

Manned underwater operations

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Foreword

The NORSOK standards are developed by the Norwegian petroleum industry to ensure adequate safety, value adding and cost effectiveness for petroleum industry developments and operations. Furthermore, NORSOK standards are, as far as possible, intended to replace oil company specifications and serve as references in the authorities' regulations.

The NORSOK standards are normally based on recognised international standards, adding the provisions deemed necessary to fill the broad needs of the Norwegian petroleum industry. Where relevant, NORSOK standards will be used to provide the Norwegian industry input to the international standardisation process. Subject to development and publication of international standards, the relevant NORSOK standard will be withdrawn.

The NORSOK standards are developed according to the consensus principle generally applicable for most standardisation work and according to established procedures defined in NORSOK A-001.

The NORSOK standards are prepared and published with support by The Norwegian Oil Industry Association (OLF), The Federation of Norwegian Industry, Norwegian Ship owners' Association and The Petroleum Safety Authority Norway.

NORSOK standards are administered and published by Standards Norway.

Annex A and Annex B are informative.

Introduction

This NORSOK standard is the result of an industry-wide effort to establish a standard for MUOs.

1 Scope

This NORSOK standard defines basic requirements for personnel, equipment and systems for MUOs within the petroleum industry.

2 Normative and informative references

The following standards include provisions and guidelines which, through reference in this text, constitute provisions and guidelines of this NORSOK standard. Latest issue of the references shall be used unless otherwise agreed. Other recognized standards may be used provided it can be shown that they meet the requirements of the referenced standards.

2.1 Normative references

ISO 9001,	Quality management systems – Requirements
ISO 19901-6: — ¹⁾ ,	Petroleum and natural gas industries – Specific requirements for offshore structures – Part 6: Marine operations
NORSOK U-101,	Diving Respiratory Equipment
NORSOK U-102,	Remotely operated vehicle (ROV) services

- [1] IMO. Guidelines for Vessels with Dynamic Positioning systems, issued by IMO. MSC Circ. 645. London: IMO.
- [2] The Norwegian Board of Health. Norwegian guidelines for medical examination of occupational divers. Oslo, 2000; 1-00 IK-2708. (Statens helsetilsyns veiledningsserie ; vol 2000).
- [3] HSE. The medical examination and assessment of divers. Guidance Note MA1. London: HSE.
- [4] IMO. Code on noise levels on board ships A 468 and recommendations on methods for measuring noise levels A 343. London: IMO, 1976-1982: 742.
- [5] The Norwegian Labour Inspection Authority. Administrative standards for contamination in the working atmosphere. (In Norwegian). Ordering No 361.
- [6] IMCA D 020. Scheme for recognition of diver medic training – Guidance for training establishments. London: IMCA.

One of the following two [7] or [8] referenced classification rules shall be used:
- [7] DNV. Rules for certification of diving systems. The Norwegian Veritas.
- [8] LRS. Rules and regulations for the construction & classification of submersibles and underwater systems. Lloyd's Register of Shipping.
- [9] IMO. International conventions for the safety of life at sea, 1974, as amended. London: IMO, 2004: 552 + 2 amendments + ISM Code + resolutions the 1997 conference.
- [10] IMO. Code of safety for diving systems, resolution A.536(13) - A 831(19). London: IMO, 1997.
- [11] AODC 035. Code of Practice for The Safe Use of Electricity underwater. London: IMCA.
- [12] IMCA D 043. Marking and colour coding of gas cylinders, quads and banks for diving application. London: IMCA.
- [13] IMCA D 010. Diving operations from vessels operating in Dynamically Positioned mode. London: IMCA.

¹⁾ To be published.

2.2 Informative references

EN 12464-1,	Light and lightning – Lightning of work places – Part 1: Indoor work places
ISO 32:1977,	Gas cylinders for medical use – Marking for identification of content
ISO 6385,	Ergonomic principles in the design of work systems
ISO 8995,	Lightning of indoor work places
NORSOK S-002,	Working Environment
NS 5814,	Krav til risikoanalyser [including Rausand: Risikoanalyse – Veiledning til NS 5814 (Risk analysis – A guidance to NS 5814), 1 st edition. Trondheim: Tapir, 1991; ISBN 82-519-0970-8 (all in Norwegian – Alternative in English language: IEC 60300-3-9)]

NOTE A new guidance to NS 5814:2008 will be published during 2009.

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- [17] EDTC. Fitness to Dive Standards. Guidelines for Medical Assessment of Working Divers. www.edtc.org
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- [19] Risberg J, Brubakk AO, Groenning M *et al.* Health surveillance of deep divers. (In Norwegian). Bergen: Norwegian Underwater Technology Centre AS, 1994; NUTEC report no. 20-94.
- [20] OLF Guideline 073. Recommended guideline for medical supplies in manned underwater operations in the petroleum activities on the Norwegian continental shelf. www.olf.no
- [21] NPD. Man-machine interface in control rooms for manned underwater operations in the petroleum activity. (In Norwegian). Stavanger: NPD, 1993; ISBN82-7257-386-5.
- [22] NRPA. Guidance for industrial radiography. Guideline for "Regulations for radiation protection and use of radiation". (In Norwegian). Østerås: The Norwegian Radiation Protection Authority. Guideline no. 1.
- [23] NRPA. Personal dosimetry for occupational exposed personnel – ionising radiation from external radiation sources. (In Norwegian). Østerås: The Norwegian Radiation Protection Authority. Radiation Protection leaflet no. 8.
- [24] Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz). Health Phys 1998; 74(4):494-522.
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- [27] ACGIH. TLVs and BEIs. Ohio: American Conference of Governmental Industrial Hygienists.

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- [29] HSE. Diving at Work Regulations 1997. Approved Code of Practise. Commercial diving projects offshore. London: HSE, 1998.
- [30] PSA. Safety notes and letters in pursuance of the regulations. Stavanger: PSA.
- [31] HSE information sheets. London: HSE.
- [32] Bergan T, Warncke M. Emergency and contingency training for diving personell. (In Norwegian). Stavanger: NPD, 1993; YA-539, ISBN 82-7257-385-7.
- [33] OLF Guideline 002. Guidelines for Safety and Emergency training. www.olf.no
- [34] NUI. Handbook for testing of diving equipment. Bergen: Norwegian Underwater Intervention AS.
- [35] IMCA D 018. Code of practice on the initial and periodic examination, testing and certification of diving plant and equipment. London: IMCA.
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- [46] IMCA guidance notes and codes. London: IMCA.
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- [60] EDTC Training standards for diving and hyperbaric medicine. www.edtc.org

3 Terms, definitions and abbreviations

For the purposes of this NORSOK standard, the following terms, definitions and abbreviations apply.

3.1 Terms and definitions

3.1.1

accident

unwanted event which causes personal injury, environmental/material damage or loss of production

3.1.2

assistant life support technician

ALST

person with the proper theoretical qualifications who is undergoing a period of planned work experiences for his training to become a LST

3.1.3

bell run

time between disconnection and reconnection of the diving bell from and to the surface chamber complex when a diving bell is used for transport of divers to and from the work site

3.1.4

can

verbal form used for statements of possibility and capability, whether material, physical or casual

3.1.5

competent person

person with authorisation/documentated qualifications for performing a specified function

3.1.6**compression period**

compression commences at the start of pressurisation and is completed upon arrival at the working depth, or for saturation diving, the planned living depth including stand-off periods and HPNS screening time

3.1.7**contingency diver**

diver who is appointed to the position of contingency diver and have the necessary equipment ready for use

3.1.8**decompression period**

- a) *during saturation diving*: from the start of build-up of the pO_2 in preparation for the final decompression phase, until arrival at atmospheric pressure
- b) *during surface oriented diving*: from starting final ascent until arrival at surface pressure

3.1.9**diver**

person holding a diving certificate and a valid medical certificate issued by an approved authority or by institutions/organizations accredited by an approved authority

3.1.10**diving basket**

device used to lower and recover divers to and from work-sites sub sea, which do not protect against contact with surrounding water

3.1.11**duty diving doctor**

medical doctor, approved as duty diving doctor, who is on call during diving operations

3.1.12**diving bell**

submersible compression chamber designed for transport of personnel between the surface and the work site at atmospheric pressure or under increased pressure

3.1.13**diving operation**

activity where the diver is directly exposed to increased ambient pressure

3.1.14**diving superintendent**

person who has been appointed in writing by the underwater contractor to be the person in charge of, and responsible for, a MUO

3.1.15**diving supervisor**

person who has been appointed in writing by the underwater contractor to be in charge of a MUO or parts of such operation

3.1.16**diving work-site**

site from which the diving is performed

NOTE Also referred to as diving platform.

3.1.17**excursion**

any descent or ascent from pressure at living depth

3.1.18**incident**

generic term covering any undesired event

3.1.19**life support supervisor****LSS**

person who has been appointed in writing by the underwater contractor to act as "person in charge" of the operation of a chamber complex with associated equipment

3.1.20**life support technician****LST**

qualified person operating a chamber complex with associated equipment

3.1.21**living depth**

pressure/depth at which the saturation divers stay in the chamber complex following the compression period and intermediate compressions/decompressions, and prior to final decompression period

NOTE Also called "storage depth".

3.1.22**manned underwater operation****MUO**

activity when humans stay below surface and/or are exposed to increased ambient pressure

3.1.23**may**

verbal form used to indicate a course of action permissible within the limits of this NORSOK standard

3.1.24**meter of sea water****msw**

pressure unit equal to 10 kPa (making 10 msw exactly 1 bar or 100 kPa), implies a relative density of 1,01972

3.1.25**near accident**

event that, under slightly different circumstances, could have caused personal injury, fire, environmental/material damage or loss of production

NOTE Also called "Near Miss".

3.1.26**operator**

oil company, responsible as the obligated party

3.1.27**shall**

verbal form used to indicate requirements strictly to be followed in order to conform to this NORSOK standard and from which no deviation is permitted, unless accepted by all involved parties

3.1.28**should**

verbal form used to indicate 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

3.1.29**stand-by diver**

diver that shall be prepared and equipped to give immediate assistance to the diver

3.1.30**stay at working depth**

period of time between completed compression, or first compression if work is to take place at several levels of pressure, and commencement of the final decompression

3.1.31**submerged habitat**

submerged chamber or device positioned below surface and designed so as to allow personnel to work there under dry conditions

3.1.32**supervisory personnel**

personnel on the diving team acting in a supervisory role

NOTE Diving/ADS supervisors, LSSs, superintendents, etc.

3.1.33**surface oriented diving**

diving operation where the diver enters and leaves the water at normal ambient pressure

3.1.34**time in water, bell diving**

period of time from when a diver leaves the bell on a lock-out until he returns to the bell after completed lock-out, including any rest periods required during the lock-out, not including mandatory rest periods

3.1.35**trainee diving supervisor**

diver undergoing a period of planned work experiences for his training to become a diving supervisor

3.1.36**underwater contractor**

diving company or firm undertaking petroleum related MUOs

3.1.37**verification**

confirmation, through provision of objective evidence, that specified requirements have been fulfilled

NOTE 1 The term "verified" is used to designate the corresponding status.

NOTE 2 Confirmation can comprise activities such as

- performing alternative calculations,
- comparing a new design specification with a similar proven design specification,
- undertaking tests and demonstrations,
- reviewing documents prior to issue.

3.1.38**wet bell**

device with an upper section containing a pocket of breathable gas, and which is used to lower and recover divers to and from work-sites sub sea

3.1.39**working depth**

depth of the diver at work

3.2 Abbreviations

ADS	atmospheric diving system
AODC	Association of Offshore Diving Contractors (NOTE Now part of IMCA)
ALST	assistant life support technician
Ar	argon
BA	breathing apparatus
BIBS	built in breathing system
CO	carbon monoxide
CO ₂	carbon dioxide
DMAC	Diving Medical Advisory Committee
DNV	Det Norske Veritas (The Norwegian Veritas)
DP	dynamic positioning
DSV	diving support vessel
EDTC	European Diving Technology Committee
HEL	hyperbaric exposure limit
HLB	hyperbaric life boat
HRU	hyperbaric rescue unit (covers hyperbaric rescue vessel and HLB)

NOTE IMO uses hyperbaric evacuation unit for a unit in which divers are evacuated and hyperbaric evacuation to describe the entire system for evacuation of divers.

HPNS	high pressure nervous syndrome
HSE	Health and Safety Authority (UK)
IMCA	The International Marine Contractors Association (former AODC)
IMO	International Maritime Organisation
kPa	kilopascal
LSP	life support package
LSS	life support supervisor
LST	life support technician
msw	meters of sea water
MRT	modified rhyme test
MUO	manned underwater operation
N ₂	nitrogen
NO _x	mono-nitrogen oxides
NAV	the Norwegian Labour and Welfare Organisation
NPD	Norwegian Petroleum Directorate
O ₂	oxygen
O ₃	ozone
OD	Oljedirektoratet
OLF	Oljeindustriens Landsforening (The Norwegian Oil Industry Association)
pAr	partial pressure of Ar
pN ₂	partial pressure of N ₂
pCO ₂	partial pressure of CO ₂
pO ₂	partial pressure of O ₂
ppm	parts per million
PSA	Petroleum Safety Authority (former part of NPD)
QA	quality assurance
ROV	remotely operated vehicle
SHE	safety, health and environment
STEL	short term exposure limit
TUP	transfer under pressure
UV	ultraviolet

4 Administrative requirements

4.1 General

If there are safety aspects not covered in this NORSOK standard, an independent responsibility to maintain the safety level indicated by this standard is imposed on anyone engaged in MUO.

The contractor's organisation shall include administrative functions responsible for areas that ensure a safe and efficient operation. As a minimum, these functions are

- a) diving discipline,
- b) SHE,
- c) emergency preparedness,
- d) QA,
- e) personnel,
- f) management of diving equipment/system including, if relevant, the work-site in accordance with ISO 9001.

4.2 Documentation

The contractor shall document the diving methods relevant for the scope of work to be conducted under a contract. This documentation shall be based on the contractor's general diving/ADS procedures for MUO and, if relevant, include a description of DP-operations, and be in accordance with [1] and ISO 19901-6.

Management systems and quality assurance shall be implemented in accordance with ISO 9001. Technical and operational documentation shall be in accordance with national legislation and this NORSOK standard.

The contractor shall have a documented system for systematic, preventive maintenance, including updating of certificates, covering all diving related equipment, systems and machinery.

As a minimum, the contractor shall define, document and make available procedures covering

- a) normal and emergency operation of the equipment,
- b) function and verification testing, including acceptance parameters,
- c) limits for monitoring parameters, including early warning,
- d) check lists for routine operation, for technical equipment and operational aspects,
- e) manning requirements,
- f) detailed job descriptions for all personnel categories involved in the MUO,
- g) SHE activities related to the work-site (if relevant)/diving activities.

These procedures shall include minimum requirements in order to commence an operation, criteria for suspension and emergency procedures.

Findings/reports from relevant risk analyses, including resulting risk reducing measures shall be available to operational personnel, see 5.3 and Clause 9.

Personnel certification status and qualifications shall be presented in the form of a personnel qualification matrix.

Check lists are part of the operational documentation, and shall be an aid to ensure that the preconditions for initiation, implementation and termination of a safe operation are met. Check lists should have a simple and straightforward lay-out and should cover both normal operations and emergency situations.

Emergency procedures shall be specific to the equipment and work-site. Detailed emergency procedures covering all emergency scenarios shall be available. The scenarios shall include provision of medical care for a critically injured/sick diver under pressure.

4.3 Compliance and deviations

An in-date compliance measurement matrix with regards to this NORSOK standard and relevant regulatory requirement shall be available. Compliance shall be documented. The contractor shall evaluate all items of non-compliance. Qualified alternative solutions may be suggested, and shall be documented. The compliance matrix shall state the administrative function responsible for handling a non-compliance.

The contractor shall forward all non-compliances to the operator for acceptance. Only non-compliances accepted by operator can be forwarded to the authorities as a deviation request.

Dispensations have to be granted by the parties involved, including representatives from the diving personnel, their safety delegates and the operator. A risk analysis shall be performed.

4.4 Certification/verification

Documentation shall be provided to demonstrate that equipment for MUO has been manufactured, function tested and, where relevant, type approved in accordance with the requirements of this NORSOK standard.

The contractor shall document that procedures and equipment critical to SHE, and used in connection with MUOs at any given time, comply with functional and technical requirements in this NORSOK standard.

Prior to commencement of any MUO, the contractor shall ensure that the above documentation, in addition to certificates for the diving system/ADS, including all relevant components, auxiliary and emergency equipment, are issued and valid. Certificates issued shall be specific and identify the equipment they cover. Limiting factors for the above shall be included in the operating instructions. The contractor shall have a system for ensuring that the documentation is kept valid for the duration of the operation.

4.5 Document availability

As a minimum, the contractor shall ensure availability of updated editions of the documentation referred to in Table 1.

Table 1 – Documentation required

Description	Contractor	Work-site
Contractor's project QA manual/plan	X	X
Contractor's SHE plan for the operation/work-site	X	X
Contractor's operational manuals, pertaining to the relevant contract	X	X
Contractor's contingency plan for the relevant contract, interfaced with operator's plan for the relevant concession areas	X	X
Contractor's personnel documentation matrix (including sub-contractors)	X	X
Experience reports from previous, relevant operations.	X	X
All relevant regulations	X	X
All normative references applicable for the operation to be undertaken	X	X
Relevant informative references listed in 2.2 or equivalent	X	
Updated crew-lists and shift schedules, including sub-contracted personnel	X	X
Documentation to satisfy 6.3	X	
Certificates to satisfy 6.3	X	X
Suppliers instructions for maintenance and operation of all equipment	X	X
Procedures for all activities pertaining to the relevant contract	X	X
All relevant safety notices	X	X
Copies of contracts relating to the operation	X	X
Applicable classification rules	X	X
Copies of any dispensations granted from operator and/or authority requirements, together with documentation for which the dispensation is granted	X	X
Relevant risk analysis	X	X
Log books to document operational activities		X
Updated compliance measurement	X	X

4.6 Reporting

4.6.1 General

The contractor's reporting of manned underwater activities shall be structured to provide the operator with data to meet regulatory and operator's requirements for reporting.

Diver exposure data shall be recorded on an on-line data system that facilitates easy access to individual diver data during the required storage period.

The contractor shall have a system for recording data, which may be used by the operator to generate the required reports and statistics.

4.6.2 Contractor's scheduled reporting responsibilities

4.6.2.1 Daily operation

A daily progress report shall include MUO data. Copies of all logs and reports shall be made available for the operator's representative upon request.

4.6.2.2 Experience feedback reporting

Experience gained during operation shall be systematically reported back to the discipline department, where it shall be analysed and evaluated by competent personnel. If required, corrective actions shall be implemented as a result of this process.

4.6.2.3 Monthly activity report

The contractor shall, if relevant, at the end of each calendar month submit to the operator a summary of the previous month's activities, specifying abnormalities, technical and operational problems of relevance to the safety or health of the personnel, and detailing corrective actions taken.

An evaluation of the medical aspects of the operation shall be included. The working environment committee shall have reviewed this evaluation report.

4.6.2.4 Annual/final experience report

Within three weeks after completed demobilisation, or other defined work period (e.g. season), the contractor shall submit to the operator a complete evaluation report, prepared in co-operation with the safety delegates and the responsible diving doctor. All aspects relevant to the applicable regulations, safety, occupational health and technical/operational issues shall be included.

4.6.3 Notification and reporting, accident/near-accident/illness

4.6.3.1 General

The contractor shall have an established system for alert/notification, reporting and investigation of accidents, near accidents and illness, which satisfies regulatory as well as operator requirements.

Notification and reporting to the authorities shall be done in accordance with requirements in the area of operation.

In general, below listed accidents, near-accidents and illnesses requires alert/notification and subsequent reporting during MUO:

- a) every fatal accident and accidents/illnesses that require first aid and medical treatment;
- b) every case of fire in the plant; also where chamber complex is not occupied by divers and whether the complex is pressurized or not;
- c) unintentional halt in the function of any unit necessary to maintain life and health of personnel working under water; regardless of number of barriers to total failure;
- d) every form of unconsciousness;
- e) accidental change of ambient pressure;
- f) decompression illness;
- g) gas supply cut-off;
- h) faulty gas mixture;
- i) aborted operation due to illness;
- j) external ear infection.

Even if the level of risk resulting from such incidents/failures is considered to be low, this shall not prevent the alert/notification and reporting process.

Equipment failures detected during routine, pre-dive checks (documented in checklists/logs) should be registered as equipment failures (see 4.6.3.6), and are not considered to be near-accidents.

4.6.3.2 Special requirements for MUO under the Norwegian Petroleum Act

During MUO under the Norwegian Petroleum Legislation, special requirements shall be observed. All notification and reporting to Norwegian authorities shall be done by the operator (with the exception of the NAV form). For further guidance on these requirements, see annex A.

4.6.3.3 Alert/notification

4.6.3.3.1

The operator's onboard/onsite representative shall be notified immediately of all accidents/illnesses involving first aid or medical treatment and all near-accidents at the work-site (see listing in 4.6.3.1), in accordance with the emergency preparedness plan. As a minimum, following details shall be included:

- a) location and time;
- b) name and personal details of any injured/sick persons;
- c) details of the incident;
- d) plans for following up the injury/illness;
- e) name of contact person.

4.6.3.3.2

For MUO the following additional information shall be included with the alert/notification when relevant:

- a) planned depth,
- b) depth at which the first symptoms occurred,
- c) gas mixture,
- d) purpose of the ongoing operation,
- e) location of personnel,
- f) operational method,
- g) name of persons in the operation management,
- h) wind and wave conditions, visibility, etc.

4.6.3.4 Reporting

4.6.3.4.1

Every fatal accident, accidents/illnesses that require first aid and/or medical/hyperbaric treatment and near-accidents (see 4.6.3.1) shall, without delay, be reported to the operator representative, and subsequently, as required, to the authorities. For MUO, the specialized form in A.3 shall be used. All reporting shall comply with national legislation to preserve anonymity of the individual patient (medical confidentiality).

4.6.3.4.2

For MUO the following additional details shall be reported, where relevant:

- a) planned depth,
- b) depth at which the first symptoms occurred,
- c) gas mixture,
- d) purpose of the ongoing operation,
- e) location of personnel,
- f) operational method,
- g) name of persons in the operation management,
- h) wind and wave conditions, visibility, etc.

4.6.3.4.3

With respect to injury or illness, the following should be included in the report:

- a) a description of the injury or illness;
- b) the first symptom;
- c) type of first aid;
- d) who administered first aid;
- e) further treatment;
- f) location of the injury or presenting symptoms;
- g) an assessment of contributing causes to the injury or illness.

4.6.3.5 Use of medication

All use of medication shall be logged and reported to the health service.

4.6.3.6 Equipment failure

The contractor shall have an established system for registration/notification and correction of equipment failures.

4.6.3.7 Investigation

Serious accidents and near accidents shall be investigated in accordance with an established procedure, and the conclusions drawn from this investigation shall be reported to the operator, together with planned measures to prevent reoccurrence. The method used for investigation shall ensure that operational, human, technical and organisational aspects are considered when defining the causes of the occurrence.

The investigation shall take place as soon as possible after the event. The scene of the accident/near accident shall not be disturbed until all investigations are completed.

The investigation shall be carried out in addition to any investigation implemented by a public authority, or a public appointed accident commission.

5 Safety, health and environment (SHE) requirements

5.1 Health

5.1.1 General

The underwater contractor shall establish, maintain and use procedures which prevent short and long term harmful effects on divers/ADS pilots, for information see [14]. The underwater contractor shall regularly evaluate and update procedures based on empirical data from available sources.

The underwater contractor shall establish an occupational health service covering MUO.

5.1.2 Health service

5.1.2.1 Organisation

The health service shall be organized so that it remains professionally and medically independent, and the lines of reporting shall be clear and unambiguous. The health service shall have access to all information necessary to enable it to carry out required tasks.

A responsible competent diving doctor shall be appointed as medically responsible for the health service.

5.1.2.2 Duties

5.1.2.2.1

The health service is responsible for

- a) the supervision of all health-related aspects in all phases of MUO,
- b) evaluating and accepting diving procedures,
- c) reviewing diving related injuries and illnesses,
- d) promoting safety through involvement in planning of MUO,
- e) advising line management and personnel engaged in MUO on conditions of significance to health,
- f) preparing medical contingency plans,
- g) organising a duty diving doctor service to ensure diving medical treatment in cases of illness or injury,
- h) supervision of all aspects of hygiene during MUO, (examples in [15] and [16]),
- i) establishing a system for provision of adequate nutrition, including adequate fluids,
- j) establishing a system for first aid training of offshore personnel involved in MUO.

5.1.2.2.2

The medical contingency plan shall address

- a) handling of all acute medical problems in MUO,
- b) procedures for hyperbaric evacuation,
- c) how to return personnel to surface pressure and give required medical treatment during decompression period,
- d) how qualified medical treatment can be given to personnel under pressure,
- e) how drills are to be carried out in order to handle an accident or a hazardous situation.

5.1.3 Evaluation of medical fitness

ADS pilots shall hold a certificate of medical fitness as required by national regulations for offshore workers. Divers shall hold a certificate of medical fitness for personnel required to work under increased ambient pressure. The medical practitioner performing the examination shall be approved by national authority. The examination shall be performed in accordance with [2] or [3]. See also [17] or [18] for information.

Where an annual medical examination is carried out less than a month before the expiration date of the current medical certificate, the start date of the new certificate may begin from the expiry date of the current certificate.

The health service shall establish individual medical files for all divers, containing information on

- a) health status,
- b) previous work experience, including diving exposure data,
- c) illnesses and injuries with relevance to diving.

5.1.4 Short and long term health monitoring

Pre- and post-dive medical checks, in accordance with procedures approved by the responsible diving doctor, shall be conducted routinely for all divers. For saturation divers these checks shall be performed upon entering and surfacing from saturation dives, and for air divers prior to and after completion of work periods.

Reports from these checks shall be part of the individual follow-up of the divers.

A system for monitoring long and short-term health effects of diving shall be established.

Special attention shall be paid to long term health monitoring of organ systems known to be affected by diving. This shall as a minimum include monitoring of

- a) ear function,
- b) pulmonary function,
- c) nervous system function,
- d) long-bone structure.

Examinations shall be repeated at regular intervals not exceeding three years, using accepted methods.

When diving deeper than 180 msw, the divers shall be followed up in accordance with detailed examination as specified e.g. in [19] or equivalent.

When following up the individual diver's health, diving exposure data is an important parameter. The contractor shall therefore maintain a system to collect and store such data in a manner enhancing a prompt retrieval of each individual diver's exposure data. The contractor shall further contractually require that the individual diver make available to the health service (in the form of a self-declaration) all diving exposure data, including data from diving taking place outside the confines of employment/appointment with the contractor.

Sensitive individual medical data shall be protected, as a minimum, in accordance with national requirements.

5.1.5 Medical contingency

5.1.5.1 General

The contractor shall establish a system for handling medical contingencies in connection with MUO. A duty diving doctor system shall be established for this purpose.

5.1.5.2 Mandatory contingency medical supplies

The contractor shall supply medical equipment and drugs according to applicable national guidelines or e.g. [20]. The responsible diving doctor can deviate from this list if an equal or higher level of medical support/contingency can be assured by other means. Such changes shall be documented.

The contractor shall have a system ensuring that there always is a supply of the following materials:

- a) first aid equipment, with user's manual, if necessary;
- b) medical supplies and medical equipment intended for use during MUO, with user's handbooks;
- c) medical supplies and other material for medical contingency.

The stores shall be checked regularly by competent personnel.

5.1.5.3 Access to telecommunication

The person performing advanced first aid shall have priority and unimpeded access to suitable telecommunication with the responsible diving doctor, the duty diving doctor or any other competent personnel as may be required.

5.2 Working environment

5.2.1 General

The contractor shall ensure a working environment that, in all respects, enhances the safety and well-being of all personnel. A working environment programme shall describe activities to improve the working environment. This programme shall be reviewed yearly based on findings from, amongst others, working environment mapping and shall involve active participation from the workers. Such participation shall be documented. For information, see relevant clauses in NORSOK S-002 or equivalent.

5.2.2 Physical work environment

5.2.2.1 General

The physical environment for divers in water, chambers, bells, mono-baric craft and/or habitats, shall be subject to particular and close monitoring, with control of all parameters relevant to the safety and health of the diver.

Methods to achieve optimum conditions shall be implemented by the contractor by actively seeking and evaluating new knowledge.

5.2.2.2 Ergonomics

The design and lay-out of plant and equipment shall aim to reduce negative effects from environmental factors on the users' safety, efficiency or comfort. This may be obtained by the incorporation of ergonomic principles, such as system models, into the design process. For information, see ISO 6385 and [21].

Mapping of ergonomic conditions in chambers, diving bells, control rooms, and the divers' working conditions, shall be performed initially and repeated following modifications. Mapping shall be initiated and followed up by contractors' health service with input from the users, and performed by competent personnel. Recommended corrective actions shall be evaluated and followed up.

5.2.2.3 Temperature

Thermal control systems for divers in water, in hyperbaric chambers, bells, habitats and in mono-baric crafts shall have the capacity and the accuracy to ensure thermal balance and comfort for the divers/occupants during all phases of a normal dive, see 7.8.

In emergency situations, where the divers/occupants cannot be returned to a safe environment, the life support systems shall ensure a thermal status within safe limits for the time required to perform the rescue operation, see 7.8.2 and 9.3.