with another diver's supply.

222 Examine the gas supplies to see they are so arranged that

when blowing down or flushing the bell there is no interference with the diver's gas supply.

223 Determine that the oxygen supply is fitted with a means whereby oxygen at a reduced pressure flows into the bell at a controlled rate or volume. HP oxygen should not be supplied into the bell.

224 Verify that there is a means available, permitting the gas cylinder pressure to be read from both inside and outside the bell.

225 Examine the oral-nasal or full face BIBS mask for each diver carried in the bell and see that they are capable of drawing gas from either the surface or the onboard mixed gas cylinders.

C 300 Depth/pressure control (A)

301 Verify that calibration of the depth and life support gauges has been carried out by a qualified competent person on a 6 monthly basis and that calibration equipment is traceable to a national standard. Tolerances are given in DNV-OS-E402 Sec.5 E or Diving Rules, Sec.4 F. Remember the gauges being stored for reserve/replacements. Diver worn depth gauges, providing only an indication of depth for the divers benefit, do not require calibration.

302 Verify that pressure-limiting devices are installed to prevent gauges, such as therapeutic depth gauges, being exposed to pressure beyond their range.

303 Verify that gas supply pressure gauges are positioned to indicate actual line pressure upstream of any crossover valves. This is in order to overcome possible equalisation of panel gauges by certain crossover valve configurations.

304 Examine life support gauges which read pressure critical to the life support function, including bell/bailout charging panel gauge and the last gauge monitoring pressure to the divers breathing apparatus, including BIBS.

305 Verify that gauges for recording pressure over 40 bar are fitted with a safety relief device or suitably protected.

306 Verify that gauges used on oxygen lines are compatible with such application. See DNV-OS-E402 Sec.4 or Diving Rules, Sec.4 and industry guidance.

307 Verify that on-line circuits are clearly identified. There should be one dedicated gauge per compartment. If additional gauges are connected to the circuit the crossover valves should be clearly identified. Determine if care is exercised in operation of a system, which at times may employ a single reference gauge, monitoring more than one compartment.

308 Verify that internal indicating gauges are fitted in each compartment and bell, and that they are calibrated. External gauges should be fitted as appropriate and also show proof of calibration.

C 400 Temperature and humidity control (body and breathing) (A)

401 Function test heaters in chambers, bells and hyperbaric evacuation systems (HES). The system should be function tested in normal and back-up modes. Some systems have a hot water buffer tank and a separate pump as a back-up to the machines and this should be tested. The machines should have adequate flow rates; typically ~
30 l/minute per diver is required. If a calorifier is fitted this should be surveyed as a pressure vessel and any electrical systems inspected.

402 Heating for the chambers is often controlled by the Environmental Conditioning Units (ECU's), so these should be run up. The temperatures should be set and monitored from saturation control and the controls should be visually inspected. Back-up heaters should also be tested in every chamber.

403 Examine the hot water piping and delivery to the bell(s).

404 Examine to see if hot water machines have a statement of conformity with given specifications issued by the manufacturer when the machine is new. Older machines, which are not accompanied by such a statement, should be demonstrated to function to the given specification.

405 Examine how power will be supplied to the heating/cooling system to maintain operations for the period of diver's recovery if the support vessel loses its main power supplies.

406 Ensure that a display indicating the temperature of hot water being passed down to the divers is available to the diving supervisor at the dive control point. The display should be fitted with audio/visual alarms, which will indicate when the temperature has moved outside pre-set high and low limit. Alarms for high and low temperature and low pressure should be tested.

407 Ensure that for diesel fired heaters it is not possible to overflow the diesel day tank, i.e. a high level shut-off, return pipe or alarm should be fitted. The fuel supply system to the ready use fuel tank on oil fired HW machines should be fitted with an automatic shut off facility that will operate when the ready use tank is full, or a dead-man's handle. Where possible the fuel supply should be hard plumbed.

408 Verify that, where applicable, oil fired hot water machines are so placed as to minimise risk to the diving system should they malfunction and catch fire. They should be mounted in a suitable spill tray, and the spill tray should be fitted with a drain leading to a safe dump area i.e. where there is no danger of ignition or pollution of other supplies/services. The flow rate capacity of the overflow system should exceed the flow rate capacity of fuel supply system.

409 Functions test the cooling systems for the divers where these are fitted in warm climates.

410 Instrumentation should be examined and evidence of valid calibration should be verified.

C 500 O_2/ CO_2 / contamination analysis (A)

501 Function test environmental control units and gas regeneration units. The solenoids for oxygen injection on the ECUs should be tested within their set points. A form of safety lock (interlock) shall be present on the ECU scrubber canister to ensure it is not opened up under pressure.

502 Verify that the atmosphere in the chambers are monitored for levels of O_2, CO_2, temperature and relative humidity, with both primary and secondary methods being provided to monitor O_2 and CO_2. There should be means by which the diving supervisor can monitor the bell atmosphere for O_2 and CO_2 levels independently.

503 Verify that there is an oxygen analyser fitted with audio/visual hi/low alarm on the downstream gas supply to the divers. Where a diver gas reclaim system is used, a CO_2 analyser with audio/visual hi/low alarm should be installed into the down-stream diver gas supply. The adjustment of gas sample flow rate should not affect the correct functioning of any other analyser fitted at the same point.

504 Verify that gas analysers are calibrated.

505 Verify that oxygen analysers with audio-visual high/low alarm are provided in enclosed diving control rooms to warn of changes in the atmosphere O_2 levels caused by leakage in the diving gas supply systems.

506 Determine the means by which divers in the bell can monitor O_2 and CO_2 levels independently of the surface.

Proof should be available that analysers in the bell have been examined and tested.

507 Examine the primary powered scrubber unit removing CO_2 from the bell atmosphere.

508 Examine the secondary means of CO_2 scrubbing in the

bell that is independent of any surface power supply and determine if it has a minimum endurance of 24 hours.

C 600 Sanitary (A)

601 Examine the toilet flush system and function test it with special attention to safe working under pressure. Verify that the safety locking mechanisms is still in operation. It is sometimes removed for convenience. The locking mechanism is to ensure that it is not possible to sit on the toilet and flush it at the same time. This is often done by means of a linkage between the seat cover and a 1/2 turn valve.

Note also that the hyperbaric evacuation unit (HEU) may have a toilet. Ref. DNV Rules for certification of Diving Systems (1988) Sec.4 I 'Diving Crew Facilities'.

602 The sewage tanks shall be internally inspected.

603 Function test the bilge drains in chambers giving special attention to the chamber shell under the deck plates; this is to ensure that no accumulation of water or corrosion is evident. Water often lies around the split lock bulkhead (dished end of the inner chamber). Ultrasonic thickness measurements should be carried out at the discretion of the surveyor.

604 Examine hot and cold water supplies to chambers. Hot and cold water systems should be run up.

C 700 Auxiliary services to life support equipment (electrical/hydraulic/pneumatic) (A)

701 Power supplies to the life support system may be:

— electric powered
— hydraulic powered
— pneumatic powered.

702 Examine/test main and emergency power supplies for the following:

— lighting of chambers and bell (external on bell in addition)
— monitoring devices
— control consoles - saturation/dive and local control stands i.e. medical-locks and handling area
— normal and emergency life support systems
— alarm systems including fire loops
— condition of the switchboards, breakers and cables including cleanliness
— megger test records
— dynamic positioning alarm.

703 Ensure that the required level of lighting is available around the diving system, and any other working areas, is sufficient to allow personnel to safely and efficiently carry out their duties. There should be self-contained emergency lighting provided in dive and saturation control rooms.

704 Test that the change over from main to emergency supplies operates correctly. See DNV-OS-E402 Sec.5 B202 or Diving Rules, Appendix 3 and Sec.5.

705 Verify that electrical hazard warning signs are affixed to relevant panels.

706 Determine if the bell electrical supply is fitted with an earth leakage detection system and alarms.

707 Verify that emergency supplies are available to maintain essential supplies to divers, including:

— lights
— power packs
— scrubbers
— monitors
— analysers
— heating systems
— communications.

708 Verify that bell is illuminated 360 degrees to assist diver location/orientation. The lights should be hard wired in parallel so as to avoid single point failure.

709 Verify that the battery terminals/leads on external bell battery packs are insulated to protect them against short circuits.

710 Verify that the battery housing on the bell has a relief valve.

711 Test the earth monitoring systems, if applicable. See the Diving Rules, Sec.5 A and Appendix 3.

712 Examine/test the following:

— main electrical power supplies
— lighting of chambers and bell (int. and ext.)
— monitoring devices
— control consoles (sat, dive, handling)
— normal and emergency life support systems
— alarm systems
— switchboards, breakers, cables
— megger test records.

713 Examine if lighting is adequate, and positioned so as to clearly illuminate the gas control panel and depth gauges. Secondary lighting should be provided. There should be lighting adequate for illuminating the chambers for surveillance purposes, and for divers' convenience. Examine external lights/assemblies on the chambers to ensure no damage to either the light assembly or the windows has occurred.

714 Test the correct operation of change over from main to emergency supplies. Verify and ensure maintenance and tests are being carried out regularly.

D. Communication (A)

D 100 General

101 Test the primary and secondary links with the vessel's Command Centre and the dive control stations, including when the vessel is operating on D.P. (DP alarms red, yellow and green). The primary links should be dedicated and hard wired.

102 For R.O.V. monitoring AODC 032 Rev 1 may be applied. Where an R.O.V. is being used in conjunction with diving operations a monitor should be provided in Dive Control and dedicated hard wired communications installed between the diving supervisor and R.O.V. supervisor/pilot. If this is the case, the system should be tested.

D 200 Primary (A)

201 Examine the communication systems between the control stand and the:

— divers in the water
— bell
— compartments
— bridge
— Various control stands.

202 Test the two-way communications between the:

— control station and the chambers/bells
— saturation control room and the dive control room
— saturation control room and the food locks (medical locks)
— saturation control room and the HES lock-off position.

Testing should include sound powered phones, headsets and other systems. Diver's mask communications should be tested in the bell(s).

203 Determine if the supervisor has two-way voice communications with the divers, and the stand by diver. Play the tape recorder that is provided to record the communications includ-

ing through water communications, examining the playback facility and spare tapes.

204 Verify that the diving stations, machinery areas and the diving supervisor have means of:

— communicating with the key diving machinery areas and the winch/crane operator (where practicable this should be hard wired with dedicated link to the winch driver)
— surveillance of working areas as appropriate
— diving station, winch/crane operator
— dedicated link to winch driver
— C.C.T.V. where necessary.

205 Examine if provision are made for the divers inside the chambers to be within sight of life support personnel outside. Where there is no clear access to the ports, or life support control is remote from the bell, a closed circuit TV system should be fitted.

D 300 Secondary (A)

301 Examine the secondary communication between control stand and the:

— divers in water
— bell
— compartment
— bridge
— various other control stands.

302 Test the sound powered telephone providing the supervisor secondary communications to the diving bell.

D 400 Emergency (A)

401 Examine and test the emergency communications including direct voice communication between the control stand, and the:

— bell
— compartment
— control stands as applicable
— the bridge (operational command centre).

The test should include use of the sound powered phone, headsets and other back up systems.

402 Examine if the bell through-water communications has available connections into the tape recorder.
(A procedure for testing on the surface and prior to each bell run is given in AODC 019 (Rev 1)).

403 Examine if the surface transducer can be arranged so that interference by noise from the vessel's machinery or thrusters is minimised. This may involve deployment below the lowest point of the vessel.

404 Test the communications in the breathing apparatus sets provided for the moon-pool team, with communication facility to the dive control.

405 Test the bell emergency locating device for the bell. Determine if it has an operating frequency of 37.5 kHz. The validity date of the batteries on the transponder and strobe on the bell should be examined. See DNV-OS-E402 Sec.5 D305 or Diving Rules, Sec.4 G. A transponder should be fitted to the bell to aid relocation should it become separated from the support vessel. Transponder fitted, 37.5 KHz rated to 200 meters should be tested. A means of testing and interrogating the transponder should be readily available.

406 Test the strobe light on the bell, and determine if it has a minimum of 24 hours duration to aid visual relocation.

407 Verify the presence of a standard bell emergency communication tapping code. A copy of the AODC emergency tapping code should be placed on the bell external where a rescue diver can easily read it.

D 500 Alarms

501 Verify that alarms are listed as part of the planned maintenance system and that the alarms are examined at least every 6 months or more often, when applicable. An audio/visual alarm, which is activated by the D.P. Operator, should be fitted at each diving control point to alert the Diving Supervisor of the D.P. status. It should be tested before the start of each dive when operating on D.P.

502 Examine if the vessel or installation general alarm system is linked into the dive control room, or sited close by so that it can be heard and seen (where appropriate) at the dive control point. The audio component should not be so loud that it prevents the life support technicians from communicating with the divers.

503 Examine if oxygen analysers with audio/visual hi/low alarms are provided in enclosed diving control rooms to warn of changes in the atmospheric O_2 level caused by leakage in the diving gas supply systems. A repeater of the gas storage compartment O_2 high/ low alarm should be located either in saturation control, or external to the compartment.

E. Launch and Recovery System (A)

E 100 General

101 Launch and recovery systems are often exposed to harsh environments, but should be well maintained.

102 Examine the bell main lifting arrangements closely, with particular attention given to the load bearing components. NDE should be performed at the surveyor's discretion.

103 Determine the working weight of the bell(s) and enter the weight(s) into the records. The current result should be compared with the previous result. Ensure a calibrated load cell is used.

104 Perform a dynamic load test of the launch and recovery system. Test Load factors are 1.25 x working weight of bell with independent brake test:

a) The bell should be loaded with 150 kg per diver plus the weight of his excluding equipment and tools, times the number of divers the bell is rated for.
b) The function test should be demonstrated by raising and lowering the bell on primary and secondary means. Normal and emergency electrical power should be tested. The bell should stop gently without excessive creep.
c) Independent brakes should be demonstrated by locking off one of the brakes, i.e. locking off the band brake (if applicable) and examining for creep on the counter balance valve and vice versa. Creep should not be excessive.
d) The hydraulic power system should be observed during running and examined for unusually high vibration levels, oil leakage, pressure peaks and jerking during bell launch and recovery. Oil analysis should be taken as necessary.
e) Ensure that winch-operating levers returns to a central neutral position upon being released by the operator and that the "raise" “lower” and “neutral” position of the operating levers are clearly marked.
f) Ensure that the automatic brakes come into operation whenever the operating lever returns to the neutral position, or when there is a loss of operating power to the winches. Verify also that the secondary brakes operate in case of failure of the primary brakes.
g) The required load may be achieved by using water bags, if there is space. Solid weights may also be used, or the load may be increased by partially filling the bell with fresh water through the hot water hoses. If the internal equipment is shielded, water contamination should not be a problem.

On completion of testing, the water may be drained using the bell bilge drain, while increasing the internal pressure. If no bilge drain is available, a hose should be connected to the bell main exhaust before the water filling commences.

h) The alignment between the bell and the chamber trunk should be verified. The bell should be mated to the chamber trunk and the closing devices function tested. *Ensure the locking mechanisms function and that it is not possible to move the launch and recovery system when the bell is mated to the chambers. See DNV-OS-E402 Sec.3 B304/ 305 and Sec.7 B109 or Rules for Certification of Diving Systems, 1988 Sec.3 B303/304 and Sec.7 B109.*

i) Verify that alarms and safety functions are in order.

105 Verify that the man-riding winch systems used for bell/ basket deployment incorporate secondary motors and sources of operating power. If clutches are fitted to the winch drive shafts, they should be prevented from becoming disengaged while the winches are in operation.

106 Perform a simulated power failure test of the launch and recovery system according to the procedure for emergency retrieval of the bell, as given in Form 20.201a.

107 Verify that emergency supplies are available to recover the bell including:

— lights
— power packs
— winch controls
— monitors
— bell/power/lights
— communications.

108 Examine the winch drum capacities that should be sufficient to accommodate the full length of the wire used except where special guards are fitted to prevent overspill. The distance between the top layer of rope, when evenly wound onto the drums, and the outer edge of the drum flanges, should be at least 2.5 times the diameter of the rope used. Where they are open to normal access, winch drums should be guarded to prevent anything being drawn into the machinery.

109 Examine the wire certificates and verify that the wires are non-rotating when that is required.

E 200 Submergence launch and recovery (primary/ secondary/ emergency) (A)

201 Examine the attachments and frameworks to ensure structural integrity and determine corrosion status of the launch and recovery system.

202 Examine supporting steelwork for launch and recovery system including bolts and carry out NDE if it is considered necessary

203 Examine the wires and terminations, i.e. bell wire, guide wires, cursor wires. Visual examination may be carried out according to ISO standard 4309, “Wire rope for lifting appliances - code of practice for examination and discard.” The minimum breaking load should not been reduced by 10% or more of its strength compared to new. The factor of safety between rope strength and SWL should not fall below 8:1.

204 Wire should be cut and re-terminated at the bell end every 12 months. This applies also for the guide wires and cursor wires, if required. The minimum length to be removed will be from the bell to 5 metres beyond the sheave nearest the bell, as it becomes fully submerged.

For DNV Classified systems, the re-socketing of wires should be witnessed once by DNV to qualify the procedure that is followed for the socketing. A competent person should carry out the socketing. It is of utmost importance that the wires are clean and degreased, and that the wire that is to be inserted in the socket is well “brushed out” before the resin is poured. Any lifting wires that have been re-socketed should be load tested to the launch and recovery systems design load.

205 Examine the sheaves and guide rollers that are in contact with the moving wire for signs of surface wear. The line out indicator should be examined for operation. See the DNV Offshore Standard or Diving Rules, Sec.7.

206 Examine the attachment point on the bell for connection of the main lift wire. Where a main lift wire is connected to a deployment device with a shackle or socket, there should be a suitable and safe method of attaching the main lift wire, utilising an appropriate locking device.

207 Examine that the wire has been pressure lubricated from the winch drum to the bell as far as the depth of deployment. This should be done every 6 months, and prior to an extended period of non-use.

208 If a winching system is used to traverse the bell laterally while it is at working depth, and thereby supports the weight of the bell in water, this should be tested to give a design load based on the weight of the bell in water when it is fully equipped, manned and ballasted. If this Cross-Haul System is designed for bell recovery to the deck then it should be tested according to the requirements for the main system.

209 Ensure that a dedicated means of attaching a secondary lift wire is fitted e.g. delta plate sling or other. The secondary lift wire need not be attached in normal operation but should be examined annually.

210 Examine the secondary means of recovery that is independent of the primary launch and recovery system.

Ensure that it enables the bell to be mated to the TUP chamber. It should have a certified design load that is equal to or greater than the primary system. Where the secondary system is only capable of lifting the weight of the bell in water there should be an alternative designed and tested method of hoisting the bell clear of the water which enables it to be mated to the TUP chamber. Rigging identification numbers should be provided.

211 In certain circumstances reliance on buoyant ascent as a means of diver rescue might be utilised and should be examined to meet the criteria listed below:

a) Drop weights should be capable of release from inside the bell and precautions should be taken to prevent accidental release.

b) The ballast release system should work in two independent stages, so that one action cannot release the ballast. See DNV-OS-E402 Sec.7 B300 or Diving Rules, Sec.7 B.

c) Examine that the drop-weights are secured to prevent accidental shedding.

d) Examine the bell ballast release wires (if applicable). Wires should be well lubricated. Particular attention should be paid if bright, not galvanised, wire is being used.

e) Allowances should be made for the bell tilting during deployment in which case the weights should be incapable of inadvertent release i.e. falling off, while remaining capable of deliberate release.

f) If operation of the primary and secondary release mechanisms relies on a common structural component, then an independent means should be provided to retain the ballast i.e. no single component failure should result in buoyant ascent of the bell. However, in cases where the release mechanism structure has been specifically designed to withstand application of gross external force, then provision of an independent means of retaining the ballast may be dispensed with at the discretion of the competent person e.g. a bell with two separately releasable drop weights.

g) Where hydraulic/pneumatic systems are used their design should be such as to preclude accidental activation by means of hydrostatic pressure or leakage of helium into

the system. The mechanisms should be tested from inside the bell. The umbilical cutters and lifting wire cutters (if applicable) can be tested on a spare piece of umbilical/ wire. On completion of the tests, ensure that shear pins of an acceptable quality are refitted, as required. Examine the blades on the cutters after testing, to ensure they have not been damaged or badly notched.

212 When one of the emergency systems for recovery of the bell is by buoyant ascent of the bell, the value of the positive buoyancy should be determined.

a) The drop weights should be removed for the test and the bell loaded with 150 kg per diver, plus the weight of his equipment, times the number of divers that the bell is rated for.
b) The minimum required positive buoyancy is 3% of the total displacement including the external appendages, such as external lights and onboard gas, etc.
c) The trunk is also to be filled with water. This can be accomplished by using a hose fitted in the trunk and led some distance up the side of the bell. Water pressure will then displace the air in the trunk.
d) A comparison should be made with the results of the previous buoyancy test to see if any differences have occurred.
e) Examine for 'unauthorised' modification to the buoyancy.
f) Details of buoyancy and stability shall be entered in the equipment register.

213 Test the following bell emergency release mechanisms on the bell:

— umbilical connection/umbilical cutters
— lifting wire connection
— guide wire release (if applicable)
— ballast weights.

Ensure that the release is carried out with the ballast weight supported to avoid shock loading on the bell.

214 When applying the diving rules, in accordance with DNV Rules for Certification of Diving Systems (1988) Sec.7 B300, then it should be noted that some diving bells do not have the above emergency arrangements. In some cases two bells is utilised, one being standby.

215 The bell should be fitted with a rope hoist to lift an injured diver into the bell.

E 300 Surface and interface launch and recovery (primary/ secondary/ emergency) (A)

301 Examine the attachments and the framework. Examine supporting steelwork for launch and recovery system including bolts.

302 Determine that there is structural integrity and examine the corrosion status of the system.

303 Date and results of last test should be recorded.

304 Examine the wires and terminations. (Ref.: ISO 4309.) Examine sheaves and guide rollers for wires.

305 Carry out load tests. Date of test should be recorded and the following tests should be carried out:

— function test the system at 1.25 x working weight: specified in kg
— carry out a brake test at 1.25 x working weight: specified in kg.

306 Function tests should be carried out on normal and back-up power. Brakes should be tested independently and dynamically.

307 Examine bell transfer and mating flanges. Examine the alignment with TUP. Function test locking mechanisms and test on emergency power.

308 Examine hydraulic power system and determine that the last oil analysis date was / is recorded.

309 Examine the power system whilst running and look for unusual high vibration / leaks / jerkiness.

310 Test the system by simulating power failure.

E 400 Control functions (electrical/ pressure) (A)

401 Examine the main electrical power supplies to:

— monitoring devices
— control consoles
— alarm systems
— switchboards, breakers, cables.

Examine the Megger test records.

402 Determine that there is correct operation of change over from main to emergency supplies. Determine if maintenance and tests are being carried out regularly.

E 500 Auxiliary services to launch and recovery system (umbilical launch and recovery/ blocks and tackles/ power supplies – electrical/ hydraulic/pneumatic) (A)

501 Determine that there are two independent power supplies to the launch and recovery system.

502 Examine the attachments and framework. Examine supporting steelwork for launch and recovery system and tap bolts gently.

503 Determine if there is structural integrity and examine the corrosion status of the system:

— examine the umbilical winch systems and carry out function tests
— examine what provision there are to stop the umbilical(s) from jumping out of sheaves and becoming damaged
— examine the condition of the umbilical(s)
— examine the slip ring(s) with umbilical(s) under pressure and electrical power supplied
— the line out indicator should be examined for operation.

504 Determine that the umbilical is secured to the bell by means of a strength member or strain relief fitting so that no bell penetration connections are subjected to load.

505 Examine the breathing apparatus provided for the winch operator(s) in case of a fire related emergency requiring recovery of the bell. If an umbilical supplied breathing system is provided, communications should be fitted and the fixed air intakes for the compressor supplying the breathing apparatus umbilical should be located in pollution free area.

506 Examine if there is a means available of indicating the amount of umbilical and bell wire that has been paid out. This may take the form of "Line Out" indicators or identical markings on both the wire and umbilical at 10m (or equivalent) intervals. This will enable the bell launch and recovery system operator to prevent excess umbilical being paid out that may become snagged.

507 Determine if the umbilical winch is fitted with a mechanical brake to prevent the umbilical paying out under load when the winch drive motor is in use. This needs to be examined.

508 The main bell umbilical should only be designated for use as a secondary method of bell recovery, where it is specifically designed and tested to perform that function, or if it can be established that all the services have already been lost. The manufacturer should provide a test procedure for such eventualities.

F. Safety Equipment (A)

F 100 Fire safety (A)

101 Determine if a general arrangement diagram of the diving system layout and configuration is attached. The location of the chamber complex should be indicated on the diagram.

102 Examine the condition of the A-60 fire protection towards any enclosed spaces from the outer area of the diving system.

103 Examine the fire detection systems in unmanned machinery spaces. Verify that type is suitable and that there are sufficient appliances. The permanently installed fire detection / alarm in gas storage and chamber rooms / diving areas should be tested. Alarm and safety limits should be examined as well as failure conditions of the fire systems. The ventilation system described in DNV Offshore standard or Rules for certification of Diving Systems, 1988 Sec.6, should be function tested.

104 Proper provision should be made for fire fighting in the diving control rooms and machinery spaces.
Verify that type is suitable and that there are sufficient appliances. Proof should be available of examination and test. Determine that the type is suitable and that there are sufficient appliances. Equipment should be provided to the levels and standards required by the appropriate maritime administration who will also be responsible for ensuring compliance.

105 Examine the fixed fire extinguishing systems. Note that CO_2 is not accepted as an extinguishing agent in a fixed fire extinguishing systems for the outer area around the diving system. In due course, Halon will also be prohibited as an agent. Determine if the deluge systems include the chambers and gas storage rooms.

106 Examine the portable fire extinguishers in the chambers. Some extinguishers need safety valves incorporating bursting discs or relief valves to prevent over-pressurisation of the low pressure container. Older Comex Pro extinguishers have conversion kits which fit to the low-pressure container. At least one of the extinguishers should be function tested and the surveyor should choose which one.

107 Examine the portable fire extinguishers outside chambers. The extinguishers should be stored where they can be easily and quickly used in an emergency. Different extinguishers should be available to tackle different types of fire. The safety plan should be examined to see if sufficient numbers of extinguishers have been posted.

108 Examine the breathing apparatus with communications to chambers provided in the control rooms to enable the occupants to carry out emergency and life support functions in a smoke-laden atmosphere. The communication shall be tested. If the breathing apparatus is umbilical supplied, the fixed air intakes for the compressor supplying the umbilical should be located in a pollution free area.

F 200 Hyperbaric evacuation (A)

201 See Appendix B.

F 300 Personal protective equipment (including personal diving equipment) (A)

301 Examination of personal diving equipment may be carried out according to IMCA guidelines, as it is not part of the class scope.

F 400 Guard rails, life lines, gangways or under deck passages etc.

401 Satisfactory means (in the form of guard rails, life lines, gangways or under deck passages etc.) shall be provided for the protection of the crew in getting to and from their quarters, the machinery space and all other parts used in the necessary work of the ship. (Ref. DNV Rules for Classification of Ships, Pt.3 Ch.3 Sec.8 and ICLL Reg.25.4) This requirement applies equally to the diving system.

SECTION 5
INTERMEDIATE SURVEY (2 OR 3 YEARLY) (I)

(Semi-annual and annual surveys shall be carried out in addition to the following scope)

A. General (I)

A 100 General

101 Intermediate surveys are carried out at the second or third annual survey after a renewal survey.

102 The scope for the semi annual and annual survey is added to the following scope for the intermediate survey.

B. Pressure Containing Equipment (I)

B 100 General

101 See Appendix A for a summary of the tests carried out on pressure equipment.

102 Leak testing should be carried out at low and high pressures by stepwise increasing the pressure to the working pressure. Leak tests are normally carried out with a minimum of 10% He, if the pressure vessel or piping is designed to hold Heliox mixtures or pure He.

103 Note that there is a fire risk with use of air at high pressure. Most leak tests therefore incorporate Nitrogen where applicable.

B 200 Pressure vessels for human occupancy (chambers/ bells) (I)

201 Leak test the chambers and bells to the maximum allowable working pressure (MAWP) with min. 20% He.

The test duration should be minimum 6 hours. Safety precautions shall be stated in the procedure. The procedure shall include an examination for leaks at low pressure before increasing to MAWP. Record:

a) pressure: _____bar

b) duration:_____hrs.

c) result:_____.

B 300 Gas storage (seamless gas cylinders – welded pressure vessels) (I)

301 Leak test the gas containers to maximum allowable working pressure (MAWP) with min. 10% He. The test duration should be minimum 6 hours. Safety precautions shall be stated in the procedure. The procedure shall include an examination for leaks at low pressure before increasing to MAWP. Record:

a) pressure: _____bar

b) duration:_____hrs.

c) result:_____.

302 A number of safety valves on permanently installed gas bottles selected by the surveyor should be tested to ensure their setting and operation. A register should be kept detailing the serial number of the valve and its set point. Valves should be labelled. The selected valves should be tested individually on a test stand, if possible. If considered safe, they can be tested on the bottle by taking the pressure above set point. The pressure should not exceed the safe working pressure.

303 Examine and test safety valves on permanently installed gas bottles according to the manufacturer's instructions. Record the dates of calibration / test.

B 400 Pressure vessels in supply and return lines (I)

401 Leak test the pressure vessels to maximum allowable working pressure (MAWP) with min. 10% He. The test duration should be minimum 6 hours. Safety precautions shall be stated in the procedure. The procedure shall include an examination for leaks at low pressure before increasing to MAWP. Record:

a) pressure: _____bar

b) duration: _____hrs.

c) result:_____.

B 500 Pumps and compressors (I)

501 Boosters and compressors may be tested in running condition by letting the pressure exceed the safety valve setting. It may be necessary to use a calibrated gauge to ensure the pressure does not reach a dangerous level in the event of a safety valve failing to operate. A register should be kept detailing the serial number of the valve and its set point and the valves should be labelled.

502 Examine and test safety valves on compressors and boosters according to the manufacturer's instructions. Record the dates of the test.

B 600 Piping/hoses/valves/fittings/filters/driers/umbilicals (I)

601 Leak test the pipe work to the maximum allowable working pressure (MAWP) with min. 10% He. The test duration should be minimum 6 hours. Safety precautions shall be stated in the procedure. The procedure shall include an examination for leaks at low pressure before increasing to MAWP. Leakage rates should normally be less than 1% pressure drop in 24 hours. Record:

a) pressure: _____bar

b) duration:_____hrs.

c) result:_____.

602 Examine manual / automatic control valves and reduction valves and test by varying set point of control parameters to ensure correct pressure / power delivery. Verify that valves are working within their pressure rating.

603 A number of valves should be tested in the presence of the class surveyor. A register should be kept for valves. Valves should be identifiable.

604 Functions test the Main Bell umbilical to the maximum working pressure of the umbilical gas hoses.

A flow check should also be carried out. For the hot water hose, this may need to be done by blowing a ball through to check against crushing. Insulation tests of the electrical conductors as well as function test (loop test) measurements of signal cables to the specified properties should be carried out. During insulation resistance testing, the umbilical should be disconnected at the upper part (slip ring) and at bell connection to avoid damage to electrical components such as heaters and scrubbers.

605 Visually examine the umbilical(s) and function test to the maximum allowable working pressure of the hoses. Electrical lines should be Megger tested. Record:

a) pressure: _____bar

b) duration:_____hrs.

c) result:_____.

C. Environment and Breathing Gas Controls (Supply and Return) (I)

C 100 Gas supply control (I)

101 Examine and test life support systems during the survey, including pipe work and reclaim units. Gas delivered by the compressors should be examined for contamination by a competent company.

C 200 Depth/pressure control (I)

201 Follow the scope for semi-annual and annual survey.

C 300 Temperature and humidity control (body and breathing) (I)

301 Follow the scope for semi-annual and annual survey.

C 400 O_2/ CO_2 / contamination analysis (I)

401 Follow the scope for semi-annual and annual survey.

C 500 Sanitary (I)

501 Follow the scope for semi-annual and annual survey.

C 600 Power LSS (I)

601 Follow the scope for semi-annual and annual survey.

C 700 Auxiliary services to life support equipment (electrical/hydraulic/pneumatic) (I)

701 Follow the scope for semi-annual and annual survey.

D. Communication (I)

D 100 Primary communications (I)

101 Follow the scope for semi-annual and annual survey.

D 200 Secondary communications (I)

201 Follow the scope for semi-annual and annual survey.

D 300 Emergency communications (I)

301 Follow the scope for semi-annual and annual survey.

D 400 Alarms (I)

401 Examine and test instrumentation alarms according to a written list that should include:

— high/low pressure alarm for chamber, if fitted
— temperature alarm for chamber, if fitted
— humidity alarm for chamber, if fitted
— divers hot water temperature alarms
— divers hot water pressure alarms
— change over to standby heater alarm
— gas delivery compressor - high pressure alarm
— compressor cooling system - low pressure alarm
— compressor - low pressure lubrication oil alarm
— O_2 analysers, high/low alarm
— high level alarm for gas reclaim bag, if applicable
— low O_2 atmosphere sensors in control rooms.

The alarms should be function tested as applicable, according to a list and the manufacturer's instructions. The list should include the position and type of alarm. Examine any historic faults and recurring problems which may be an indication of problems in the rest of the system. These should have been recorded in the planned maintenance system.

402 Examine the planned maintenance system to determine when these alarms are routinely tested.

E. Launch and Recovery System (I)

E 100 Submergence launch and recovery (primary/ secondary/ emergency) (I)

101 Determine the working weight of the bell and record this in the report and Data sheet:

— the bell weight: (in kN or kg)
— the previous weight: (in kN or kg).

Consider the current weight against the previous results. Ensure that a calibrated load cell is being used.

102 Test the following hydraulic systems power failure alarms for bell launch and recovery:

— low pressure alarm
— high temperature alarm
— low oil level in tank alarm.

E 200 Surface and interface launch and recovery (primary/ secondary/ emergency) (I)

201 Follow the scope for semi-annual and annual survey.

E 300 Control functions (electrical/ pressure) (I)

301 Test the power failure alarms for the launch and recovery systems, including:

— hydraulic system for bell launch and recovery - low pressure alarm.
— hydraulic system for bell launch and recovery - high temperature alarm
— hydraulic system for bell launch and recovery system - low oil in tank alarm.

Alarms to be function tested as applicable according to the manufacturer's instructions. Examine the planned maintenance system as to determine when these alarms are routinely tested.

E 400 Auxiliary services to launch and recovery system (umbilical launch and recovery/ blocks and tackles/ power supplies – electrical/hydraulic/pneumatic) (I)

401 Follow the scope for semi-annual and annual survey.

F. Safety Equipment (I)

F 100 Fire safety (I)

101 Test the fire detection and alarms.

102 Functions test one portable extinguisher at random. Ensure the extinguisher has been pressure tested. Safety valves shall be fitted on regulators for 2 piece extinguishers used in the chambers.

103 Examine the permanently installed fire extinguishing systems and record the date of the last inspection by a competent company. Ensure extinguishing system covers the chambers and gas containers.

104 For water deluge systems, lines should be blown through with air to verify that they are clear.

F 200 Hyperbaric Evacuation systems (I)

201 See Appendix B.

F 300 Personal protective equipment (including personal diving equipment) (I)

301 Saturation control and other control rooms with a fixed fire extinguishing system shall have a portable self contained breathing apparatus fitted with communications. Verify that the cylinders are full.

302 Examine the breathing apparatus outside the chambers and record the last pressure test.

SECTION 6
RENEWAL SURVEY (5 YEARLY) (R)

(Semi-annual, annual and intermediate surveys should be carried out in addition to the following scope)

A. General (R)

A 100 General

101 Renewal surveys are carried out before the anniversary date, set 5 years after the previous renewal survey.

102 The scope for the semi-annual, annual and intermediate survey is added to the following scope for the renewal survey.

A 200 Positioning systems (R)

201 A survey according to a checklist for **DYNPOS** should be carried out to determine compliance with **DYNPOS AUTR** class notation. If the DSV is based upon a mooring system utilising anchors, a survey of this system should be carried out. Acceptance should be to a minimum of DNV class notation **POSMOOR V**.

B. Pressure Containing Equipment (R)

B 100 Pressure testing and leak testing – General

101 See Appendix A.

B 200 Pressure vessels for human occupancy (chambers/ bells) (R)

201 Examine the bell insulation and determine if affected areas require removal because of damage or signs of corrosion. Parts of the bell insulation should be removed if evidence of cracking exists. Areas around windows and attachments are prone. Ultrasonic examination should be carried out as necessary.

Guidance note:

If the insulation shows no signs of deterioration, and experience with this insulation is well known, other inspection methods may be allowed in lieu of removal of the insulation. Such methods may include, but need not be limited to, ultrasonic inspection from the interior of the bell.

---e-n-d---of---G-u-i-d-a-n-c-e---n-o-t-e---

202 Pressure testing of chambers shall be carried out according to a procedure based on the design code (See Appendix A). The following shall be recorded:

— test date
— serial nos.
— test pressure (in bar)
— test duration (in hrs.)
— type of test
— reference should be made to Table A-1 in Appendix A.

203 Bells are hydro-tested with an internal pressure equivalent to the test pressures given by the design code. If diving bells are to be used for observation diving (internal pressure at one atmosphere), they shall be hydrostatically tested to the external test pressure determined by the design code. The following shall be recorded:

— test date
— serial numbers
— test pressure (in bar)
— test duration (in hours)
— type of test.

B 300 Gas storage (seamless gas cylinders – welded pressure vessels) (R)

301 Gas storage tubes, shall be hydrostatically tested to the test pressure determined by the design code(s). Most design codes for seamless cylinders have the test pressure (TP) stamped on the neck of the cylinder. The following shall be recorded:

— test date
— serial numbers
— test pressure (in bar)
— test duration (in hrs.)
— type of test.

B 400 Pressure vessels in supply and return lines (R)

401 Pressure testing of pressure vessels in supply and return lines shall be carried out according to a procedure based on the design code(s). Air and gas volume tanks, and sewage tanks, shall be hydrostatically tested to the test pressure determined by the design code. Hot water tanks shall be hydrostatically tested to the test pressure determined by the design code. The following shall be recorded:

— test date
— serial numbers
— test pressure (in bar)
— test duration (in hrs.)
— type of test.

B 500 Pumps and compressors (R)

501 Follow the scope for semi-annual, annual and intermediate surveys.

B 600 Piping/ hoses/ valves/ fittings /filters/ driers/ umbilicals (R)

601 Examine piping systems to ensure that cleanliness is maintained. Piping that is not found to be clean should be cleaned in accordance with an approved cleaning procedure.

602 Pressure testing of piping systems shall be carried out according to a procedure based on the design code(s). The safety factor (SF) for piping is normally 1.5 to determine the maximum allowable working pressure (MAWP). The following shall be recorded:

— test date
— serial numbers
— test pressure (in bar)
— test duration (in hours)
— type of test.

C. Environment and Breathing Gas Controls (Supply and Return) (R)

C 100 Gas supply control (R)

101 Follow the scope for semi-annual, annual and intermediate surveys.

C 200 Depth/pressure control (R)

201 Follow the scope for semi-annual, annual and intermediate surveys.

C 300 Temperature and humidity control (body and breathing) (R)

301 Follow the scope for semi-annual, annual and intermediate surveys.

C 400 O_2/ CO_2 / contamination analysis (R)

401 Follow the scope for semi-annual, annual and intermediate surveys.

C 500 Sanitary (R)

501 Follow the scope for semi-annual, annual and intermediate surveys.

C 600 Auxiliary services to life support equipment (electrical/ hydraulic/pneumatic) (R)

601 Follow the scope for semi-annual, annual and intermediate surveys.

D. Communication (R)

D 100 Primary (R)

101 Follow the scope for semi-annual, annual and intermediate surveys.

D 200 Secondary (R)

201 Follow the scope for semi-annual, annual and intermediate surveys.

D 300 Emergency (R)

301 Follow the scope for semi-annual, annual and intermediate surveys.

D 400 Alarms (R)

401 Follow the scope for semi-annual, annual and intermediate surveys.

E. Launch and Recovery System (R)

E 100 General

101 Static load test the bell launch and recovery system to the design load, making sure that load bearing parts are closely examined by including NDE. The design load according to the DNV Offshore standard or Diving Rules, Sec.1, is given in Form No. 20.201a, filed on board the vessel.

E 200 Submergence launch and recovery (primary/ secondary/ emergency) (R)

201 Load test the bell ballast weight release to 1.5 x the weight of the ballast in air.
NDE should be performed after the test on load bearing members.

E 300 Surface and interface launch and recovery (primary/ secondary/ emergency) (R)

301 Load test the various systems according to a written procedure based on the manufacturer's instructions, to the design loads of the system. Loads can be found in DNV Form 20.201a.

302 NDE should be carried out on the load affected areas, prior to and, after the test.

303 Emergency retrieval of bell, as described in DNV Form 20.201a, should be tested.

E 400 Control functions (electrical/ pressure) (R)

401 Follow the scope for semi-annual, annual and intermediate surveys.

E 500 Auxiliary services to launch and recovery system (umbilical launch and recovery/ blocks and tackles/ power supplies – electrical/ hydraulic/pneumatic) (R)

501 Follow the scope for semi-annual, annual and intermediate surveys.

F. Safety Equipment (R)

F 100 Fire safety (R)

101 Additional fire protection should be examined where appropriate.

F 200 Hyperbaric evacuation systems (R)

201 Follow the scope for semi-annual, annual and intermediate surveys.

F 300 Personal protective equipment (including personal diving equipment) (R)

301 Follow the scope for semi-annual, annual and intermediate surveys.

SECTION 7
SURVEY OF NEW MANUFACTURE, ASSEMBLY AND INSTALLATIONS (NB)

A. General (NB)

A 100 General

101 Follow the scope for semi-annual, annual, intermediate and renewal surveys in addition to the following scope.

102 When a diving system, not certified by DNV, is installed on a vessel or rig Classified by the Society, the system is to be surveyed with respect to possible interference with the relevant ship's Rules. Survey of «not certified» diving systems installed on classified vessels also may involve approval of certain components such as launch and recovery systems etc. on behalf of the National Authorities, DNV should be contacted for further information and advice before such surveys takes place. Special attention should be paid to the following:

— all decompression chambers, bells and other pressure vessels shall be certified
— safety valve arrangement on pressure vessels
— gas-storage, especially O_2 storage with regard to hazards
— during a potential fire
— fire detection and fire protection
— electrical installations, especially installations in hazardous areas
— strength of structure supporting the diving equipment.

A 200 Documents to be submitted for approval/ information

201 Request as follows:

— (Form 14.30a) Request for Classification or Certification of Diving Systems and Parts of Diving Systems
— (Form 20.201a) Data Sheet for Diving Systems (Draft version with request).

202 Ensure that the required plans are approved. Unless special agreement for local approval is made, the drawings and strength calculations required by the Rules should be forwarded to DNV Approval Centre for approval. In DNV-OS-E402 "Offshore Standard for Diving Systems, 2004" lists of required documentation are given in each section under A300.

203 Reports and certificates that may be required for the ship files should be submitted to the DNV approval centre.

204 When main items for diving systems are certified, a copy of the certificate is to be submitted to DNV:

— (Form 51.71a) Installation report
— (Form 14.31a) Certificate for Chambers for Diving Systems
— (Form 14.32a) Certificate for Diving Bell
— Certificate for windows
— Certificate for valves and fittings
— Certificates for other components
— (Form 20.201a) Data Sheet *for* Diving Systems (Completed and signed by Owner and DNV Surveyor).

B. Pressure containing equipment (NB)

B 100 Pressure testing - General

101 Pressure testing shall be carried out according to approved procedures. (See Appendix A).

102 For DNV Certified pressure vessels, all pressure tests shall be witnessed by a DNV surveyor. Internal visual inspections may be undertaken by a competent company in accordance with a prior agreement.

103 Prior to hydro testing, a thorough visual inspection internally and externally shall be conducted.

104 Acoustic emission testing in lieu of hydrostatic testing of gas storage tubes is normally not accepted.

B 200 Leak testing

201 Leak testing shall be carried out according to approved procedures. (See Appendix A).

202 Leak testing is carried out at low and high pressures by stepwise increasing the pressure to the working pressure. Leak tests are normally carried out with a minimum of 10% He, if the pressure vessel or piping is designed to hold Heliox mixtures or pure He.

203 Note that there is a fire risk with use of air at high pressure. Most leak tests therefore incorporate Nitrogen.

Guidance note:

IMPORTANT NOTE: Most codes give you safety procedures to follow when pneumatic testing is carried out. The codes should also stipulate visual inspection with acceptance criteria. If not, contact us. Proper visual inspection is ESSENTIAL.

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B 300 New pressure vessels

301 New *chambers and bells* are hydro-tested with an internal pressure equivalent to the test pressures given by the design code. If diving bells are to be used for observation diving (internal pressure at one atmosphere), they shall be hydrostatically tested to the external test pressure determined by the design code.

302 New *gas cylinders* – including those used underwater, and new gas storage tubes, shall be hydrostatically tested to the test pressure determined by the design code. Most design codes for seamless cylinders require the test pressure (TP) to be stamped on the neck of the cylinder.

303 New *air and gas volume tanks, and sewage tanks*, shall be hydrostatically tested to the test pressure determined by the design code.

304 New *hot water tank*s shall be hydrostatically tested to the test pressure determined by the design code. The safety factor (SF) for piping is normally 1.5 to determine the maximum allowable working pressure (MAWP).

305 New *piping* shall be hydrostatically tested to the test pressure determined by the design code.

B 400 Pressure vessels for human occupancy (chambers/ bells) (NB)

401 Manufacturers of pressure vessels for human occupancy, and other pressure vessels to class I and II, shall be approved by DNV for such production, when the pressure vessels are certified by DNV.

402 Necessary surveys should be carried out in order to ensure that:

— certified materials are used
— construction with attachments is in accordance with approved drawings
— flanges, sealing surfaces, openings for windows and hatches are satisfactory with regard to tolerances and for sealing-systems
— out of roundness for vessels intended for external pressure are within tolerances

— welds are tested
— pressure tests upon completion are satisfactory.

403 If a pressure vessel is to be delivered with valves, fittings and or insulation this is to be inspected and recorded in the certificates/ documentation.

404 Determine if there is sufficient strength in the foundations and support for the chambers and gas cylinders when installed onboard. Extra weight caused by possible later hydraulic pressure testing should be taken into account. Alignment of chambers, mating of bell including control of clearances is to be performed.

B 500 Gas storage (seamless gas cylinders – welded pressure vessels) (NB)

501 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

502 Examine the bell(s) to verify that there is adequate emergency supply of on board gas sufficient to support one diver outside the bell for a minimum of 30 minutes, at a breathing rate of 40 litres/minute and at the maximum depth of the diving operation. Also sufficient oxygen carried at a reduced pressure for a metabolic consumption of 0.5 litres (0.018 cu. ft.) per minute per diver for a minimum of 24 hours at the end of a bell run. Examine the condition of the O_2 regulator.

B 600 Pressure vessels in supply and return lines (NB)

601 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

B 700 Pumps and compressors (NB)

701 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

B 800 Piping/ hoses/ valves/ fittings /filters/ driers/ umbilicals (NB)

801 Pressure, leakage and cleanliness test should be performed. Piping systems and mountings are normally to be hydraulic tested to 1.5 x design pressure.

802 After pressure testing the piping/hoses and mountings in the breathing gas systems shall be carefully cleaned. Cleaning procedure shall be approved by DNV. It is of the greatest importance that the high-pressure oxygen system is free from particles, oil, grease or other non-volatile residue that might represent a fire hazard. After the installation of piping and mountings in a deep diving system is completed, a leakage test of the total system with helium or air/helium mixture to design pressure is to be carried out.

C. Environment and Breathing Gas Controls (Supply and Return) (NB)

C 100 Gas supply control (NB)

101 *Components in life supporting systems*. Drawings and specification for the components shall be submitted for approval/ information. Surveys shall be carried out to ensure that the maker's specifications, DNV Rules and approved drawings are complied with. Parts exposed to high pressure shall be pressure tested. Pressure vessels that are part of the system shall be certified. When capacity tests of environmental units are required the maker's detailed test programme is to be submitted to DNV for evaluation before the test takes place.

C 200 Depth/pressure control (NB)

201 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

C 300 Temperature and humidity control (body and breathing) (NB)

301 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

C 400 O_2/ CO_2 / contamination analysis (NB)

401 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

C 500 Sanitary (NB)

501 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

C 600 Auxiliary services to life support equipment (electrical/ hydraulic/pneumatic) (NB)

601 Electrical components installed inside chambers/ bells shall be of a construction suitable to withstand the atmosphere which may be of high oxygen -and humidity content. Components installed outside bell shall also be of watertight type and should be pressure tested to at least 1.3 times max. Design pressure.

D. Communication (NB)

D 100 Primary (NB)

101 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

D 200 Secondary (NB)

201 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

D 300 Emergency (NB)

301 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

D 400 Alarms (NB)

401 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

E. Launch and Recovery System (NB)

E 100 Submergence launch and recovery (primary/ secondary/ emergency) (NB)

101 All main strength members in the launch and recovery systems shall be inspected according to approved drawings.

102 Certificates shall be produced for hoisting ropes, main strength members, blocks, sheaves, shackles etc.
The manoeuvre system shall be equipped with automatic zero positioning when the operating handle is not operated.

103 All lifting equipment should be tested and certified after installation, major alteration or repair. Bell launch and recovery systems should be tested as integral units.

104 Strength test as well as a function test including emergency functions shall be carried out. Static load test is given from the calculations of the design load.

105 The function test shall be carried out at 1.25 x the working weight of the bell. The mating procedure between bell and chamber shall be tested for proper function. Emergency procedures for recovery of the bell(s) shall be tested.

E 200 Surface and interface launch and recovery (primary/ secondary/ emergency) (NB)

201 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

E 300 Control functions (electrical/ pressure) (NB)

301 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

E 400 Auxiliary services to launch and recovery system (umbilical launch and recovery/ blocks and tackles/ power supplies – electrical/ hydraulic/pneumatic) (NB)

401 Pipes and hoses should be pressure tested to 1.5 times the maximum allowable working pressure.

F. Safety Equipment (NB)

F 100 Fire safety (NB)

101 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

F 200 Hyperbaric evacuation systems (NB)

201 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

F 300 Personal protective equipment (including personal diving equipment) (NB)

301 Follow the scope from the manufacturers and/or IMCA.

SECTION 8
STATUTORY SURVEYS FOR NATIONAL AUTHORITIES (STA)

A. General (STA)

A 100 General

101 Statutory surveys are carried out by, or on behalf of, the national maritime authorities where the diving support vessel is registered.

102 Port or shelf state authorities may also carry out surveys.

103 Class surveys may be combined with surveys for National authorities. The Owners' representatives should then request this.

104 If there is doubt that a diving system installed on a Norwegian registered vessel complies with the NMD's Regulations dated 10th April 1984, DNV shall be notified.

105 IMO has published a Code of Safety for Diving Systems, in its latest version from 1995 as resolution A.831(19). The surveyor should be familiar with this Code if the vessel has a diving system safety certificate (DSSC). An authorised surveyor, at the periodical surveys, should endorse this Certificate. Diving Systems are also referenced in the 1989 MODU Code under Pt.14.6 with a reference to the IMO Code of Safety for Diving Systems.

B. Pressure Containing Equipment (STA)

B 100 General (STA)

101 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

C. Environment and Breathing Gas Controls (Supply and Return) (STA)

C 100 General (STA)

101 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

D. Communication (STA)

D 100 General (STA)

101 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

E. Launch and Recovery System (STA)

E 100 General (STA)

101 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

F. Safety Equipment (STA)

F 100 Fire safety (STA)

101 Investigate if the class society is accredited to carry out the survey in the region.

102 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

F 200 Hyperbaric Evacuation systems (STA)

201 Investigate if the class society is accredited to carry out the survey in the region.

202 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

APPENDIX A
PRESSURE CONTAINING EQUIPMENT SUMMARY

A. General

A 100 Pressure testing

101 Pressure testing should be carried out in accordance with an *approved procedure* on the relevant pressure vessels. Both Norwegian and British authorities require this testing. When modifications to the pressure boundaries have been carried out, the test requirements apply as given for new pressure vessels. Procedures for testing along with qualifications etc. should be submitted well in advance for review.

102 Pressure testing shall be carried out in accordance with the procedure, and *to the test pressure (TP), required by the design code of the pressure vessel*. The maximum allowable working pressure (MAWP) is determined by dividing the test pressure (TP) by a safety factor (SF). The minimum safety factors on DNV Classed support vessels shall be 1.3. More stringent safety factors may be required by statutory regulations or by operators.

103 All pressure tests should be witnessed by a DNV surveyor. Internal visual inspections may be undertaken by a competent company in accordance with a prior agreement.

104 Prior to hydro testing, a thorough visual inspection internally and externally shall be conducted.

105 Acoustic emission testing in lieu of hydrostatic testing of gas storage tubes is normally not accepted.

A 200 Downgrading of pressure vessels

201 In lieu of hydraulic pressure testing, it may be acceptable to carry out a pneumatic pressure test to the maximum allowable working pressure (MAWP) and to downgrade the existing working pressure by the applicable safety factor (minimum 1.3). Pneumatic pressure tests shall adopt the safety precautions in Pt.5, 5.8.4 of PD 5500:2000 “Unfired Fusion Welded Pressure Vessels”.

202 For downgrading of pressure vessels in DNV-certified diving systems, refer to the design code of the pressure vessel when determining Test and Maximum Allowable Working Pressures (TP and MAWP). Determine the new shell thickness if there is corrosion and apply the new shell thickness to the original design so you arrive at the New TP and a New MAWP.

Guidance note:

IMPORTANT NOTE: The test pressure TP is an engineering concept that relates to a certain factor compared to yield (normally 90% of yield). The Maximum Working Pressure MAWP is a policy concept relating to a safety factor determined by standards, codes or statutory regulations. In one case, it may be 1.3 whereas in another it might be 1.5. It may also differ between the design codes and the materials applied in the manufacture of the pressure vessel.

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203 Downgrading procedure:

a) start with the design code for the PV
b) map thicknesses of the shell
c) apply the thicknesses to the calculations in the code and calculate the New TP
d) divide the New TP with the safety factor in the code to arrive at the New MAWP (or - apply the safety factor given by regional regulations *if this is greater*)
e) submit test procedure for approval
f) for hydrostatic testing, test to the New TP and use to the New MAWP
g) for pneumatic testing, test pneumatically to the New MAWP. Divide the New MAWP by the safety factor used in d. to arrive at the Downgraded MAWP. Use at the Downgraded MAWP.

Guidance note:

IMPORTANT NOTE: Most codes give you safety procedures to follow when pneumatic testing is carried out. The codes should also stipulate visual inspection with acceptance criteria. If not, contact DNV for guidance. Proper visual inspection is ESSENTIAL.

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204 Downgrading of chambers may be requested either:

— to carry out periodical pressure testing after ten years pneumatically at a reduced pressure, or
— after installation of windows with a lower design pressure than the chamber, or
— after any other causes which may or may not imply a reduction of strength of the pressure vessel.

205 The procedure necessitates the following alterations and recordings:

a) the pressure vessel shall be marked at a location close to the original marking and the original marking shall be covered, and
b) the filed copies of the certificates shall be marked, and
c) issue of an MO (Memo to Owners), and
d) issue of an MS (Memo to Surveyor)
e) memos shall include the necessary information as to:
   — the new maximum operating pressure of the diving system, and
   — the reasons behind the downgrading.

This is done in order to simplify the procedure when the owner might, at a later stage, want to recertify the pressure vessel to its original operating pressure.

A 300 First year periodic survey

301 All pressure vessels and piping shall be visually examined externally on an annual basis. Chambers and diving bells shall be visually examined internally also.

A 400 Second year periodic survey

401 All pressure vessels shall be visually examined internally as well as externally at two yearly intervals, excepting gas storage tubes and piping. The latter are examined externally only.

402 Gas cylinders used in or under water shall be hydrostatically tested at intervals of 4 years.

A 500 Fifth year periodic survey

501 At five year intervals *chambers* and *bells* are hydrotested with an internal pressure equivalent to the test pressures given by the design code.

If diving bells are to be used for observation diving (internal pressure at one atmosphere), they shall be hydrostatically tested to the external test pressure determined by the design code.

502 At five year intervals *gas cylinders* and *gas storage tubes*, shall be hydrostatically tested to the test pressure and procedure (permanent set evaluation) as determined by the design code. At the first complete periodical survey the interval for hydraulic pressure testing of gas containers may be extended to 10 years if the following principles are applied:

— external and internal survey by intra-scope
— if internal survey is not possible or if corrosion or other items of concern are found, hydraulic test shall be carried out to the test pressure determined by the design code.

At the subsequent complete periodical surveys:

— external and internal survey by intra-scope, and
— hydraulic test to the test pressure determined by the design code.

503 At five year intervals *air and gas volume tanks, and sewage tanks*, shall be hydrostatically tested to the test pressure determined by the design code.

504 At five year intervals *hot water tanks* shall be hydrostatically tested to the test pressure determined by the design code.

Table A-1 Summary

Item	*New*	*1st year*	*2nd year*	*5th year*
Chambers	Visual Hydro-test Leak test	Visual (Int. and Ext.)	Visual (Int. and Ext.) Leak test	Visual (Int. and Ext.) Hydro-test Leak test
Diving bells	Visual Hydro-test Ext. Hydro Leak test	Visual (Int. and Ext.)	Visual (Int. and Ext.) Leak test	Visual (Int. and Ext.) Hydro-test Leak test
Gas bottles underwater	Visual Hydro-test Leak test	Visual (Ext.)	Visual (Int. and Ext.) Hydro-test on 4th year	Visual (Int. and Ext.) Leak test
Gas storage tubes and HES bottles	Visual Hydro-test Leak test	Visual (Ext.)	Visual (E) Leak test	Visual (Int. and Ext.) Hydro-test Leak test
Air and gas volume tanks and Sewage tanks	Visual Hydro-test Leak test	Visual (Ext.)	Visual (Int. and Ext.) Leak test	Visual (Int. and Ext.) Hydro-test Leak test
Hot water and other tanks	Visual Hydro-test Leak test	Visual (Ext.)	Visual (Int. and Ext.) Leak test	Visual (Int. and Ext.) Leak test
Pipework	Visual Hydro-test Safety factor 1.5	Visual (Ext.)	Visual (Ext.) Leak test	Visual (Ext.) Leak test

APPENDIX B
HYPERBARIC EVACUATION SYSTEMS (HES)

A. Introduction (HES)

A 100 Mandate

101 Lifesaving appliances, including lifeboats, are in general the responsibility of national maritime authorities. Contact the Product Responsible for Diving Systems in DNV to determine the scope of DNV involvement relative to Hyperbaric Evacuation on the DNV Classed diving support vessel being surveyed.

102 Diving systems built after July 2001, including transferable diving systems, should have a means of hyperbaric evacuation, according to the DNV Rules for Classification of Ships. This should be determined and recorded in the survey report.

103 A hyperbaric evacuation system should not represent a hazard to the remainder of the diving system. The interface with the vessel and main diving system should accordingly be examined.

104 Requirements for hyperbaric evacuation come from statutory requirements such as NMD/NPD in Norway, HSE/MSA in Britain or the flag state maritime administration. The mandate from the maritime administration where the support vessel is registered should therefore be determined and recorded in the survey report.

105 The hyperbaric chamber, other pressure vessels and life support systems, if connected to the main diving system, should be considered as a mobile diving system integrated with the main diving system. Examine the documents separately.

106 The following should be checked:

— sufficient BIBS fitted and functional
— BIBS overboard dump fitted and functional
— lighting fitted and functional
— toilet provided
— locking mechanism fitted and functional
— 6 monthly examination tests carried out
— 2 yearly pressure and leak tests
— doors can be opened from both sides
— doors can be secured "open"
— equalisation can be done if appropriate
— seatbelts for the maximum complement of divers provided
— protective headgear provided
— recovery system available
— falls of sufficient length, where applicable.

107 Other guidance:

— Guidance for Hyperbaric Evacuation Systems can be found on Merchant Shipping Notice M.1450 DSM6/1992
— IMO Resolution A.692(17)
— NORSOK U-100
— DNV-RP-403 “Hyperbaric Evacuation Systems”.

B. General (HES)

(Semi-annual, annual and intermediate surveys should be carried out in addition to the following scope)

B 100 General

101 Hyperbaric Evacuation Systems (HES), are connected to the diving system, and should be surveyed in the same way as the main diving system. Attention should be made to corrosion on the chamber exterior due to high levels of humidity.

102 Examine if the hyperbaric evacuation unit (HEU) is marked in accordance with IMO requirements.

103 Examine if the HEU is clearly marked externally with the green, white and yellow “Diver Rescue” sign. A form of tapping code should be placed inside and outside the chamber. An arrangement for lifting an injured diver should be fitted.

104 Launch the HEU and examine if the free-floating unit is positively buoyant when fully equipped and manned. Ensure that it has undergone a stability test to ensure that it will float in the correct orientation.

105 Examine if the HES has some form of propulsion or other suitable method of rapid clearance from the installation, where a saturation diving system is mounted on a production and/or drilling installation, with a potential risk of hydrocarbon release.

106 Determine if the HES is able to accommodate the maximum number of divers that may be under pressure.

107 The HES should be included in the PMS so as to ensure that systems are operational.

108 Determine if contingency plans are in place according to DNV-RP-E403 Sec.1 A700.

Investigate if there is a written procedure for launching the HES, which identifies by job function of the operators responsible for various aspects of the launch and which stations should be manned by them.

109 Practices involving the equipment should be carried out at intervals as close as is practicable to 6 months.

110 Examine if a first aid kit is provided to the levels prescribed by the diving contractor's medical consultant.
The kit should be marked with a white cross on a green ground, kept in a splash-proof cover, and examined periodically for deterioration or damage.

Date when the kit is due for next examination should be marked on the box, and included in the PMS.

111 Examine if emergency food and water supplies are according to SOLAS standards as specified below. Consideration should be given to the fact that seasickness will cause a high level of loss of body fluids:

— watertight receptacles containing a total of 3 litres of fresh water per person for the maximum number of occupants
— a rustproof dipper/ladle with lanyard
— a rustproof graduated drinking vessel
— a food ration totalling not less than 10 000 kJ per person for the maximum number of occupants these rations to be kept in airtight packaging and stowed in a watertight container
— three tin openers
— six doses of anti-sickness medicine and one seasickness bag per person for the maximum number of occupants. Seasickness pills should be available for issue to all divers prior to launch of the HEU.

C. Pressure Containing Equipment (HES)

C 100 Pressure testing – General

101 See Appendix A.

C 200 Pressure vessels for human occupancy (chambers/ bells) (HES)

201 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

C 300 Gas storage (seamless gas cylinders – welded pressure vessels) (HES)

301 Examine if cylinders exposed to seawater are certified and tested every 2 years.

C 400 Pressure vessels in supply and return lines (HES)

401 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

C 500 Pumps and compressors (HES)

501 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

C 600 Piping/ hoses/ valves/ fittings /filters/ driers/ umbilicals (HES)

601 Examine if valves are firmly secured to prevent any movement due to vessel motion in rough water.

602 Examine if external valves on HECs are secured "open" to prevent accidental operation during deployment.

D. Environment and Breathing Gas Controls (Supply and Return) (HES)

D 100 Gas supply control (HES)

101 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

102 Determine if there is sufficient oxygen available for metabolic make-up for the maximum complement of divers at a rate of 0.5 litres (0.018 cu.ft.) per minute per diver, for a minimum duration of 24 hours.

103 Determine if the oxygen supply is fitted with a device whereby the oxygen is injected at a controlled measure.

104 Determine if there is a minimum amount of He/O_2 carried sufficient to compensate for the use of medical locks, as specified by the equipment manufacturer or diving contractor.

D 200 Depth/pressure control (HES)

201 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

D 300 Temperature and humidity control (body and breathing) (HES)

301 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

302 If the HES has an external diesel fired heater, this should be function tested and in good condition.

303 Determine if there are adequate means of maintaining the diver's thermal balance in the compression chamber to the required level, for a minimum of 24 hours.

D 400 O_2/ CO_2 / contamination analysis (HES)

401 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

D 500 Sanitary (HES)

501 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

D 600 Auxiliary services to life support equipment (electrical/ hydraulic/pneumatic) (HES)

601 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

602 Examine the safety provisions applied to reduce potential explosion hazards from charging of batteries. Due to serious accidents which have occurred in the past the following minimum provisions should be examined:

— rechargeable batteries should be enclosed in separate, well-ventilated housings located outside the cockpit for the crew members
— the ventilation of hydrogen gas is to be ducted for dumping at a safe place
— overcharging of batteries should be avoided.

603 During charging, batteries give off potentially explosive fumes. This can also apply to sealed batteries if the recommended charging voltage is exceeded. The two main causal factors appear to be:

— inadequate ventilation of flammable gases omitted during charging
— faulty trickle charging which generates explosive gases.

604 If battery charging is carried out in situ (i.e. within the enclosed lifeboat), guidance such as given in AODC/IMCA 054 (Ref. A13) should be followed and relevant items included in the PMS. i.e. pressure relief valves, chargers, batteries and their maximum possible age, and ventilation systems and warning signs should be affixed.

E. Communication (HES)

E 100 Primary (HES)

101 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

102 Examine if there is an effective hard wired communications system linking saturation life support control/HES launch control/HES internal.

E 200 Secondary (HES)

201 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

E 300 Emergency (HES)

301 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

302 Examine if the HEU has relocation devices including:

— radar reflector
— strobe light
— radio distress beacon.

E 400 Alarms (HES)

401 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

F. Launch and Recovery System (HES)

F 100 General

101 Follow manufacturer's instructions that should be in accordance with SOLAS requirements.

102 Refer also to DNV-RP-E403 Sec.7 A404.

F 200 Launch and recovery (HES)

201 Examine the release arrangements for the HES.

202 Launch test the HES with a full load during surveys. In the case of a float away chamber, a floatation test should be carried out with a full load.

203 Examine if a suitable method of assisting an injured/ unconscious diver into the chamber is available. If a rigid system is used the falls should reach the chamber floor.

204 Examine if a safety locking mechanism is fitted between the saturation diving complex and the hyperbaric evacuation system.

205 Dedicated launch systems may be fully certified to SOLAS requirements or designed and built to specified standards other than SOLAS.

206 Examine the falls, and see if they are of sufficient length to allow the HEU to be fully supported in the water when the vessel/installation is in the lightest sea-going state. This should be determined at the worst angle of list and trim on the side where the HEU is located.

207 Falls should be turned end for end at intervals of not more than 30 months and renewed when necessary due to their deterioration, or at intervals of not more than 5 years, which ever is the earlier, unless falls are so designed that they cannot be end-for-ended. Stainless steel falls should be turned end for end at intervals of not more than 30 months but need not be renewed provided that on inspection there are no signs of mechanical damage or other possible defects.

208 Some falls are supplied complete e.g. endless, with Crosby ring boat attachment, and cannot be end for ended, in which case the test requirements given here will apply:

— 30 monthly end for ending of falls, and replacement depending on rate of deterioration, or at 5 years
— 12 monthly load tests to 1.5 x SWL with spreader beams.

209 Examine if the HEU and diving bell are fitted with handling/towing lines to enable them to be towed clear of the vessel. There should be clear directions in the Emergency Procedures as to how the tow should be carried out. Consideration should also be given to the limitation, which will be imposed by environmental conditions.

210 For certain configurations of HES, 6 monthly practice deployments may be impractical. In such cases alternative procedures should be agreed with the relevant maritime administration and a more practical time scale agreed for a practice deployment.

211 Where the practice deployment is not to sea level, correct functioning of the lift wire release mechanism should be demonstrated by independent means.

212 Where a secondary means of launch is provided, practical deployment of the system using the secondary method should be tested under the same conditions and frequency as the primary system.

213 Submit test procedures for approval as follows:

— 6 - monthly (or alternative) deployment
— alternative procedures
— pressurised/unmanned
— not pressurised/manned
— lift wire release operational
— falls meet requirements
— pressurised/unmanned
— not pressurised/manned
— lift wire release operational
— falls meet requirements
— secondary system.

F 300 Control functions (electrical/ pressure) (HES)

301 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

F 400 Auxiliary services to launch and recovery system (umbilical launch and recovery/ blocks and tackles/ power supplies – electrical/ hydraulic/pneumatic) (HES)

401 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

G. Safety Equipment (HES)

G 100 Fire safety (HES)

101 Fire fighting equipment should be tested to the levels and standards required by the appropriate maritime administration or certifying authority, who will also be responsible for ensuring compliance.

G 200 Personal protective equipment (including personal diving equipment) (HES)

201 Follow the scope for semi-annual, annual, intermediate and renewal surveys.

APPENDIX C
EXAMPLE CHECKLISTS

A. General

A 100 Objective

101 The objectives of writing a survey planning document that is tailor made for the particular diving system, is to make the survey more efficient by reducing the time it takes to move around the system, to look for relevant information and to adapt generic documentation to the particular case at hand.

102 To supplement and support the planning document, checklists should be made with the same layout as the planning document. In some cases IMCA checklists may be used with few modifications, in other cases dedicated checklists need to be written for the system or component.

103 The following checklists are therefore meant only as examples to writing dedicated checklists, and not as replacements for them.

A 200 Annual survey checklist

Table C-1 Annual survey checklist - Example

System Status	*Condition*	*Action*	*Comment*
Diving System Operational Status			
General			
Operations manuals			
Cleanliness of system, gas storage, esp. oxygen compressor room and oxygen distribution room.			
View ports and their protective plating			
Acrylic Windows Date of manufacture: ___/___/___			
Hatch and medical lock sealing surfaces			
Permanent marking of equipment			
Calibration of essential gauges and clocks Date of calibration: ___/___/___			
Attachments and framework			
Structural Integrity and corrosion status of: — chambers and bell — gas containers — handling structure.			
Gas distribution system			
Oxygen make-up system			
Gas regeneration units and ECU			
Main electrical power supplies to: — lighting of chambers and bell (int. and ext.) — monitoring devices — control consoles (sat, dive, handling) — normal and emergency life support systems — alarm systems — switchboards, breakers, cables — megger test records.			
Communication includes emergency communication between control stand and the following: — divers in water — bell — each compartment — bridge — emergency through water communication for bell — other control stands.			
Shell penetrations in chambers and bell			
Bilge drains, supply and exhaust valves in bell(s)and chambers			
Fire Protection			

Table C-1 Annual survey checklist - Example (Continued)			
Submersible Diving Chambers – Bells 1			
Submersible Diving Chambers – Bells 2			
Bell emergency systems Last load test on ballast weight release mechanism: ___/___/___			
Hot water piping to bell			
Bell electrical system			
Deck Decompression Chamber 1			
Hot and cold water supplies to chambers			
Heating system of chambers			
Toilet flush system.			
Deck Decompression Chamber 2			
Hyperbaric Rescue Vessel			
Survey of chamber and launching system. Date last launch test was carried out: ___/___/___ Entry in ships logbook verified.			
Bell Handling System 1			
Bell Handling System 2			
Hoisting Wires Date of last test: ___/___/___ Result of last tests:_____			
Load Testing Date of test: ___/___/___			
Bell Deployment and mating			
Umbilical winch system			
Hydraulic power system Last oil analysis: ___/___/___			
Bell buoyancy test Freeboard measured: _____m			

A 300 Intermediate survey Checklist

Table C-2 Intermediate survey Checklist - Example			
System Status	*Condition*	*Action*	*Comment*
Portable fire extinguishers in chambers Date of last pressure test: ___/___/___			
Portable fire extinguishers outside chambers			
Breathing apparatus outside chambers Last pressure test: ___/___/___			
Permanently installed fire extinguishing systems Date of last inspection by competent company: ___/___/___			
Instrumentation alarms: — high / low pressure alarm for chamber, if fitted — temperature alarm for chamber, if fitted — humidity alarm for chamber, if fitted — divers hot water temperature alarm — divers hot water pressure alarm — change over to standby heater alarm — gas delivery compressor - high pressure alarm — compressor cooling system - low pressure alarm — compressor - low pressure lub. oil alarm — o_2 analysers, high / low alarm — high level alarm for gas reclaim bag, if applicable — low o_2 atmosphere sensors in control room.			

Table C-2 Intermediate survey Checklist - Example (Continued)			
Power failure alarms for handling systems — hydraulic system for bell handling - low pressure alarm — hydraulic system for bell handling - high temperature alarm — hydraulic system for bell handling system - low oil in tank alarm.			
Manual / automatic control valves and reduction valves			
Safety valves on compressors and boosters Dates of calibration / test: ___/___/___			
Safety valves on permanently installed gas bottles Dates of calibration / test: ___/___/___			
Life support systems			
Umbilical			
Leak testing Pressure: _____bar Duration: _____hrs. Result:_____			
Working weight of bell Bell weight:_____kg Previous weight:_____kg			

A 400 Renewal Survey Checklist

Table C-3 Renewal Survey Checklist - Example			
System Status	*Condition*	*Action*	*Comment*
Bell insulation Areas insulation removed from:			
Pressure testing of chambers Test date: ___/___/___ Serial nos.:_____ Test pressure:_____bar Test duration:_____hrs Type of test:_____			
Pressure testing of bell(s) Test date: ___/___/___ Serial nos.:_____ Test pressure:_____bar Test duration:_____hrs Type of test:_____			
Pressure testing of gas containers Test date: ___/___/___ Serial nos.:_____ Test pressure:_____bar Test duration:_____hrs Type of test:_____			
Load testing Test date: ___/___/___ Serial nos.:_____ Type of test:_____			
Emergency retrieval of bell			
Positioning systems			
Additional fire protection			