

Guideline for Offshore Diving

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Table of Contents

1.	Preliminary Comments.....	1
2.	Scope of Application.....	3
3.	Definition of Terms and Abbreviations	4
3.1.	Definition of Terms.....	4
3.2.	Abbreviations	8
4.	Legal Regulations, Norms and Guidelines	11
4.1.	Statutes.....	11
4.2.	Ordinances.....	11
4.3.	DGUV Regulations	12
4.4.	Standards.....	12
4.5.	Other regulations	13
5.	Requirements for the Performance of Offshore Diving.....	14
5.1.	Administrative Principles and Responsibilities.....	14
5.1.1	General	14
5.1.2	Client.....	14
5.1.3	Diving company	15
5.2.	Personnel Involved	15
5.2.1	Offshore Diving Project Manager	15
5.2.2	Diving supervisor	16
5.2.3	Divers.....	17
5.2.4	Dive tender	18
5.2.5	Dive assistant.....	18
5.2.6	Diver pressure chamber operator	19
5.2.7	Person with advanced medical knowledge	19
5.2.8	Designated physician.....	19
5.2.9	Additional operators.....	19
5.3.	Technical Requirements	20
5.3.1	Breathing apparatus.....	20
5.3.2	Auxiliary gas supply system	20
5.3.3	Carrying device, body bandages and lifting harness for divers.....	21
5.3.4	Lines, ascent and descent aids	21
5.3.5	Breathing gas supply system for divers.....	21
5.3.5.1	Breathing gas supply	22
5.3.5.2	Breathing gas compressor	23
5.3.5.3	Marking.....	23
5.3.6	Diving systems	23
5.3.6.1	Diver pressure chambers.....	23
5.3.6.2	Diving bells open/closed, diving baskets.....	23
5.3.7	Dive site	24
5.3.8	Emergency equipment	24

5.3.9	Tools and technical work tools.....	24
5.3.9.1	Electrical equipment.....	25
5.3.9.2	Pressure-driven work tools	26
5.3.9.2.1	Hydraulic work tools.....	26
5.3.9.2.2	Pneumatic work tools.....	27
5.3.9.2.3	High-pressure equipment.....	27
5.3.9.3	Measuring equipment	27
5.3.9.4	Cranes, lifting appliances.....	27
5.3.10	Auxiliary anchor points under water	27
5.3.11	Remotely Operated Vehicles (ROVs).....	27
5.4.	Rescue Equipment.....	28
5.4.1	Requirements for first aid equipment.....	28
5.4.2	Diver pressure chamber	28
5.4.3	Equipment for rescue from the water.....	28
5.4.4	Treatment area.....	28
5.4.5	Hoist Marking	28
5.4.6	Communication	28
6.	Operation (performance of diving work)	29
6.1.	Principles for the performance of diving work.....	29
6.1.1	Leadership and Supervision.....	29
6.1.2	Dive team (composition)	30
6.1.3	Compliance with rest periods and breaks (particularly for divers)	31
6.1.4	Medication, alcohol, drugs.....	31
6.2.	Planning, Preparation and Documentation.....	32
6.2.1	General	32
6.2.2	Diving project plan.....	33
6.2.3	Risk assessment.....	33
6.2.4	Work permit procedure.....	33
6.2.5	Diver's log	34
6.2.6	Preparing the diving plan	34
6.2.6.1	Calculation of breathing gas quantities.....	35
6.2.6.2	Diving and decompression times	35
6.2.6.3	Specific risks and impediments	36
6.2.6.4	Emergency and rescue plans	37
6.3.	Performance of diving work	38
6.3.1	Monitoring, control points and communication	38
6.3.2	Divers' entry and exit routes	38
6.3.3	The dive	38
6.3.4	Weather / Environmental conditions.....	39
6.3.5	External risks /Risks from third parties	40
6.3.5.1	Diving with ROVs	40

- 6.3.5.2 Underwater piling work..... 40
- 6.3.5.3 Flora and fauna..... 40
- 6.3.6 Diving and decompression times 40
- 6.3.7 Emergency surface decompression..... 40
- 6.3.8 Behaviour after a dive 41
- 6.4. Conduct in the case of diver injury..... 41
 - 6.4.1 Measures 41
 - 6.4.2 Reporting..... 42
- 6.5. Diving platforms 43
 - 6.5.1 General points 43
 - 6.5.2 Diving from ships..... 43
 - 6.5.2.1 Ships at anchor 43
 - 6.5.2.2 DP ships 43
 - 6.5.2.3 Diving from a rigid inflatable boat (RIB)..... 44
 - 6.5.3 Diving from fixed platforms..... 45
 - 6.5.3.1 Diving in structures (confined spaces/special access)..... 45
- 6.6. Fire Protection 46
 - 6.6.1 General fire protection..... 46
 - 6.6.2 Fire protection in diver pressure chambers 46
- 7. Maintenance and Inspection..... 48
 - 7.1. General 48
 - 7.2. Maintenance..... 48
 - 7.2.1 General 48
 - 7.2.2 Breathing apparatus 49
 - 7.2.3 Pressure chambers and diving systems..... 49
 - 7.2.4 Rescue equipment..... 49
 - 7.2.5 Diver launch appliances..... 49
 - 7.3. Inspection 49
 - 7.3.1 General, manufacturers’ instructions, intervals..... 49
 - 7.3.2 Testing before commencement of diving work 50
 - 7.3.3 Testing before deployment 50
 - 7.3.4 Testing after deployment..... 50
 - 7.3.5 Initial testing..... 50
 - 7.3.6 Regular testing /time intervals..... 51
- 8. List of References 52
- Annex A Requirements for Diver Pressure Chambers..... 53
 - 1. General 53
 - 2. Terms..... 53
 - 3. General Requirements 53
 - 4. Technical and Constructional Requirements 54

4.1.	General	54
4.2.	Main chamber	56
4.3.	Ante chamber	56
4.4.	Control devices and display instruments	56
4.5.	Air and oxygen supply	57
4.6.	Equipment for Communication	57
4.7.	Equivalent power supply	58
5.	Operation	58
Annex B	Sample Checklist for Collection of Findings	60
Annex C	Sample Maintenance and Inspection Checklist.....	61

1. Preliminary Comments

The German version of this guideline was developed under the leadership of DNV GL SE and with the support of the German Federal Ministry for Economic Affairs and Energy (BMWi) by the working group “Offshore Diving“ in order to achieve uniform minimum standards for diving in German coastal waters and the German exclusive economic zone (EEZ).

The translation and preparation of the English version of this guideline was solely sponsored by DNV GL SE.

With the growing significance of offshore diving within the German area of responsibility it has become clear that the rules and guidelines in place up to now have not adequately taken account of the particular circumstances and risks of offshore diving. The working group “Offshore Diving“ intends to counter this with this newly developed guideline – taking account of existing national and international legal standards, regulations and guidelines.

The working group is composed of representatives from diving companies, supervisory authorities, the statutory accident insurance scheme, diving medicine, professional associations and technical service providers, see list of members below.

This guideline is intended to aid planners, clients, safety and health protection coordinators, supervisory authorities, diving companies, expert assessors, insurers and other involved parties as a foundation for the planning, tendering and performance of diving work in offshore contexts.

In case of any doubt about the content or understanding, the German version shall be consulted. The German version of this guideline is the binding document.

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2. Scope of Application

The spatial scope of application of this guideline is limited to German territorial waters and the German Exclusive Economic Zone (EEZ) and does not include inland waters on the land side of the baseline, their bays, deltas and harbours nor inland waters such as rivers and lakes. This guideline is supplementary to the provisions of the accident prevention regulation of the German Social Accident Insurance DGUV Regulation 40 "Diving Work" (previously BGV C23).

It is applicable to German and foreign diving companies and divers.

This guideline is not applicable to diving operations by research divers.

Note: For scientific diving work in German and international waters, please refer to the provisions of the accident prevention regulation "Deployment of Research Divers" (DGUV Rule 101- 023, previously BG/GUV-R 2112) and the corresponding practical tips by the professional association Kommission Forschungstauchen Deutschland (KFT).

3. Definition of Terms and Abbreviations

3.1. Definition of Terms

<u>Term</u>	<u>Explanation</u>
Client	The client is the contracting party who charges another with performance of a service within the context of an order.
Surfacing	Breaking the surface of the water.
Ascent	Rising to a shallower water depth.
Deck plan	Schematic outline diagram of a deck (level / floor) of a ship or construction.
Pressure chamber recompression	Acute treatment measure for a diver with symptoms of decompression sickness consisting of placing him in a pressure chamber and re-raising the ambient pressure.
Operations meeting	General and comprehensive discussion between all persons involved in diving work before divers are deployed. Also known as toolbox meeting.
Risk assessment	Evaluation of the risks to employees associated with their work (§5 of the German Occupational Safety Act [ArbSchG]).
Anchor line	Rope which serves as a vertical guide for the diver between the surface and the underwater workplace.
Auxiliary anchor point under water	Artificial attachment point used temporarily.
Hoist marking	Special marked area on deck for winching operations by a helicopter.
CCP system	Live power system for protection against cathode corrosion.
Control stand	Workplace of the diving supervisor for the technical management and monitoring of the diving operation (at least monitoring of breathing gas and pressure, audio and video tracking, recording, communication and reporting).
Horizontal line	Rope that serves as a horizontal guide to the diver under water.
Diving apparatus	Breathing apparatus through which the diver is supplied with breathing gas by his own respiration

3. Definition of Terms and Abbreviations

Emergency surface decompression	Decompression of a diver in a diver pressure chamber (“catch-up dive”) in the case of premature unplanned aborting of a dive requiring decompression if the diver cannot comply with the necessary decompression stops due to acute danger (e.g. due to unforeseen bad weather or technical defects on the diving vessel). Through surfacing without observing the necessary ascent rules, the affected diver is subject to a considerably increased risk of diver injury.
Pneumo	Diver’s depth measurement hose.
Offshore diving project manager	The representative of the diving company at the site of operations.
Stand-by diver	A diver who will come to the aid of the diver involved in the dive operation (operational diver) in the case of risk or accident.
Specialist	A person who, due to their specialist training and experience has sufficient knowledge in the field of the relevant work tool and who is sufficiently familiar with the relevant state regulations on occupational safety, the rules of the statutory accident insurance scheme and the generally accepted rules of technology (e.g. DGUV regulations, norms, VDE provisions, technical regulations of other Member States of the European Union or other contracting states of the Treaty of the European Economic Area) as to enable evaluation of the state of the work tool in terms of occupational safety.
Expert assessor	<p>Expert assessor within the meaning of this guideline is someone who is recognised by the relevant public authority or other office responsible for the inspection of diving equipment and breathing gas supply systems or who is a member of a recognised expert assessment office for this activity. Those persons recognised by other public authorities e.g. in accordance with a mining ordinance (BVOT/FlsBergV) as expert assessors for the field of diving equipment are also expert assessors within the meaning of this guideline.</p> <p>The expert assessor shall be able to provide evidence of knowledge and experience in the inspection of diving equipment, pressure chambers, breathing gas supply systems and launching devices.</p>
Lifeline	Rope which serves to secure the diver and provides a connection between the dive tender and diver for the communication of signals.
Dive tender	Member of the dive team to which a diver is allocated and who monitors the whole dive and maintains contact with the diver via the lifeline or umbilical.
Downline	A fixed line connection from the surface to the workplace under water.

Diving equipment	Diving equipment includes the personal protective equipment (breathing apparatus, diving suit, harness, etc.) and everything the diver carried with him on the dive. The diving equipment also includes aids needed for controlled decompression and the avoidance of diving illnesses, e.g. depth gauge, diving watch. The diving equipment shall consist of at least the components described in the sections 5.3.1 to 5.3.6.
Diver	Member of the dive team who has sufficient knowledge, ability and expertise to carry out diving work safely and who fulfils the preconditions of § 10 of the Accident Prevention Regulation UVV "Diving Work" and who is provided with breathing gas by a breathing apparatus while working underwater.
Diving work	Work under water during which divers are supplied with breathing gas via a breathing apparatus.
Diver pressure chamber	Pressurised container in which persons can be placed for emergency surface decompression or recompression.
Diving operation	All the dives under the same conditions and in the same location for the performance of diving work.
Diving supervisor	Leader of the dive team who oversees the whole diving operation. He has to be able to assess the operational conditions and allocates responsibilities within the dive team. The supervisor is responsible for the diving operation and may not himself participate in the dives led by him. The beginning and end of the diving operation is established by the diving supervisor. This shall be done in close cooperation with in particular the ship's crew as regards an abandonment of the diving operation.
Dive team	Organisational unit of the diving company for the personnel deployed for the relevant diving work.
Dive assistant	Member of the dive team responsible in conjunction with the diving supervisor for operating, switching and monitoring the supply system as well as the equipment and appliances used.
Diver telephone	Constant two-way speech link between the diver and the control point, if appl. also between the divers deployed.
Dive	A limited time, single period under water.
Diving apparatus	Protective breathing equipment of the diver. Personal Protective Equipment (PPE).
Diving plan	Approved organisational plan of the diving work for a defined period (e.g. working day, one or more shifts, tidal cycle, etc.).

3. Definition of Terms and Abbreviations

Diving project plan	Approved organisational plan of the diving work within the framework of the overall project.
Dive site	The area covering the workplace of the dive team, the place the diver enters the water and the workplace of the diver underwater.
Diving pressure	The atmospheric pressure prevailing at the relevant diving depth.
Diving company	Diving business carrying out the diving work.
Umbilical	The supply line of the diver containing the breathing gas line, the pneumo and other technical components such as telephone, light and video cables, warm water hose, probe cables, etc. and which supply the diver from the surface and support him in his work.

3.2. Abbreviations

<u>Abbreviation:</u>	<u>Meaning:</u>
AG	Client Auftraggeber
AGE	arterial gas embolism Arterielle Gasembolie
AMS BAU	Occupational safety management system of the company BG BAU Arbeitsschutzmanagementsystem der BG BAU
RMV	respiratory minute volume
ArbMedVV	German Ordinance on Occupational Healthcare Verordnung zur arbeitsmedizinischen Vorsorge
ArbSchG	German Occupational Safety Act Arbeitsschutzgesetz
ArbSchV	German Ordinance on Occupational Safety Arbeitsschutzverordnung
ArbStättVO	German Workplace Ordinance Arbeitsstättenverordnung
ASR	Technical Rules for Workplaces Technische Regel für Arbeitsstätten
AWMF	Working group of the registered Association of Academic Medical Specialists Arbeitsgemeinschaft der Wissenschaftlichen Medizinischen Fachgesellschaften e.V.
EEZ	Exclusive economic zone
BaustellV	German Construction Site Ordinance Baustellenverordnung
BetrSichV	German Ordinance on Industrial Safety Betriebssicherheitsverordnung
BGV	Regulation of the Occupational Insurance Association Berufsgenossenschaftliche Vorschrift
BMWI	German Federal Ministry of Economics and Energy Bundesministerium für Wirtschaft und Energie

BVOT	Mining Ordinance for deep-boring, underground storage and for the exploitation of natural resources from mining in the Federal State of Lower Saxony Bergverordnung für Tiefbohrungen, Untergrundspeicher und für die Gewinnung von Bodenschätzen durch Bohrungen im Land Niedersachsen
DGMM	German registered Society for Maritime Medicine Deutsche Gesellschaft für Maritime Medizin e.V.
DGUV	German Social Accident Insurance [umbrella association of public and industrial sector accident insurance institutions] Deutsche Gesellschaft Unfallversicherung
DNV GL	DNV GL SE (company formed from Det Norske Veritas & Germanischer Lloyd)
DP	Dynamic positioning
DP ship	Ship with dynamic positioning
FlsBergV	German Ordinance on Continental Shelf Mining Festlandsockel Bergverordnung
RA	Risk assessment
GefStoffV	German Ordinance on Hazardous Substances Gefahrstoffverordnung
GL	Germanischer Lloyd
GTÜM	German Society for Diving and Hyperbaric Medicine Gesellschaft für Tauch- und Überdruckmedizin
IMCA	International Maritime Contractors Association
IMO	International Maritime Organization
LARS	Launch and Recovery System
LasthandhabV	German Ordinance on the Handling of Load Lastenhandhabungsverordnung
Offshore-ArbZV	German Ordinance on Offshore Working Times Offshore Arbeitszeitverordnung
ProdSV	German Ordinance on the Product Safety Act Verordnung zum Produktsicherheitsgesetz

PPE	Personal Protective Equipment
PSA-BV	German Ordinance on the Use of Personal Protective Equipment PSA-Benutzungsverordnung
RAB	Rules on Occupational Safety on Construction Sites Regel zum Arbeitsschutz auf Baustellen
RIB	Rigid Inflatable Boat
ROV	Remotely Operated Vehicle
SCC	Safety Certificate Contractors
TauchPrV2000	German Ordinance on the Examination for Recognised Qualification as a Certified Diver Verordnung über die Prüfung zum anerkannten Abschluss Geprüfter/Geprüfte Taucher/in
TRBS	Technical Rules for Industrial Safety (published by the Federal Institute for Occupational Safety and Health- BAuA) Technische Regeln für Betriebssicherheit
TRGS	Technical Rules for Hazardous Substances (published by BAuA) Technische Regeln für Gefahrstoffe
UVI	Information on accident prevention Unfallverhütungsinformation
UVR	Accident prevention rule Unfallverhütungsregel
UVV	Accident prevention regulations Unfallverhütungsvorschrift
UW	Underwater
VCA	Safety checklist for employees (Veiligheid Cecklist Aannemers)
VDD	Association of German Hyperbaric Treatment Centres Verband deutscher Druckkammerzentren

4. Legal Regulations, Norms and Guidelines

The following legal regulations apply in the German territorial waters and most of them also in the Exclusive Economic Zone (EEZ) – and thus in offshore areas. In addition, the non-binding information texts, guidelines, norms etc. should also be observed for their recommendation character. The following list does not claim to be exhaustive.

4.1. Statutes

- Act on the implementation of occupational safety measures to improve the safety and health protection of employees in the workplace (German Occupational Safety Act - ArbSchG)
- Act on the delivery of products to the market (German Product Safety Act - ProdSG)

4.2. Ordinances

- Ordinance on the protection of employees from risks through noise and vibrations (Noise and Vibrations Ordinance - LärmVibrationsArbSchV)
- Ordinance on protection of safety and health in the use of personal protective equipment at work (PSA-BV)
- Ordinance on protection of safety and health in the provision of work tools (BetrSichV) with Technical Rules for Industrial Safety (TRBS)
- Ordinance on protection from hazardous substances (GefStoffV) with the Technical Rules for Hazardous Substances (TRGS)
- Ordinance on protection of safety and health on construction sites (BaustellV) particularly Annex II: Particularly dangerous work with the Rules for Industrial Safety on Construction Sites (RABs)
- Ordinance on working times during offshore activities (Offshore-ArbZV)
- Mining Ordinance for the Continental Shelf (FlsBergV)
- Ordinance on workplaces (ArbstättVO) with the Technical Rules for Workplaces (ASR)
- Ordinance on health and safety in the manual handling of heavy loads in the workplace (Load Handling Regulation - LastenhandhabV)
- Ordinance on the examination for qualification as a certified diver (TauchPrV 2000).
- Eighth Ordinance to the Product Safety Act (Ordinance on the delivery of personal protective equipment to the market - 8. ProdSV)
- Ninth Ordinance to the Product Safety Act (Machine Ordinance - 9. ProdSV)

4.3. DGUV Regulations

- DGUV Regulation 1 “Principles of Prevention” (in particular § 8 Hazardous Work))
- DGUV Regulation 2 “Occupational Physicians and Specialists in Safety at Work”
- DGUV Regulation 38 “Construction Work (previously BGV C22)
- DGUV Regulation 40 “Diving work“ (previously BGV C23)
- DGUV Rule 100-500 “Operation of Work Tools” (previously BGR 500)
- DGUV Rule 101 “Raisable Means for Lifting Personnel “ (previously BGR 159)
- DGUV Rule 101-022 “Diver Pressure Chambers” (previously BGR 235)
- DGUV Rule 112–139 “Use of Personnel Emergency Signalling Equipment” (previously BGR/GUV-R 139)
- DGUV Information 201-025 “Diver’s Log” (previously BGI 817)
- DGUV Information 201-033 “Instructions for Handling Diving Operations with Mixed Gas (previously BGI 897)
- DGUV Information 201-034 “Instructions for Handling Diving Operations in Contaminated Waters“ (previously BGI 898)
- DGUV Information 203-071 “Regular Inspections of Portable Work Tools” (previously BGI 5190)
- DGUV Information 203-007 “Wind Energy Plants“ (previously BGI 657)
- DGUV Information 240-310 “Instructions for Handling Occupational Medical Care in accordance with the professional association Principle G31 “Excess Pressure“ (previously BGI/GUV-I504-31)
- DGUV Information 250-006 “Leaflet on the Treatment of Conditions caused by Working at Excess Pressure (Working in Compressed Air, Diving Work)“ (previously BGI 690)
- DGUV Recommendation “First Aid in Offshore Wind Parks”

4.4. Standards

- DIN VDE 0100-410:2007 Setting up low voltage systems - Parts 4-41: Protection measures – Protection against electric shock (IEC 60364-4-41:2005, modified); German adoption HD 60364-4-41:2007
- DIN VDE 0108:2005 Setting up and operating high voltage systems in construction plants for groups of persons and safety lighting in workplaces
- DIN EN 1808:2015 Safety requirements for suspension lifts for carrying personnel – calculation, structural stability, construction inspections
- DIN EN 1829-1:2010 High pressure water spray machines - Safety requirements – Part 1: Machines
- DIN EN 1829-2:2012 High pressure water spray machines – Safety requirements - Part 2: Hoses, hose conduits and connection elements
- DIN EN ISO 9001:2008 Quality management systems – Requirements
- DIN EN 12021:2014 Respiratory equipment - Compressed gases for breathing apparatus

4. Legal Regulations, Norms and Guidelines

- DIN 13024-1:1997 Casualty stretchers - Part 1: with rigid rails; dimensions, requirements, inspections
- DIN 13024-2:1997 Casualty stretchers - Part 1: with foldable rails; dimensions, requirements, inspections
- DIN EN ISO 14001:2009-11 Environmental management systems – Requirements with Instructions for use
- DIN EN 14225-1:2005 Diving Suits – Part 1: Wet diving suits – Requirements and Inspection Procedures
- DIN EN 14225-2:2005 Diving Suits – Part 2: Dry diving suits – Requirements and Inspection Procedures
- DIN EN 14225-3:2014 Diving Suits – Part 3: Actively heated or cooled suit systems and suit parts – Requirements and Inspection Procedures
- DIN EN 15333-1:2008/AC:2009 Breathing Apparatus – Hose-fed self-contained breathing apparatus with pressurised gas – Part 1: Automatic lung-controlled systems
- DIN EN 15333-2:2009 Breathing Apparatus – Hose-fed self-contained breathing apparatus with pressurised gas – Part 2: Apparatus with constant volume flow
- DIN EN 16081:2014 Pressure chambers – Specific requirements for firefighting systems - Performance, assembly and inspection
- BS OHSAS 18001:2007 Health and Safety at Work – Management systems – requirements
- FprEN 50308:2013 Wind Energy Plants – Protection measures - Requirements for construction, operation and maintenance
- DIN EN 50525-2-21:2012 Cables and Connections – High voltage connections with nominal voltages up to 450/750 V (U0/U) - Part 2-21: High voltage cables for general uses - Flexible connections with connected elastomer insulation; German version EN 50525-2- 21:2011
- DIN EN 60529:2014 Types of Protection by Casing (IP-Code) (IEC 60529:1989 + A1:1999 + A2:2013); German version EN 60529:1991 + A1:2000 + A2:2013

4.5. Other regulations

- AWMF S1 Guideline “Medical suitability testing for employees of offshore wind energy plants and platforms (version: 02/2015)” (AWMF registration number: 002/43, previously DGMM Recommendation)
- AWMF S2k Guideline “Diver injury 2014 - 2017 by the Society for Diving and Hyperbaric Medicine (version from: 08.04.2015)” (AWMF registration number: 072-001)
- Germanischer Lloyd, Rules for Classification and Construction, I – Ship Technology, 1 – Seagoing Ships, 3 – Electrical Installations
- Germanischer Lloyd, Rules for Classification and Construction, I – Ship Technology, 5 – Underwater Technology, 1 – Diving Systems and Diving Simulators
- Germanischer Lloyd, Rules for Classification and Construction, I – Ship Technology, 5 – Underwater Technology, 3 – Unmanned underwater craft (ROV, AUV) and Underwater Working Machines

5. Requirements for the Performance of Offshore Diving

5.1. Administrative Principles and Responsibilities

5.1.1 General

The performance of offshore diving is done in cooperation between the client, i.e. the builder of an offshore wind park, and the diving company carrying out the work. All activities are coordinated and carried out in such a way that the health and safety of not only the parties involved in the offshore diving but also that of third parties and also environment protection are assured.

There are minimum requirements that shall be fulfilled for the performance of offshore diving. Compliance can be shown by the following or equivalent systems:

In the field of quality management:

- DIN EN ISO 9001:2008 Quality Management Systems – Requirements

In the field of occupational safety:

- DIN EN ISO 9001:2008 Quality Management Systems – Requirements
- BS OHSAS 18001:2007 Health and Safety at Work – Management systems - Requirements
- VCA / SCC
- AMS BAU

In the field of environmental protection:

- DIN EN ISO 14001:2009-11 Environment Management Systems – Requirements with instructions for use

Should these minimum requirements not be fulfilled then before a contract is awarded an audit of the selected company is to be performed by an approved certification office.

5.1.2 Client

The client shall organise the award of contracts in such a way that the applicable legal provisions and requirements of this guideline are fulfilled.

For this the client shall ensure in particular the following:

- written commissioning of the diving company
- nature and scope of the contract
- necessary framework conditions
- compliance with the requirements resulting from the corresponding certificates
- deployment of appropriately qualified personnel
- availability of all documents (incl. risk assessments, procedural instructions, valid guidelines and regulations, etc.)

The client shall immediately pass on to the diving company new knowledge regarding the working environment. The client shall coordinate all project activities.

5.1.3 Diving company

The diving company is responsible for performance of the work in agreement with the necessary procedural instructions, valid guidelines and regulations. The diving company shall ensure that all relevant certifications and documentations are submitted to the client before commencement of the work. This also includes informing the accident insurance provider responsible for the diving company.

The performance of offshore diving may only be done by dive teams. The dive team is to be formed and deployed by the diving company.

5.2. Personnel Involved

A diving company may only deploy personnel suitable for the intended tasks. Basic requirements of the personnel are health suitability and professional qualifications (see §7 DGUV Regulation 1).

In addition the company shall carry out occupational health checks in line with the German Ordinance on Occupational Healthcare (ArbMedVV) depending on the risks in the workplace.

All members of a dive team deployed in offshore diving projects shall be trained in line with the DGUV Recommendation "First Aid in Offshore Wind Parks". In addition the members of a dive team shall have general knowledge on what to do in an emergency and on the relevant operations site.

5.2.1 Offshore Diving Project Manager

The offshore diving project manager shall have practical/professional experience in offshore plant construction /offshore diving in order to be able to act as a link between the client and the diving company. The diving company shall establish the suitability of the offshore diving project manager, including certification of offshore fitness.

The offshore diving project manager shall be appointed by the diving company in writing and the client informed. He is the contact point on the construction site for all requests in connection with the diving work.

The offshore diving project manager is responsible for the monitoring and coordination of the diving project in terms of industrial safety, which includes:

1. Compliance with state and professional association regulations and other applicable provisions.
2. Obtaining all authorisation and approvals for the diving operation.
3. Performance of personnel safety instruction and emergency training.
4. Monitoring for compliance with the agreed quality standard.
5. Ensuring that all employees are familiar with the work plan, the dive system being used, the diving procedure, and the safety and emergency measures.
6. Maintaining contact with the client, the captain of the ship, the operator of a platform and the offshore installation manager.
7. Ensuring periodical and specific maintenance and inspections of the systems and equipment and maintaining documentation at the latest versions.
8. Preparing daily reports and all other reports required by the diving company.
9. Informing the diving company of safety notices in the form of work instructions or of weekly and monthly meetings.
10. Reporting to the diving company on possible risks, accidents or near misses.
11. Implementation of safety measures in line with the requirements of the diving company.

The project manager can delegate some of these tasks to a capable person but the offshore diving project manager retains overall responsibility.

The tasks of the offshore diving project manager can also be performed by the diving supervisor as long as only one dive team is deployed and the diving supervisor is not negatively affected in the performance of his own tasks.

In the case of shift operation with more than 12 hours per day or deployment of several dive teams, an offshore diving project manager shall be appointed for the diving project.

5.2.2 Diving supervisor

Each dive team shall be led by a capable diving supervisor who is to be appointed in writing by the diving company for each offshore diving operation. A deputy diving supervisors shall also be appointed in writing.

The diving supervisor carries out the offshore diving with his dive team. He is authorised to instruct all members of the dive team. The diving supervisor shall assess the operating conditions, monitor the safe progression of the diving operations and be able to take the necessary measures in the case of accidents and disruptions.

5. Requirements for the Performance of Offshore Diving

The diving supervisor shall fulfil the following conditions:

1. He shall be physically and mentally suitable (at least certification of offshore fitness).
2. He shall be certified as a diver in line with 5.2.3 and additionally have at least 200 diving hours, of which at least 100 shall be offshore diving hours.
3. He shall show that he has spent at least 14 working days with the working procedures and tools (e.g. DP ships) used.
4. He shall have completed at least 200 hours on the breathing gas supply system under the supervision of an experienced diving supervisors.

The required certifications can be documented for instance in a safety pass / logbook / diver's log.

In the case of shift work with more than 12 hours per day or deployment of several dive teams the diving company shall also deploy and appoint in writing additional diving supervisors.

The diving supervisor shall always be in the direct vicinity of the dive site and in direct contact with the divers, crane driver, machine operators and signal staff. The diving supervisor may only leave this position during a dive if his appointed deputy can take over the position.

5.2.3 Divers

The diver performs offshore diving. He is a member of the dive team and is to be listed in the diving plan with his name and position.

The diving company may only employ as divers persons who

1. have reached the age of 21,
2. are physically and mentally suitable (in accordance with ArbMedVV or similar),
3. have successfully completed training as a certified diver or a similar qualification and have sufficient knowledge, skills and abilities for the safe performance of the planned diving work (see Annex 1, DGUV Regulation 40) ,
4. can show that they have spent at least 14 working days with the working procedures and tools (e.g. DP ships) used and
5. under the preconditions of no. 3 can show a total of 12 diving hours offshore in the last 12 months. The requirements of DGUV Regulation 40 (6 diving hours in the last 6 months) remain unaffected.

If a diver is unable to provide proof in line with no. 4 or 5 he shall initially only be deployed within an experienced dive team. At its minimum level the dive team may contain at most one diver who is unable to provide the proof in line with no. 4 or 5.

The proofs can be documented, for instance, in a safety pass / logbook / diver's log.

5.2.4 Dive tender

The dive tender secures and supports the diver during the performance of offshore diving. He is a member of the dive team and to be listed in the diving plan with his name and position.

The dive tender supports the diver with his equipment and with inspection of breathing apparatus before a dive. In addition he secures the diver on the upper deck and when getting in and out of the water. If required he feeds out the supply line and maintains contact with the diver.

The dive tender can be deployed for other tasks connected to entering the water, e.g. support in operation of the breathing gas supply system, the welding system or lifting devices provided this does not affect his performance of the duties assigned to him as dive tender, in particular maintenance of constant telephone contact with the diver.

The diving company may only employ as signalmen persons who

1. have reached the age of 18,
2. are physically and mentally suitable (at least offshore fitness),
3. have a training certificate from a diving company and sufficient knowledge, abilities and skills for safe performance of the planned diving work (see Annex 2, DGUV Regulation 40) and
4. have received instruction on the working procedures and work tools used. This instruction shall be documented in writing.

5.2.5 Dive assistant

The dive assistant supports the diver and dive tender during performance of the offshore diving. He is a member of the dive team and also to be listed in the diving plan by name and position.

The dive assistant operates appliances and equipment and carries out supporting work at the dive site.

The diving company may only employ as dive assistants persons who

1. have reached the age of 18,
2. are physically and mentally suitable (at least offshore fitness),
3. have sufficient knowledge, abilities and skills for the safe performance of the planned diving work and have proved this to the diving company and
4. have received instruction on the working procedures and work tools used. This instruction shall be documented in writing.

5.2.6 Diver pressure chamber operator

The diver pressure chamber operator is responsible for the safe operation and technical readiness of the diver pressure chamber within the scope of the diving work. He is a member of the dive team and to be listed by name and position in the diving plan.

The diving company may only employ as diver pressure chamber operators persons who

1. have reached the age of 21,
2. are physically and mentally suitable (at least offshore fitness),
3. have sufficient knowledge, abilities and skills for the safe operation of the diver pressure chamber and have provided evidence of this. This shall be documented in writing.

Note: qualification in line with item 3 can be shown, for instance, by a VDD / GTÜM certificate of qualification as a pressure chamber operator or by the examination for qualification as a certified diver (TauchPrV 2000).

5.2.7 Person with advanced medical knowledge

At least one member of a dive team, who is not deployed as a diver or diving supervisor, shall have the following knowledge and skills for effective first aid treatment:

1. Implementation of instructions from the designated physician.
2. Knowledge of the diving techniques and procedures used as well as pressure chamber operation.
3. Support of the diving supervisor in recompression procedures.
4. Proof of fitness for exposure to pressurised air.
5. Proof of advanced medical training going beyond qualification as an offshore first aider.

5.2.8 Designated physician

The diving company shall appoint a physician familiar with diving medicine for the duration of the project and he shall be informed of the location, nature of the operation, operation time and special features. The designated physician shall be in a contractual relationship with the diving company which shall cover at least emergency consultation and availability. The designated physician is also referred to as the “diving doctor”.

5.2.9 Additional operators

In the performance of offshore diving additional operators can be deployed to support the dive team.

Additional operators may only be deployed for offshore diving if their area of responsibility, authority to instruct and lines of communication are clearly defined and documented. Additional operators are not members of the dive team, but shall be listed in the diving plan with name and function.

The decision on deployment of additional operators is to be made by the diving supervisor in conjunction with the project manager.

Examples of these additional operators are:

- crews of dive or safety vessels
- crane operators
- operators of pumps, aggregates and other auxiliary equipment

5.3. Technical Requirements

Technical equipment and the appliances serving their operation shall be designed in line with the national requirements and the recognised rules of technology and be tested in accordance with the stipulations of relevant statutes and ordinances. Certificates are to be kept ready at the operations site.

5.3.1 Breathing apparatus

Breathing apparatus shall conform to the standard DIN EN 15333. In terms of its suitability and configuration the breathing apparatus shall be selected so as to ensure the occupational safety of the diver and general industrial safety during diving work. External sources of risk shall be given specific consideration.

Face pieces are to be designed as helmets or full face masks. They shall be approved for use in cold water and equipped with an intercom system.

Breathing gas supply lines shall consist of a single hose from the breathing gas supply system to the mask. Connection elements are only permissible at the ends and are to be designed as screw connections for underwater use.

Diving suits shall correspond to the standard DIN EN 14225 and are to be designed as dry or heated diving suits.

5.3.2 Auxiliary gas supply system

There shall be an auxiliary gas supply system which enables safe ascent or enables the diver to reach a safe ascent appliance (e.g. diving bell). The auxiliary gas supply system shall be designed in line with the standard DIN EN 15333. This applies even if it is combined with a carrying device.

5.3.3 Carrying device, body bandages and lifting harness for divers

Carrying devices shall conform to the standard DIN EN 15333.

If the carrying device contains a lifting harness it shall be ensured that during the diving operation the sling is ready for immediate use and that the emergency or lifting device can be immediately fastened to the lifting harness at the lifting points. The lifting points shall be clearly marked.

Marked lifting points shall not be blocked.

The sling in combination with the diving equipment used shall not lead to any impediment of either the diver or the functioning of his equipment.

If the carrying device is equipped with additional weights, these shall have a certified jettison system.

5.3.4 Lines, ascent and descent aids

The diving equipment shall contain a safety line with neutral buoyancy. This may be a rope or the supply cable. The safety lines, including all connections, shall be designed to withstand traction of at least 3500 N.

Horizontal lines including all connections shall be designed to withstand traction of at least 3500 N.

At least one suitable vertical diver orientation aid (launching appliance, anchor line, structure, downline, etc.) which also serves to reach the operations site and ascend and which can be reached and used by all the divers involved in the operation.

5.3.5 Breathing gas supply system for divers

The breathing gas supply system shall consist of at least the following components:

- Breathing gas supply and
- Reserve breathing gas supply with separate connectors.

The breathing gas supply system can also contain the following components:

- Breathing gas compressor
- Filter station
- Breathing gas mixing system
- Oxygen supply with suitable pressure regulator system

Breathing gas supply systems shall be designed to be able to supply all deployed divers equipped with hose-fed apparatus and the stand-by divers with sufficient quantity and quality of breathing gas according to diving depth and workload.

For all divers and stand-by divers deployed underwater there shall be separate breathing gas supply connections at the surface control system.

All breathing gases available shall be analysed prior to use. The quality of the breathing gases shall satisfy at least the requirements of standard DIN EN 12021:2014.

The breathing gas supply system shall be designed so that the divers can be supplied with sufficient breathing gas at any time. The breathing gas supply system shall be able to provide each diver with breathing gas at a rate of at least 75 l/min up to the maximum diving depth.

Each diver including stand-by divers shall be equipped with separate main breathing gas feeds and reserve feeds. It shall be possible to switch between the two breathing gas feeds by means of a clearly marked switch valve.

The stand-by diver's main breathing gas feed can be supplied from the adequate reserves of the main breathing gas feed of the diver.

In diving baskets or diving bells there shall be an additional separate supply of breathing gas as an emergency ration (see 5.3.6.2).

If the breathing gas with which the divers are provided is something other than air, which is mixed on site, there shall be constant monitoring of the O₂ content of the breathing gas. The O₂ monitoring device shall be calibrated and equipped with a maximum and minimum alarm and an O₂ current value display of the breathing gas used.

For breathing gas reserves with an O₂ proportion of > 21 vol.-%, special fire protection measures shall be taken.

5.3.5.1 Breathing gas supply

The quantity of breathing gas required for the diving operation is to be calculated in accordance with §4, subs. 2, DGUV Regulation 40. In addition, a reserve supply of breathing gas shall be available for emergencies in storage containers on the basis of a minimum breathing gas delivery of 75 l/min (see formula). Calculation of the breathing gas reserves shall take account of an extended underwater period for all divers of at least 20 minutes, as well as the additional ascent periods this would require. The auxiliary breathing gas supply carried by the diver may not be taken into account in calculating the reserve breathing gas quantities.

For the stand-by divers a breathing gas reserves shall also be held in reserve tanks. The quantity of breathing gas reserves shall be calculated so that the stand-by divers can carry out a dive totalling 60 minutes plus any possible decompression stages.

The quantity of breathing gas which shall actually be kept available for emergencies in reserve tanks is to be calculated according to the following formula:

$$\text{min. reserve breathing gas quantity [l]} = 75 \left[\frac{\text{l}}{\text{min}} \right] * \text{total diving time [min]} * \left(\frac{\text{max. diving depth [m]}}{10} + 1 \right)$$

For minimum breathing gas supply of a diver pressure chamber see Annex A.

5.3.5.2 Breathing gas compressor

If a compressor is used for the main breathing gas supply, this shall be connected in series to a pressure tank with sufficient volume for the correction of pressure fluctuations.

Compressors shall be suitable for use on board.

5.3.5.3 Marking

The diving company shall ensure that the gas supply (particularly pressurised gas bottles) are labelled and marked in line with regulations. If the breathing gases are transported via a pipe system the connection channels, e.g. hoses or solid piping, shall be clearly marked.

5.3.6 Diving systems

Diving systems, pressure chamber systems, diving bells (open and closed), diving baskets and launching appliances shall conform to the technical requirements of the GL Rule I-5-1 (see also DGUV Rule 101-022) or equivalent classification provisions.

5.3.6.1 Diver pressure chambers

For diver pressure chambers the minimum requirements in accordance with Annex A Requirements for Diver Pressure Chambers shall be met.

5.3.6.2 Diving bells open/closed, diving baskets

For diving bells and diving baskets the applicable requirements in accordance with TRBS 2121 Part 4, DGUV Rule 101-005 and DIN 1808:2015 shall also be considered.

In addition to reserve supply of breathing gas diving bells shall be equipped with an emergency breathing gas ration of at least two pressurised gas bottles (each of at least 50 l / 200 bar), diving baskets with at least one. These pressurised gas bottles shall be securely affixed to the personnel lifting device. This emergency breathing gas supply is to be equipped with a breathing regulator. In the case of diving baskets a valve / hose combination shall be installed in parallel which allows the diver to feed the hose of the emergency air supply inside his helmet under the neck seal. In the case of suitability, as an alternative to this a coupling system can also be used.

5.3.7 Dive site

The dive site shall be organised so that all the necessary equipment items can be stored and the work can be carried out without encumbrance.

It shall be ensured that the routes for the divers carrying equipment are as short as possible, safe and free of trip hazards.

Several dive teams may only be deployed at a dive site at the same time if the chance of them encumbering each other can be excluded.

Locations where the workplace of the dive team is to be established shall be sufficiently secure and stable.

If the diving supervisor does not have a direct view of the dive site, this is to be transmitted via an additional camera image to the location of the diving supervisor. A heated changing room shall be provided for the dive team at the dive site.

5.3.8 Emergency equipment

For emergencies at least the following emergency equipment shall be kept ready at the dive site:

- diver pressure chamber
- mobile oxygen breathing apparatus
- first aid kit
- stretcher
- emergency equipment appropriate to the operational and local conditions in order to bring an injured diver on board from the water (e.g. sling for a lifting harness in line with EN 15333-1).
- Reliable (tested and constantly available) means of communication to a designated physician (e.g. satellite telephone)

A treatment area shall be provided near the dive site (see 5.4.4). The emergency plan / operational disruption plan / rescue plan shall be displayed near the workplace of the dive team so that it is accessible to everyone.

If decompression is not possible at short notice, e.g. when leaving the ship, measures are to be taken to ensure the safe evacuation of the divers. (e.g. mobile pressure chamber)

5.3.9 Tools and technical work tools

In the performance of diving work a wide range of work equipment is used (e.g. high pressure cleaner, welding/flame cutter, generator) which represent predominantly electrical and mechanical risks. This equipment may only be used by divers who have been trained and instructed beforehand on their safe use.

5. Requirements for the Performance of Offshore Diving

No work tools may be used which represent a risk for users under the foreseeable conditions. A precondition for this is that the tools are properly maintained and used.

Power units (generators, hydraulics, etc.) shall be suitable for use on board or in an offshore environment.

The work tools for underwater operation shall be suitable and tested for the intended diving depth.

The weight and buoyancy of underwater tools carried by the divers shall be chosen so that they do not negatively affect the diver's buoyancy and provide the best possible handling and ergonomics. All underwater power tools carried by divers shall be equipped with a safety system which automatically cuts the power and immediately makes the tool safe as soon as the diver releases the operating button. In addition the control point shall be able to shut off all power to the tools and work tools deployed. All tools and work tools shall be tested for functionality and safety before each underwater use.

5.3.9.1 Electrical equipment

Electrical equipment is all electrical devices and work tools which can be used for diving work above and under the water. They shall be set up and operated in accordance with the electro-technical regulations.

Electrical equipment shall comply with the following:

1. Germanischer Lloyd Rules for Classification and Construction for Electrical Equipment (I-1-3) or equivalent classification rules in conjunction with the national regulations applicable for the workplace of the dive team.
2. Non-permanently installed flexible cables shall be suitable for construction site operations (e.g. H07RN-F or H07BQ-F in accordance with DIN EN 50525-2-21:2012 or equivalent regulations applicable for the operations purpose).

Note: Use in saltwater conditions shall be considered in the course of risk assessment.

3. It shall be possible to shut off the electrical systems and work tools at the dive site for all poles from above the water by means of a prominently marked main switch whose switch position is obvious. The main switch shall be within the direct sphere of influence of the users.

Electrical equipment underwater shall also satisfy the following requirements:

1. The electrical equipment and work tools are to be incorporated into one of the following safety measures for protection against defects (early protection in the case of indirect contact) taking account of their risk potential:
 - Safety extra-low voltage (SELV) in accordance with VDE 0100-410 Section 414. Only work tools of safety class III may be used.
 - Protective electrical separation with insulation monitoring in accordance with VDE 0100-410 Sections 413.5.1 and 413.5.2. Here only one work tool may be connected per secondary winding of an isolating transformer or mobile generator. The windings shall be galvanically isolated from one another. If several work tools are connected to one generator these are each to be connected individually via an isolating transformer.
2. The work tools used underwater shall be pressure watertight.

Note: Electrical work tools are pressure watertight if e.g. they conform to protection level IP 68 (+ diving depth) in accordance with DIN EN 60 529/DIN VDE 0470-1 "Degrees of protection by mechanical casings (IP Code)".
3. Power sources for welding may only provide direct current. The peak value of the open-circuit voltage may not exceed 65 V.
4. When using frequency-controlled work tools (e.g. inverters) pre-switched defect circuit breakers of Type B + (all-pole sensitive) shall be used.

In addition for underwater working devices and machines the Germanischer Lloyd Rules for Classification and Construction for autonomous underwater vehicles (AUV) and underwater working machines (I-5-3) and for electrical appliances IMCA D045 (AODC 035) can be used as a basis.

5.3.9.2 Pressure-driven work tools

Pressure-driven work tools shall be designed so that noise production is reduced to a minimum.

Hoses for pressure-driven work tools are to be run safely and protected against unintended changes of position. The couplings of hoses are to be secured additionally.

5.3.9.2.1 Hydraulic work tools

Hydraulic work tools are to be operated in a closed circuit with an environmentally-friendly hydraulic fluid. Water-operated hydraulic work tools may also be operated in an open circuit.

5.3.9.2.2 Pneumatic work tools

Pneumatic work tools shall be able to be operated in such a way that the visibility of the diver is impeded as little as possible by the air bubbles released.

5.3.9.2.3 High-pressure equipment

High-pressure equipment shall conform to DIN EN 1829-1 and -2 "High Pressure Water Jet Machines – Safety Requirements". For work with liquid jets the requirements of Chapter 2.36, DGUV Rule 100-500 shall be observed.

Depending on the design of the high-pressure equipment appropriate safety devices are to be used to protect the divers from high-pressure injuries.

5.3.9.3 Measuring equipment

Measuring equipment shall be easily readable and able to be used safely under the operational conditions and deliver reproducible results.

5.3.9.4 Cranes, lifting appliances

Cranes and lifting appliances including underwater lifting balloons used in offshore diving shall be suitable and approved for this purpose. Lifting balloons are to undergo type testing. The requirements for the technical specifications of cranes and lifting equipment are to be taken from the Germanischer Lloyd Rules for Classification and Construction (VI-2-2) or equivalent classification rules.

5.3.10 Auxiliary anchor points under water

Dead man anchors as auxiliary anchor points under water shall be designed in shape and weight to provide sufficient stability for the intended usage. The dead man anchor shall be set so that tipping or moving during operations is impossible. The expected traction force shall be calculated with a safety factor of at least 2 and the unfavourable buoyancy ratios shall be taken into account. Ropes shall be securely fastened to the dead man anchor.

5.3.11 Remotely Operated Vehicles (ROVs)

ROVs which are used in direct cooperation with divers shall conform to state of the art technology standards and should be tested by a recognised classification organisation. ROVs are also to be equipped with at least the following equipment:

- cameras which enable the safe monitoring, manoeuvring, and performance of the intended tasks.
- The drive propellers of the ROV shall be equipped with safety guards to ensure that divers are not injured and that objects such as umbilicals and lines cannot get caught up.

If safe working cannot be ensured due to lack of clear visibility, an ROV may not be used for the diving work.

5.4. Rescue Equipment

There shall be a sufficient number of suitable and approved emergency equipment items available for the diving project. The corresponding test specifications are to be stated and complied with. The numbers and types of equipment items are determined on the basis of the risk assessment.

5.4.1 Requirements for first aid equipment

The first aid equipment shall conform at least to the DGUV Recommendation "First Aid Offshore" and shall be adjusted according to the stipulations of the designated physician for the diving project. In addition suitable and sufficient oxygen supplies shall be available, as well as a stretcher.

5.4.2 Diver pressure chamber

The diving company shall provide at the dive site a fully operational diver pressure chamber in accordance with Annex A Requirements for Diver Pressure Chambers.

A first aid kit with the necessary materials as agreed with the designated physician shall be kept at the diver pressure chamber and be easily accessible.

5.4.3 Equipment for rescue from the water

Equipment suitable for the rescue of persons shall ensure the safe and rapid evacuation of a diver from the water to a place of safety.

At a distance of more than two metres from the water surface power operated lifting equipment is to be used. In the case of power operated lifting equipment the drive is to be provided redundantly.

A suitable boat with sufficient weight capacity and motor power shall be available during the diving work. Propellers shall be equipped with safety guards.

5.4.4 Treatment area

For the treatment of accident injuries a protected treatment area is to be designated in the course of project planning.

5.4.5 Hoist Marking

Vessels or operation sites which are not equipped with a helicopter landing pad shall have hoist markings.

5.4.6 Communication

Reliable communication between onshore and offshore shall be ensured. See also 6.3.1 Monitoring, Control Points and Communication.

6. Operation (performance of diving work)

6.1. Principles for the performance of diving work

In the course of commissioning the diving platform (construction site) and in the case of a change of personnel, all those involved are to be familiarised with the local conditions and instructed in the applicable safety regulations. In this respect not only divers but also all other persons involved (technicians, ROV pilots, if appl. ship crews, crane drivers etc.) are to be initiated. Proof is to be kept of all instructions.

All employees are to be instructed on the work to be performed on the basis of the risk instruction before commencement of work and at regular intervals thereafter.

Each diving operation is to be discussed at the beginning of the shift with all those involved in all detail, with all possible risks and the safety measures to be implemented and documented in writing.

6.1.1 Leadership and Supervision

After proper checking and preparation taking account of the following points, the diving supervisor can commence the diving operation. If a separate offshore diving project manager is required, this person shall approve the diving operation in advance.

During the diving operation it shall be ensured organisationally that the diving supervisor or his deputy is at his workplace.

Exclusive responsibility from the beginning of the diving work is with the diving supervisor.

The diving supervisor has the following tasks:

1. Responsibility for the diving operation, but may not participate personally in the dives he is leading.
2. Ascertaining the fitness for duty of all members of the dive team. In the case of justified doubt as to fitness for duty, a member may not be deployed for the intended tasks.
3. Ensuring that the diving operation is carried out from a safe and suitable location.
4. Ensuring that systems and equipment are properly serviced in line with the manufacturers' instructions and fully operational, that they are suitable for the operation and satisfy the statutory regulations.
5. Ensuring that the divers have properly serviced and checked their breathing apparatus before the dive.
6. Ensuring that the diver is suitable in accordance with the requirements of section 5.2.3 and qualified to carry out his tasks. In the case of dangerous or complex tasks, additional training may be necessary before operations start.
7. Giving documented instruction to all those involved on the diving plan, alternative and emergency plans in the course of an operations meeting.

8. Ensuring that there is a suitable and reliable communication link between all involved parties. Besides the dive team involved parties also include e.g. boat captains, crane and winch operators (for diving launch & recovery systems (LARS)).
9. Checking that visual contact is ensured with the divers in the diving bell (wet bell) or pressure chamber either through a window (on the surface) or via monitor.
10. Ensuring that the designated physician is available and can be contacted.
11. If possible the diving supervisor should try to set up video links with all locations under his control which he cannot see directly from his location.
12. Operational debriefing of the dive teams after the dive.
13. Preparing a log of the diving operation and all other required documents.
14. Reporting on technical changes, equipment replacements, equipment defects / errors, aborting of dives, other possible risks and near misses or accidents.
15. Signing of the divers' logs after each dive and maintenance of a personal logbook.
16. Instruction of his relief worker at change of shift.
17. Communication link between offshore diving project manager and ship's crew.
18. Preparing a diving plan.

6.1.2 Dive team (composition)

Offshore diving may only be carried out by dive teams. Each dive team shall consist of at least

- 1 diving supervisor,
- 1 diver,
- 1 stand-by diver,
- 1 dive tender for the diver,
- 1 dive tender for the stand-by diver and
- 1 dive assistant

Further personnel as required:

- 1 offshore diving project manager in the case of 24 -hour shift operation and/or several dive teams
- 1 other diving supervisor in the case of 24 shift operation
- additional divers
- technicians (LARS)
- diver pressure chamber operator

The size and composition of a dive team depends on a range of factors. But it should always be large enough to be able to carry out the diving project safely. Factors to be considered are:

1. The nature of the diving work
2. Type of dive (air, mixed gas, open diving bell, closed diving bell, single dive with decompression stage (bounce), decompression with oxygen)
3. Use of hot water systems for diving operations
4. Position, location
5. Water depth, water temperature and visibility
6. Special conditions (e.g. strong tidal movements or currents)
7. Operating schedule (12 or 24 hours per day)
8. Alternative and emergency planning
9. Information from the risk assessment
10. Required expansion of the dive team due to experiences in the project

A dive tender shall only operate one umbilical at a time. At all times the dive tender shall be able to communicate not only with the diver but also with the diving supervisor.

Stand-by divers shall be ready above the water at any time so that they can be immediately deployed underwater i.e. they need only don helmets/facemasks to be ready. In the case of particular risks, such as diving work in constructions, in tight spaces, over large distances, with the risk of spillages, and in the case of platform use at the latest from a height of 15 m above the water surface another diver shall also be in the water for safety purposes. The divers shall be able to communicate with one another. Other operational circumstances, such as DP ships, are to be considered in accordance with the risk assessment.

For every diver in the water a stand-by diver with a dedicated dive tender shall be provided. Deviations from this regulation require a special authorisation from the responsible providers of the statutory accident insurance.

6.1.3 Compliance with rest periods and breaks (particularly for divers)

The stipulations of the Offshore-ArbZV are applicable for all for persons involved in the diving operation.

Divers may not be required to perform any physically demanding tasks within two hours of the end of the dive. Jarring and joint stress should be avoided. In the 12 h following decompression the divers shall be within three hours of an operational diver pressure chamber.

6.1.4 Medication, alcohol, drugs

Alcohol and illegal drugs are universally banned.

In the case of medications, each individual case shall be examined by the responsible company physician / designated physician as to whether the person affected is fit for deployment in the dive team from a medical viewpoint.

6.2. Planning, Preparation and Documentation

6.2.1 General

Before commencement of the diving project a written diving project plan and a risk assessment (RA) shall be prepared.

The diving project plan and the RA shall be submitted to the diving supervisor or the offshore diving project manager before commencement of diving operations together with a summary of responsibilities. Its feasibility is to be checked and approved in writing.

The documents listed below are to be made available to every person involved at the dive site:

- Detailed work instruction for the relevant work
- Risk assessment for the relevant activities
- Detailed rescue procedures in the case of a diver injury
- Checklists, e.g. prior to Dive (pre-dive), after the dive (post-dive), pressure chamber inspection
- Diving plan
- Rescue chain for diver injury / coordinated with overall rescue concept for the dive site (visibly displayed)
- Summary of all necessary certificates for each member of the dive team
- Proof of instruction
- Dive report
- Operational discussion report
- Video & photographic documentation

Other documentation required:

- Diver's log
- Dive report
- Abort report

The appropriate time periods for keeping this documentation are to be considered and complied with.

6.2.2 Diving project plan

Before commencing a diving project a diving project plan is to be prepared in which the following points are considered:

- Risk management process for planning and work preparation during performance including risk assessment, workers meetings, responsibilities of relevant personnel
- Work procedures, including change procedures
- Procedure for document management with all parties involved
- Sources of weather forecasts
- Establishment of operational limitations (abort criteria) in particular environmental and weather conditions
- Diving, operating and maintenance procedures
- Mobilisation and demobilisation processes (deck plans)
- Handbooks and documentation of the diving company, including inspection certificates and certificates for equipment, work tools and breathing gases
- Communication matrix, organisation chart for the construction site
- Qualifications matrix
- Procedures for accidents, near misses and disruptions, notification, reporting, investigation procedures, written orders and electrical requirements calculations for all the technology used, including reserves and redundancy

If there are changes in the diving project the diving project plan is to be adjusted accordingly. All parties involved in the diving project are to be informed of the changes.

6.2.3 Risk assessment

Before every diving project a risk assessment (RA) has to be performed.

The risk assessment is to be checked and adjusted if necessary before each diving operation.

If the RA highlights safety risks, existing work procedures are to be adjusted accordingly. Changes in work procedures shall be established by the responsible parties. These changes shall be communicated to all involved parties in the course of an operations meeting and documented.

6.2.4 Work permit procedure

Before commencing activities all the necessary authorisations and approvals for the relevant activity, location and schedule shall have been obtained.

6.2.5 Diver's log

The diving company shall provide all the divers deployed with all the necessary information to allow the preparation of divers' logs. These shall contain at least the following information:

- Date
- Dive site
- Diving depth
- Beginning, end and overall duration of the dive
- Necessary ascent stages
- Decompression gas used
- Work carried out
- Breathing apparatus used
- Name of the diving supervisor and his signature
- Specific events or impediments with explanations (e.g. emergency decompression, aborting of dive, emergency treatment)

6.2.6 Preparing the diving plan

Before each dive the diving supervisor shall prepare a diving plan. Before commencement of diving work all persons responsible (ship's captain, operator of a platform, etc.) shall certify their approval of the diving plan.

The diving plan shall be set out in writing and shall contain at least the following information and instructions:

- Dive procedure
- Diving depth
- Diving and decompression times
- Work to be carried out
- Dive team and the number and qualifications of other personnel involved
- Calculation of breathing gas quantities
- Prevailing environmental and local conditions (current weather situation, sea state and wind, work in progress at the same time etc.)
- Specific risks and impediments
- Emergency and rescue plans
- Communications matrix

The diving plan shall be discussed with all parties involved in the course of an operations meeting (toolbox meeting) before commencement of diving work and it is to be displayed prominently at the dive site. In particular, the diving supervisor shall inform the parties involved before every diving operation about

- the work tasks and scope of work
- the operational conditions at the dive site and the equipment to be used
- the specific risks and impediments at the dive site and
- the behaviour in case of accidents and disruptions.

In the case of deviations from the diving plan all responsible persons and parties involved shall be informed immediately.

The diving supervisor shall check that the dive site has been properly marked out and shall document this accordingly.

6.2.6.1 Calculation of breathing gas quantities

The expected quantities of breathing gases for the diving operations, including reserve quantities, shall be calculated in advance in the planning of a diving operation in accordance with 5.3.5.1. The quantity of the breathing gas reserves shall be checked at regular intervals during the diving operation. A current diving operation is to be aborted immediately if the remaining quantity of breathing gas goes below the volume established in advance in the diving plan for safe ascent.

6.2.6.2 Diving and decompression times

The diving and decompression times are ascertained in the planning of a dive and set out in the diving plan. The following framework conditions shall be taken into account in the planning:

- The diver shall ascend in the water according to the ascent table (Annex 1, DGUV Regulation 40). The reference point for stop depths (Annex 1, Ascent table col. 3, DGUV Regulation 40) is the diver's torso.
- If other ascent tables are to be used, a special authorisation shall be obtained in advance of the diving project from the provider of the diving company's accident insurance or the responsible accident insurer.
- If the diver has performed demanding physical work or if there are other factors affecting nitrogen saturation, the necessary stop time should be read off for the next decompression stop down.
- An ascent speed of 10 m/min shall not be exceeded. This applies to both ascent without stop times and to ascents between the individual stop depths.
- When ascending according to the table it shall be borne in mind that the ascent time to the first decompression stop is included in the first stop time and from stop to stop in the stop time of the respective next stop (Annex 1, Ascent table col. 3, DGUV Regulation 40).
- The diver may not perform any gymnastic exercises during the stop time. He should remain still and relaxed and breathe evenly.
- The stops are to be determined using fixed markings and checked using the pneumo.

- If a diver has accidentally failed to comply with the stop times as soon as he reaches the surface he shall descend again to the first stop depth he left too quickly. The stop times shall then be recalculated from the sum of the dive time and the time elapsed until the stop depth left prematurely is reached again.
- In deviation from that stated above, divers with symptoms of decompression sickness shall undergo recompression.
- Divers who undergo recompression following symptoms of decompression sickness shall present to the designated physician. He shall recertify their fitness to dive and fitness for work.

6.2.6.3 Specific risks and impediments

In principle offshore diving within the scope of this guideline is to be seen as diving work with specific impediments in accordance with §23, DGUV Regulation 40 requiring additional measures. These measures are to be examined for effectiveness.

Other specific risks and impediments to be considered in the planning include the following:

- Movement of the diving support vessel
- Tidal range and current
- Crane work and load movements in the area of the dive site or in connection with the diving work; these also include work with underwater lifting balloons
- Piling work around the dive site
- Marine traffic
- Emergencies on the diving platform (fire on board, man overboard, etc.)
- Visual conditions
- Power cables
- Diving work with parallel or joint use of ROVs
- Other risks and impediments can occur depending on the situation and are to be included in the risk assessment.

In the case of work whose work procedures, nature of the tasks, materials used or local conditions represent an increased or even critical risk, it could be that in an emergency that the casualty has a limited or even a total incapacity to act. This is known as work with increased accident risk.

Note: Actual indications for work with increased accident risk can be taken from the following regulations and rulebooks:

- *Particularly risky work in accordance with BaustellV, Annex II*
- *DGUV Regulation 1- Principles for Prevention, §8 Dangerous work*
- *DGUV Rules 112 – 139 – Deployment of Personnel Emergency Signalling Equipment*

Before each diving operation the diving supervisor shall ascertain the operational conditions (e.g. tides, currents, marine traffic, water temperature, visibility under water, weather conditions, underwater obstacles) and any particular risks and impediments around the dive site.

The diving supervisor shall take the necessary measures to secure the diving operation. He shall

ensure in particular that the dive site is clearly marked in waters where there is marine traffic, eliminate danger spots and minimise risks.

In the case of crane work in connection with the diving work the valid occupational safety regulations are to be applied. The person responsible for duty of care is the diving supervisor.

Crane work may only be carried out during diving work if the diver, having been instructed by the diving supervisor in accordance with the RA performed in advance and the resulting working procedures, is at a safe location with sufficient horizontal distance from the load. All crane movements shall be able to be safely stopped at any time by all participants, particularly the diver. This is to be ensured by an appropriate chain of communication.

6.2.6.4 Emergency and rescue plans

The diving company shall prepare an emergency plan and a corresponding rescue plan for each construction site.

All parties involved shall be instructed on the emergency and rescue plans before commencement of diving work. This instruction shall be documented. The emergency and rescue plans shall be displayed prominently and visible to all at the dive site.

The emergency and rescue plans shall contain the following information and instructions:

- Rescue chain and notification paths (operations manager / bridge, designated physician, etc.)
- Allocation of tasks in the case of diver injury
- Rescue equipment in accordance with 5.4
- Emergency routes and gathering points
- Rescue equipment
- Firefighting measures
- Details on adequate oxygen reserves (see 5.4.1, for pressure chambers see Annex A 4.5.4)

The efficacy of the emergency and rescue plans shall be proven before project commencement by means of a practical exercise and thereafter at least every 4 weeks (for each shift separately). The intervals are to be adjusted depending on changes of personnel. Knowledge and changes resulting from the exercise are to be documented and if necessary worked into the emergency and rescue plans.

6.3. Performance of diving work

6.3.1 Monitoring, control points and communication

The diving supervisor is responsible for the relevant diving operation.

All divers are to be equipped with a communication system which ensures a constant voice link between the diving supervisor and the divers (also stand-by divers). In addition all divers shall have a helmet camera with recording system. The audio and visual recordings of the last 48 diving hours are to be stored by the diving company. In the case of accidents or other specific events the recordings are to be kept as evidence until the end of the investigations.

On a diving support vessel/platform there shall be a redundant communication system between the diving supervisor and the bridge/operations management. One of these systems shall be a cable link. If operations require further alarm systems, it shall be ensured that these are installed in the control point of the diving supervisor. Particularly in the case of DP ships, there shall be visual and acoustic alarm systems.

In addition, secure communication is to be ensured between the diving supervisor and the personnel relevant to the diving operation (e.g. crane operator).

6.3.2 Divers' entry and exit routes

It shall be possible for a diver to enter or leave the water at any time during a diving operation. There shall always be two separate entry and exit routes available. In addition there shall be a suitable and fully operational rescue device at hand to bring an injured diver up out of the water.

If the distance from the water surface is more than 2 m, a ladder may not be used as an entry and exit route nor may this be planned as an escape route.

The path to and from the diver pressure chamber shall be as short as possible and freely accessible at any time. Moreover the times stated in the RA for surface intervals shall be observed for an emergency decompression operation.

6.3.3 The dive

A dive in its entirety shall be planned and implemented to ensure that a controlled descent, underwater period and ascent are possible at any time (see 6.2.6 Preparing the diving plan). A controlled aborting of the dive shall be possible at any time.

6.3.4 Weather / Environmental conditions

During the dive the diving supervisor shall monitor the following factors at all times and abort the dive if necessary:

1. Current / Direction of current
2. Tides
3. Sea state
4. External risks (e.g. uncontrolled marine traffic, flotsam, etc.)
5. Visibility on the surface (e.g. sea fog)
6. Visibility underwater
7. Wind state
8. Temperature
9. Thunderstorm (interval < 10 s)
10. Ice drift

For the relevant environmental conditions, reference values are to be established in advance as abort criteria to ensure safe working.

Table 1 Reference values for abort criteria

Weather/Environmental conditions	Recommended ref. value
Current	>0.5 m/s
Wave height	>1.20 m max. h
Thunderstorm Interval	< 10 s
Visibility above the water	< 500 m
Air temperature	< -5°C
Wind speed during crane work	>12 m/s

Deviations from the recommended reference values from Table 1 are possible and shall be justified by means of a risk assessment.

The boundary values for diving operations, such as maximum wave height, shall be established in advance by RA with detailed procedural instructions. These are also to be established in conjunction with operation-specific factors such as scope of work, characteristics of the vessel and the positioning system used. The main criterion is the ability to safely complete the dive under all conditions (even emergency situation).

Before and during each diving operation the diving supervisor assesses the weather and environmental conditions in accordance with the factors listed above. These are to be recorded in writing each time. The decision on diver deployment as regards the weather situation is to be made on site by the diving supervisor.

Local weather forecasts for the dive site, including wave height and wind speeds, are to be consulted several times a day. These shall be carefully checked in advance and compared with the actual conditions.

6.3.5 External risks /Risks from third parties

Before commencing activities a check shall be made as to where there are possible risks from third parties.

Risks from third parties include consideration of factors such as the following:

- The movement of other vessels / vehicles near the dive site.
- Other work being carried out at the same time even at some distance away, e.g. piling work, investigations.
- Other work being carried out at the same location on the construction or platform above the water e.g. scaffold building work, helicopter landings etc.

6.3.5.1 Diving with ROVs

If diving and ROV work is being carried out at a location at the same time special measures shall be introduced to ensure that there is no additional risk. The resulting measures are to be explained in the working procedures and risk assessment.

The ROV operator and diving supervisor shall be able to communicate with each other at all times during the diving operation. In addition both shall be able to see the camera image of the diver and the ROVs at all times.

6.3.5.2 Underwater piling work

It shall be ensured that no piling work is carried out within 3 nautical miles of the dive site.

6.3.5.3 Flora and fauna

The diving company is obliged before commencement of diving work to find out about any particular risks from flora and fauna at the dive site. Necessary measures and/or emergency plans are to be prepared accordingly and published or displayed at the location.

6.3.6 Diving and decompression times

Diving and decompression times shall be observed in accordance with 6.2.6.2.

During decompression divers may not carry out any other work tasks. Emergency surface decompression may only be used in an emergency, see also 6.3.7.

6.3.7 Emergency surface decompression

A procedure is to be established for emergency surface decompression in the diver pressure chamber. The working equipment necessary for this is to be kept available in a fully operational condition. The dive team shall be prepared for this emergency and shall ensure through exercises that each person within a dive team has received instruction (see 6.2.4.4).

An emergency surface decompression is only permissible in an emergency. An emergency occurs if the diver has to be evacuated from the water immediately and the dive cannot be completed as planned (non-compliance with decompression stops). In this case the diver shall be placed in the operational diver pressure chamber upon surfacing accompanied by a person with advanced medical knowledge (see 5.2.7).

The designated physician shall be informed of the emergency surface decompression immediately.

6.3.8 Behaviour after a dive

The diver shall comply with the following behavioural rules:

- No heavy physical work
- Avoidance of powerful jarring or vibrations
- No flying until at least 12 hours after surfacing
- Repeat dives in line with diving tables from DGUV Regulation 40
- In the 12 hours following decompression the diver shall remain within three hours of an operational diver pressure chamber.

6.4. Conduct in the case of diver injury

6.4.1 Measures

Preliminary note: A distinction shall be made between a “diver injury” and an “accident while diving” because the necessary measures are fundamentally different.

A **diver injury** should be used only to describe symptoms caused or exacerbated by changes in the environmental pressure to which the diver is exposed. These include all forms of barotrauma, decompression sickness and the transfer of breathing gas to the arterial branch of the circulatory system (known as AGE). Inert gas narcosis (“rapture of the deep”) is self-treatable by ascending from the depth but can lead to wrong behaviour with serious consequences.

Because the symptoms of the condition are liable to false interpretation by lay persons leading to a delay in appropriate treatment, the diving supervisor shall immediately make urgent contact with the designated physician. This applies even if the diver reports only diffuse, non-specific health impairments up to several hours after a dive and there is only a vague suspicion of diver injury. Here a compiled checklist should be used to assess the findings (see sample checklist in Annex B). Details on involvement of the designated physician are to be established by the commissioned diving company in their written order and the client is also to be informed accordingly.

Responsibility for performance of measures to treat a diver injury at the dive site remains with the diving supervisor. He should remain in constant contact with the designated physician, especially if recompression treatment is performed on board. The presence of a doctor on board is not necessary.

As a general recommendation: in a case of suspected decompression sickness where there is an operational pressure chamber available on board, treatment should be carried out there rather than arranging helicopter transport because vibrations during the flight would significantly exacerbate the condition.

A decision on further deployment of the diver after treatment should be made by the designated physician based on the applicable regulations.

The term **accident while diving** should be used to describe all other damage to health which does not occur as a result of a diver's exposure to excess pressure, in order to avoid initial confusion in dealing with the incident. Medical conditions with an internal cause which can occur "offshore" should not be considered here. They can however lead to problems in establishing a differential diagnosis when they occur together with exposure to excess pressure, which can only be overcome by a close cooperation between first aiders and the designated physician.

In the case of illnesses and acute conditions the standardised principles of advanced first aid, as established for training and for deployment as an offshore first aider, are to be applied.

Exception: If an injury or illness occurs during an underwater operation, such as trauma with internal or external tissue damage, e.g. massive bleeding which necessitates immediate and unplanned aborting of the dive and non-compliance with decompression rules, the designated physician is to be brought in immediately and contact established between him and the first aiders. In isolated cases in which the acute treatment of external wounds competes with the equally necessary recompression therapy no binding regulations can be established; in this case if necessary primary treatment shall be continued in the pressure chamber despite the limited space. Because this would require the medics to be able to cope with pressurised air too, it seems unavoidable that all divers deployed offshore shall in turn have the same level of training as offshore first aiders and that this shall be refreshed regularly.

6.4.2 Reporting

In order to avoid delays in the progression of rescue and treatment measures the circle of parties to be informed should be kept as small as possible initially. The supervisor with the dive team and the designated physician shall certainly be informed if it is a case of diver injury; in the case of an incident in the wider sense the notification and involvement of land-based personnel may be necessary depending on an assessment of the treatment required.

The early involvement through notification of non-therapeutic instances, such as the commissioning party, client, public authorities, accident insurers etc. only leads to a collision of competences and will not result in any acceleration or improvement of the emergency treatment for the injured party. Establishment of appropriate notification duties on a "need to know" basis should be considered by the parties involved upon award of the commission or upon contractual conclusion.

Complete and transparent reporting to higher instances should be done after conclusion of rescue measures and primary treatment.

6.5. Diving platforms

6.5.1 General points

Diving platforms can be any kind of suitable starting points for diving work. These include, e.g. diving support vessels or fixed platforms.

In the selection of suitable diving platforms at least the following points should be considered:

- Nature and scope of the work to be carried out (building, repair, inspection, etc.)
- Space requirements for proper operations
- Access points above and below the water including emergency routes
- Crane options
- Weather conditions
- Water depth
- Duration of operations
- Suitable daytime accommodation

The captain of the diving support vessel or operator of a platform is responsible for all the work carried out on board. He can ban commencement of diving work and have diving work in progress stopped at any time through the diving supervisors.

6.5.2 Diving from ships

6.5.2.1 Ships at anchor

Every ship at anchor from which diving is to be undertaken shall be fixed with at least 4 anchors. For positioning of the anchors the nature of the diving work to be undertaken shall be considered. Depending on the type of operation, additional anchors may be necessary.

For nautical safety while the ship is at anchor the ship's crew is responsible. In the case of disruptions suitable measures shall be decided between the crew and the leaders of diving operations.

Note: As an additional source of information on anchoring, the GL Noble Denton "Guidelines for Moorings" 0032/ND can be consulted.

6.5.2.2 DP ships

Computer-controlled dynamic positioning (DP) enables a diving support vessel to automatically hold a position and course using the vessel's propellers and/or bow and stern thrusters.

In the case of DP ships the DP operator is responsible for safe positioning of the ship during the diving work. In case of uncertainty about positioning the DP operator can have diving work in progress stopped by the diving supervisor.

The diving supervisor shall inform the DP operator of every change of status during the diving operations.

Diving operations within the meaning of this guideline may only be carried out by DP ships of equipment class 2 or 3.

A DP alarm system shall be installed (see 6.3.1).

For diving operations from DP ships what is known as umbilical management shall be installed which ensures at all times that neither the umbilical nor the divers can stray into risk areas (e.g. propeller, suction points).

For diving from DP ships umbilical management shall be calculated and carried out (see e.g. IMCA D 010).

Note: Further information on the positioning of a DP ship and the management of diving operations can be taken from, e.g. IMCA D 010 Diving Operations from Vessels Operating in Dynamically Positioned Mode in the valid version.

6.5.2.3 Diving from a rigid inflatable boat (RIB)

Diving from a rigid inflatable boat with any other platform as the starting base is subject to a specific risk assessment, which takes particular account of environmental conditions, emergency plans and rescue possibilities. This is to be prepared in advance based on conditions at the relevant base platform. Diving from a RIB is only to be done if other platforms are not suitable. If the risk assessment evaluates performance of the diving work as a safe method, the following requirements shall also be met.

- If there is no boat landing at the base platform it shall be ensured that there is an alternative emergency route to the base platform for the crew of the RIB.
- The RIB shall be securely moored at the dive site.
- Visual contact shall be maintained between the starting base and the RIB and a distance of 500 m shall not be exceeded.
- There shall be possibilities to get the diver to the diver pressure chamber on the base platform immediately (see RA).
- Dives requiring decompression may not be carried out from a RIB.
- Dives from a RIB may not exceed a depth of 30 m.
- Someone on the base platform shall act as a lookout and also be in constant radio contact with the diving supervisor in the rigid inflatable boat.
- A second fully operational rigid inflatable boat shall be available at all times during diving operations.

Minimum requirements for rigid inflatable boats:

- Sufficient space and stability to ensure a safe dive and to safely store all the necessary diving and rescue equipment.
- Certified to be lowered into the water by crane with at least 2 persons.
- Safe transfer of the crew by boat landing shall be ensured.
- Engine with propeller guards.
- At least 3 hours' oxygen supply for injured divers.
- Radio connection to diving platform.
- Appropriate rescue equipment (e.g. Jason's Cradle or better) to get an injured diver or person out of the water.

Note: Further information on diving from rigid inflatable boats can be taken from e.g. IMCA D 015 Mobile/Portable/Daughtercraft Surface Supplied Systems in the version valid at any time.

6.5.3 Diving from fixed platforms

It has to be checked whether a dive can be carried out without further risks or can be performed using suitable protective measures.

When diving from fixed platforms the following minimum standards shall be fulfilled:

- Diving operations may only be carried out if in an emergency the diver can be delivered to the diver pressure chamber within the prescribed time limit (emergency surface decompression in line with DGUV Regulation 40).
- In the case of particular risk an additional diver is required (see 6.1.2).
- For the transport of divers, 2 launching appliances suitable for the transport of personnel shall be available (see 5.3.6).

6.5.3.1 Diving in structures (confined spaces/special access)

For underwater work in which the diver is working on, in or within structures, the following minimum requirements and conditions shall be considered:

- Currents, tides and visibility at the dive site.
- Possible risks from the structure, such as inflows and outflows, anodes; attachment parts, CCP systems, etc.
- Parallel work being carried out on/within the structure.
- Regardless of the diving platform (floating or fixed) distance markers shall be applied to the umbilicals used.
- The number and course of the lines and hoses the diver is using underwater for the operation, e.g. for tools, shall be noted.
- Shallow near-surface work at structures, e.g. water exchange areas, require lower weather criteria than e.g. work on the seabed.

- In the case of diving work on or in structures, the type of diving platform shall be considered, e.g. DP ship / fixed platform, etc.
- In the case of work within complex structures and within enclosed structures/spaces two divers should be used as a rule, whereby the second diver secures the first under water (see section 6.1.2).
- In the case of diving work within enclosed structures/spaces a specific rescue concept shall be prepared.
- In enclosed structures/spaces expired breathing gases and gases from tools can present an additional risk.
- In the case of diving work within enclosed structures/spaces and simultaneous deployment of personnel in enclosed structures/spaces above the waterline the safe stand of the personnel, safe access for personnel both above and below the water, sufficient illumination and air conditioning shall be ensured. Continuous O₂- monitoring is required.
- Measures shall be taken to reduce diving and decompression times within enclosed structures/spaces.
- If rapid evacuation of the diver cannot be ensured at any time a second diver is to be deployed who will also act as dive tender and standby diver underwater.

6.6. Fire Protection

6.6.1 General fire protection

Spaces inside ships or other platforms in which items of diving equipment or control devices are installed are to be protected with structural fire protection such as control stations (as defined in reg. 3 and referred to in reg. 20, Chapter II-2 of SOLAS).

Other areas of the diving location are to be equipped with appropriate fire extinguishing systems in line with the risk assessment.

Flammable and oxidising materials are to be avoided in the vicinity of the diving location or kept to a minimum.

6.6.2 Fire protection in diver pressure chambers

In enclosed spaces such as diver pressure chambers where there is a higher concentration of oxygen (fire-inducing conditions) there is a fundamental increase in the fire risk. For this reason, additional measures such as using fire extinguishing equipment and behavioural measures shall be taken in and around the diver pressure chamber (see also Annex A).

The following objects may not be taken into the diver pressure chamber:

- Easily inflammable material
- Flammable liquids or gases, or those which represent a health hazard
- Equipment or objects which can produce sparks

6. Operation (performance of diving work)

- Materials capable of carrying an electrostatic charge
- Bottles and other objects with non pressure-compensated volumes which could explode in the case of pressure changes.

Smoking and open flames are prohibited in the diver pressure chamber. This ban is to be clearly recognisable and permanently displayed at the entrance to the diver pressure chamber and inside at clearly visible points by means of the prohibiting sign "Fire, open flames and smoking prohibited".

7. Maintenance and Inspection

7.1. General

For the maintenance and inspection of diving equipment, rescue devices and work tools as well as the manufacturer's instructions, the relevant legal principles valid at any time shall also be observed.

For the provision and utilisation of diving equipment, rescue devices and work tools the national regulations like operating safety ordinance and PPE application ordinance fundamentally apply. Other points which arise from the risk assessment to be prepared for the relevant case of use are to be considered. Particular care shall be taken in the maintenance and inspection of personal protective equipment of class III and appliances for the transport of persons.

The diving company shall ensure that the personnel involved are instructed on the valid maintenance and inspection duties and trained in correct implementation.

Damaged appliances and those which are not operationally safe are to be clearly marked as such and immediately removed from service or repaired. If this is established in the course of maintenance or defect inspection, these defects are to be corrected in line with the instructions of the operator or manufacturer.

The performance of maintenance work or inspections on appliances in use is not permitted.

Note: More detailed instructions and aids to the practical implementation of maintenance measures and inspections can be taken from other recommendations, e.g. the IMCA Guidelines D018 and D023.

7.2. Maintenance

7.2.1 General

The maintenance of diving equipment, rescue devices and work tools refers to the routine servicing and upkeep of these appliances with the aim of maintaining operating safety and fully operational status.

The servicing intervals and responsibilities for diving equipment, rescue devices and work tools shall be established and complied with. (Sample table, see Annex C). The planning and implementation of maintenance work shall be documented. The maintenance of diving equipment, rescue devices and work tools is to be carried out only by trained and instructed personnel in line with the manufacturer's instructions.

7.2.2 Breathing apparatus

Breathing apparatus is personal protective equipment of the highest safety class III in line with PPE Directive 89/686/EEC. The maintenance of breathing apparatus is therefore to be done with the greatest of care (e.g. four eyes principle).

The maintenance and upkeep of air filter systems and handling of operating substances in breathing gas compression systems is to be done only by trained specialist staff.

When using oxygen or oxygen-enriched gases with an O₂ content of >21 vol-% the leaflet M034 "Oxygen" from the professional associations is to be observed.

7.2.3 Pressure chambers and diving systems

Maintenance work to pressure chambers and diving systems may only be done by the manufacturer or by personnel appropriately instructed and trained.

7.2.4 Rescue equipment

Rescue equipment shall undergo regular servicing as regards its operational status in line with manufacturers' instructions.

7.2.5 Diver launch appliances

Diver launch appliances as a means of transport for personnel are only be serviced and maintained by the manufacturer or by trained and instructed personnel.

7.3. Inspection

7.3.1 General, manufacturers' instructions, intervals

The inspection of diving equipment, rescue equipment and work tools refers to the scheduled, regular inspection of appliances and installations as regards their operating safety which is carried out by the user, specialists or persons authorised to carry out inspections as well as by expert assessors.

The diving company shall have the diving equipment, rescue devices and work tools inspected in line with the manufacturers' instructions before each deployment (see 7.3.3), but at least once every 6 months, by a specialist or person authorised to carry out inspections to ensure operating safety and fully operational status.

The inspection intervals and responsibilities for the inspection of diving equipment, rescue equipment and work tools shall be established and complied with (Samples see Annex C). The performance of inspections and the scope of equipment are to be documented.

Note: Additional information on the performance of inspections can be taken from e.g. TRBS, IMCA D018 and D023.

7.3.2 Testing before commencement of diving work

Before carrying out a planned diving operation, compliance with the requirements of this guideline shall be proven in the course of an audit.

An audit may only be performed by a person who

- guarantees proper performance of the audit on the basis of their training, expertise and experience gained through practical activities,
- is not subject to any instructing authority as regards the supervisory activity and
- has sufficient knowledge of this guideline and the relevant legal principles.

7.3.3 Testing before deployment

Before each diving deployment tests are to be carried out on diving equipment, rescue equipment and work tools to ensure completeness, operating safety and functionality.

7.3.4 Testing after deployment

After deployment the diving equipment, rescue equipment and work tools are to be checked for defects and damage in the course of restoring operational status.

7.3.5 Initial testing

When a diving company carries out diving work within the scope of this guideline for the first time the equipment is to be tested by an expert assessor. (see 7.2.6)

The scope of the equipment tested is to be documented.

After substantial technical changes to equipment, renewed initial inspections shall be carried out by an expert assessor. The establishment of substantial technical changes is to be agreed with the expert assessor.

7.3.6 Regular testing /time intervals

The diving equipment, rescue equipment and work tools shall have been checked by an expert assessor within the last year before each deployment.

The quality of the breathing gas from the air supply system is to be checked by a specialist at least once per quarter in accordance with EN 12021.

For breathing gas bottles which are used under water, including reserve breathing gas bottles on the diving basket of the LARS, the inspection intervals in line with BetrSichV are applicable.

Electrical work tools carried by the user and other electric work tools which are moved during use or subject to similarly intense use, extension and connecting cables with plug installations are to be inspected on construction sites at least every 3 months by a person authorised to conduct inspections (cf. DGUV Information 203-071, Annex 2)

8. List of References

- GL Noble Denton rules and guidelines, 0032/ND Rev 1 - 22 June 2013 - Guidelines for Moorings
- IMCA D 010 - Diving Operations from Vessels operating in Dynamically Positioned Mode
- IMCA D 015 – Mobile/Portable/Daughtercraft Surface Supplied Systems
- IMCA D 018 - Code of practice for the initial and periodic examination, testing and certification of diving plant and equipment
- IMCA D 023 Diving Equipment Systems Inspection Guidance Note (DESIGN) for surface orientated (air) diving systems
- IMCA D 045 Code of practice for the safe use of electricity under water
- International Convention for the Safety of Life at Sea (SOLAS)
- International Maritime Code for Dangerous Goods (IMDG Code)

Annex A Requirements for Diver Pressure Chambers

1. General

This Annex is applicable to all requirements for diver pressure chambers (see DIN 13256-1 “Pressure Chambers for Persons; Introduction”) which are designed for pressures above atmospheric pressure. Diver pressure chambers serve in emergencies to safely conclude a dive which is terminated unexpectedly and for which it was not possible to comply with the necessary decompression times. Diver pressure chambers can be installed both on fixed installations and on ships.

This Annex is not applicable to

- Pressure chambers for hyperbaric therapy and
- Personnel airlocks and patient pressurised air chambers for pressurised air work.

2. Terms

Main chamber	The part of the diver pressure chamber intended to house the diver during excess pressure exposure.
Ante chamber	The part of the diver pressure chamber intended as an entry and exit airlock for persons and appliances.
Supply lock (medical lock)	The part of the diver pressure chamber intended as an entry and exit airlock for, e.g. drinks or food.
Pressure chamber system	Pressure chamber including the installations necessary for its operation
Pressure chamber	Pressure containers intended for the enclosure of persons in pressurised air or other breathable gas mixes
Overpressure	Working pressure of gases or gas mixtures of more than 0.1 bar or more than 10 kPa

3. General Requirements

3.1 Diver pressure chambers shall be designed and operated in line with the generally established rules of technology (compare 5.3.6). Deviations from this Annex are permissible if at least a comparable safety standard is ensured and proven.

3.2 The primarily organisational basic duties of the diving company to ensure the safety of its employees are formulated in the accident prevention regulation “Principles of Prevention “ (DGUV Rule 100-001) and the German Occupational Safety Act (ArbSchG).

3.3 The diving company shall take the necessary measures to prevent occupational accidents, occupational illnesses and work-related health risks and to ensure an effective first aid system and thereby in particular to comply with state and professional association regulations. In addition the measures shall take account of the state of technology, occupational medicine and hygiene and other confirmed occupational science knowledge.

4. Technical and Constructional Requirements

4.1. General

4.1.1 Diver pressure chambers shall consist of at least one main chamber and one ante chamber.

4.1.2 Diver pressure chambers shall be designed so that a maximum working pressure of at least 5 bar can be achieved and reliably maintained within 6 minutes. A pressure release of 0.4 to 0.2 bar excess pressure shall be possible in 1 minute.

4.1.3 Diver pressure chambers shall be calculated for a permissible operational excess pressure which is 10% higher than the maximum working pressure and can withstand a test pressure of 1.5 times the permissible working excess pressure.

4.1.4 Diver pressure chambers shall be equipped with a safety valve as a safety device against excess pressure, which automatically prevents the permissible operating excess pressure being exceeded by more than 10% at the maximum encountered flow.

The safety valve may not respond until above the permissible operating excess pressure and shall be closed before falling below the maximum working pressure.

The safety valve shall be positioned within the diver pressure chamber in such a way that it is protected or secured against damage, unintended operation and any unintended adjustment of the pressure setting.

The opening in the diver pressure chamber through which air can flow out to the safety valve shall be designed and secured in such a way that it cannot be inadvertently sealed nor external substances sucked in.

4.1.5 Diver pressure chambers within the scope of this guideline shall have an internal diameter of at least 1.80 m and a free passage width of 0.50 m. The interior of the main chamber shall be equipped and designed to enable performance of effective first aid on a diver.

The internal diameter can be reduced to 1.60 m if the spatial conditions in terms of access and care of a diver in the main chamber are ensured.

4.1.6 Seats in diver pressure chambers shall be designed so that each person has a seat width of at least 0.5 m and a seat depth of at least 0.4 m and that cooling of the body through contact with cold surfaces is avoided.

4.1.7 Door spaces in diver pressure chambers shall be designed so that a patient can be carried in lying on a stretcher which complies with DIN 13024-1 "Stretcher with rigid rails; dimensions, requirements, inspection" or DIN 13024-2 "Stretchers with foldable rails; dimensions, requirements, inspection". Round access hatches (door openings) shall have a width clearance of at least 0.70 m.

4.1.8 Door locks shall be able to be operated from both sides after pressure equalisation.

4.1.9 On ships and during transport it shall be possible to secure the doors of pressure chambers by suitable means even in the open position.

4.1.10 Diver pressure chambers shall be fitted with observation windows which allow easy viewing of all seats in the diver pressure chambers. The panes shall be made of acrylic plastic.

4.1.11 Diver pressure chambers shall be equipped with suitable lighting systems to enable a nominal lighting level at head height on the seating area of at least 200 Lux. In addition there shall be emergency lighting in the diver pressure chamber.

4.1.12 Shut-off valves must not be installed close to the chamber wall if the connection to the first valve is short and well protected.

4.1.13 All materials used in the diver pressure chamber shall consist of flame retardant and fire-resistant materials and shall be classified at least as fire protection class B1 – flame retardant or similar. No materials may be used which produce sparks or electrostatic charge or which are easily flammable.

4.1.14 Diver pressure chambers shall be equipped with firefighting appliances in the ante and main chamber which are suitable for use in overpressure. The firefighting appliances shall each consist of at least one suitable fire extinguisher. Fire extinguishers with toxic or asphyxiating extinguishers (e.g. CO₂ or halogenating hydrocarbons) are not permissible. The installation of a firefighting system in line with DIN EN 16081 is recommended. In the case of fixed installed firefighting systems it shall be possible to release the system by hand from both inside and outside.

4.1.15 For each authorised person in the pressure chamber there shall be one oxygen mask available which can deliver at least 75 l/min at atmospheric pressure. The oxygen shall be supplied to the breathing mask via a demand valve at the relevant chamber pressure. The expired gas may not be released into the chamber atmosphere. The expired air shall be released at a location with adequate ventilation. The outlet for gas with enriched O₂ shall be marked accordingly.

4.2. Main chamber

4.2.1 Main chambers shall be designed so that they provide space for at least one person lying down and two sitting.

4.2.2 Main chambers shall be equipped with a device for air flushing. This device shall enable the flushing quantity to be set to at least 30 l/min and per person (measured by chamber pressure) at every pressure setting.

4.2.3 Main chambers shall be equipped with a supply lock. The minimum dimensions of the supply lock shall be a diameter or free cross-section of 200 mm and a length of 300 mm. The closures on the supply lock shall be secured so that one closure can only be opened when the other is closed and pressure equalisation is complete. Pressure equalisation openings shall be secured against clogging. A suitable device shall show the pressure in the supply airlock from the outside.

4.2.4 Main chambers shall be equipped with video and sound recording. The camera image shall be visible from the control stand.

4.3. Ante chamber

Ante chambers shall be equipped to accommodate at least two persons sitting.

4.4. Control devices and display instruments

4.4.1 Control devices and display instruments for ante chambers and main chambers shall be amalgamated at one control stand. They shall be designed, fitted, marked and arranged so that their purpose and switching mode are clearly recognisable. They shall be illuminated with a nominal illumination level of at least 300 Lux.

4.4.2 For display of the overpressure readings of the ante chamber and main chamber there shall be an analogue pressure gauge with a casing diameter of at least 160 mm, class 0.25, scale distribution corresponding to 0.1 bar. On the gauge of the excess pressure metre there shall be a red warning indicator showing maximum working pressure.

4.4.3 There shall be a pressure recorder for the pressure progression in the main chamber. The pressure recorder shall distinguishably show pressure changes of 0.05 bar and time periods of 1.0 minutes. It shall be possible to analyse at least the pressure progression of the last 2.0 hours.

4.4.4 In addition to the display devices in line with sections 4.4.2 and 4.4.3 the control stand shall also have instruments showing

- Pressure in the pressurised air storage containers,
- Pressure in the oxygen storage containers,
- Pressure in the storage containers of other breathing gases (if used),

- Flushing air flow volume,
- Interior temperature of the main chamber and
- Volume concentration or partial pressure of the oxygen in the ante and main chambers.

Oxygen metres shall set off a visual and acoustic alarm at levels below 19 and above 23 vol.- % oxygen and show the current value.

4.4.5 A non-electrical analogue clock with a second hand shall be displayed so that it is visible from the control stand. Clocks with digital displays are not permitted as the only time display.

4.5. Air and oxygen supply

4.5.1 Air supply systems shall have at least pressurised air supply which is sufficient for:

1. single pressure increase in the main chamber to 5 bar overpressure within 6 minutes,
2. two pressure increases in the ante chamber to 5 bar overpressure,
3. maintaining an overpressure of 5 bar in the main chamber with flushing of at least 90 l/min (measured by chamber pressure) over 30 minutes and
4. maintaining an overpressure of 1.0 bar in the main chamber with flushing of at least 90 l/min (measured by chamber pressure) over at least 300 minutes.

Note: The flow volume of 90 l/min flushing air refers to occupancy of the main chamber with three persons in line with 4.2.1 (one lying and two seated persons). If the main chamber is designed for a larger number of persons the air flushing quantity for each person shall be 30 l/min.

4.5.2 An air compressor shall be available to serve the diver pressure chamber.

4.5.3 An emergency reserve of pressurised air shall be available which is at least 50 % of the pressurised air supply in line with section 4.5.1. This emergency stock shall be kept in separate pressurised containers locked away during normal operation.

4.5.4 For the oxygen supply in line with section 4.1.15 there shall be oxygen reserves of at least 60 m³ for 3 persons. The quantity of oxygen available shall be sufficient for a period of use which enables additional oxygen to be obtained subsequently.

4.6. Equipment for Communication

4.6.1 Between the ante chamber and the control stand and between the main chamber and the control stand there shall be an intercom system with a loudspeaker which is set to receive constantly at the control stand. The intercom shall be of a push to talk design.

4.6.2 In addition to the intercom in line with section 4.6.1 there shall also be a telephone connection which operates independently of electricity.

4.6.3 Between the ante chamber and the control stand and between the main chamber and the control stand there shall always be at least one emergency signalling system installed at the control stand with a prominent visual and acoustic signal. The signalling buttons in the chambers shall be clearly identifiable, permanently marked and within easy reach.

4.6.4 Besides the internal communication there shall be an appropriate telephone system which enables a connection to be established from the control stand to the designated physician.

4.7. Equivalent power supply

For the diver pressure chamber lighting, the control stand and for all other electrical appliances required to ensure safe operation there shall be a general equivalent power supply in accordance with DIN VDE 0108 "Set-up and operation of high voltage systems in structural buildings for gatherings of persons and for security lighting in workplaces". In the case of power failure this shall take over supplying power to the power-consuming appliances and ensure power for at least 5 hours.

On ships the emergency power supply can also be provided by the vessel's own emergency power supply, provided the capacity is adequate.

For safe switching from main to substitute power, an uninterrupted power supply shall be provided.

5. Operation

5.1 Diver pressure chambers may only be operated for pressure increase and flushing with breathing gases in accordance with DIN EN 12021:2014 Respiratory equipment - Compressed gases for breathing apparatus.

5.2 Every exposure to overpressure shall be recorded with at least the following information:

- Name of the persons in the diver pressure chamber,
- Name of the diving supervisor,
- Name and address of the designated physician.
- Date, commencement and end of chamber occupation,
- Beginning and end of period at working pressure,
- Beginning and end of period at each decompression stop,
- Breathing gas used for each time period, particularly oxygen
- Particular events (e.g. lock in/out procedures).

The record is to be signed by the diving supervisor and the persons exposed to pressure.

5.3 Normal operation may only be done with the pressurised air reserves in line with section 4.5.1.

5.4 Pressure chamber exposures may only be performed within the main chamber. The ante chamber shall be kept free for access and non-pressurised.

5.5 As long as there are persons in the diver pressure chamber the control stand shall be occupied at all times by the pressure chamber operator.

5.6 During operation adequate flushing of the chamber shall be ensured (30 l/min per person).

5.7 During operation the temperature shall be monitored constantly. It should be approx. 21 °C. It should not exceed 30 °C during pressure increase and may not go below 15 °C during pressure decrease.

5.8 Materials which may not be brought into diver pressure chambers include the following:

- easily flammable materials,
- flammable or health-damaging liquids or gases,
- equipment which produce sparks,
- bottles and other objects with non-pressure-compensated volumes which could explode in the case of pressure changes
- equipment not certified/not suitable for exposure to overpressure.

5.9 Smoking and work with open flames are not permitted in diver pressure chambers. Notification of this ban shall be displayed clearly and constantly at the entrance to the diver pressure chamber by means of the prohibition sign: "Fire, open flames and smoking forbidden".

5.10 Any oxygen enrichment of the air in the diver pressure chamber is to be avoided. In the case of increased oxygen content the cause shall be ascertained, if necessary the oxygen supply in the breathing system stopped and air flushing of the chamber increased.

Annex B Sample Checklist for Collection of Findings

With kind permission of

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Recorder: Date: Time:

Comments:

.....
Telephone questionnaire in the case of suspected diver injury / decompression sickness

1. Who is calling?
2. Where are you?
3. Who are you calling about?.....
4. Age, gender, experience?
5. When was the dive?
6. How deep was the dive?.....
7. How long was the dive?.....
8. How many dives?.....
9. Repeat dive?.....
10. What work was done?
11. How was the DC phase?
12. What symptoms?.....
-
13. Where and since when?
-
14. Increasing or decreasing?
15. What has been done up to now?
16. What do you have on site?.....
17. What do you need?
18. How can you be contacted?

ACTION TAKEN:.....
.....

PROGRESSION:

Annex C Sample Maintenance and Inspection Checklist

Description of the activity	To be performed by			Interval							
	User	Specialist or maintenance firm (external)	Expert assessor	Before use	When using	After use	Upon initial commissioning	3 months	6 months	12 months	As necessary, or acc. to manufacturer's instructions
Maintenance											
Cleaning	X					X					X
Compressors		X								X	X
Pressure chambers		X								X	
Electrical appliances		X						X			
Diver launching appliance	X			x							
Inspections											
Function testing of all equipment	X			X	X						X
Inspection of equipment for operational safety		X								X	X
Initial inspection / Commissioning inspection			X				X				
Periodical inspection			X							X	