DIVING ACTIVITY: OPERATING INSTRUCTIONS AND DEFINITION OF THE MAIN RISKS

As part of the University research activities, the carrying out of scientific scuba diving activities for the collection of data and samples should also be considered. Samples can be water, sediment or elements of aquatic flora or fauna or of the microbial compartment. Sampling may involve the use of equipment that does not involve excessive physical effort for transportation or use (small nets, hammers, pliers, scissors, chisels, small capacity sorbon, underwater drills, sensors, probes, corers, etc.) or significant buoyancy variations (small lifting balloons). These specific activities identify a professional figure with precise connotations (underwater scientific operator) who, however, does not fall under any specific regulation. For this reason, and consistently with the decisions of other research bodies and institutions, it is considered essential to draw up guidelines for the correct behavioural patterns for scientific operators when carrying out underwater teaching and research activities.

Director of the Department: prof. Luigi Bubacco
Responsible for the administrative procedure: Dr. Simone Canesso tel.049.8276176 e-mail simone.canesso@unipd.it
Contact reference: tel.049.8276178, 049.8276335 e-mail direzione.biologia@unipd.it

UNDERWATER ACTIVITIES MANAGEMENT AND SAFETY PROCEDURES

INDEX

Director of the Department: prof. Luigi Bubacco
Responsible for the administrative procedure: Dr. Simone Canesso tel.049.8276176 e-mail simone.canesso@unipd.it
Contact reference: tel.049.8276178, 049.8276335 e-mail direzione.biologia@unipd.it

LIST OF ANNEXES
Annex 1: Check-list for the Head of Mission, verification of tasks;
Annex 2: Check-list for the verification of diving equipment;
Annex 3: Authorization to dive form;
Annex 4: Diving activities program;
Annex 5: Planned dive file;
Annex 6: Dive record;
Annex 7: Training course;
Annex 8: ESD and ESD minimum skills.

Director of the Department: prof. Luigi Bubacco
Responsible for the administrative procedure: Dr. Simone Canesso tel.049.8276176 e-mail simone.canesso@unipd.it
Contact reference: tel.049.8276178, 049.8276335 e-mail direzione.biologia@unipd.it

1. PREMISE

The teaching and research activities that involve scuba diving are carried out by operators of the University of Padova belonging to different departments, including, but not limited to, the Department of Biology – DiBio, the Department of Comparative Biomedicine and Nutrition – BCA, the Department of Cultural Heritage (DBC), and the Department of Civil, Building and Environmental Engineering, as well as students and visitors who operate at the Hydrobiological Station in Chioggia. These activities consist, by way of example, of:

- Measurements and surveys on the seabed
- sampling of water, organisms, sediments, rocks, etc.
- recovery and on-site conservation of archaeological finds
- video-photographic documentation
- assessment of the status of the aquatic environment and of the cultural and historical heritage
- experiments, including manipulative experiments

"By scientific diving we mean the activities carried out for research, experimentation and teaching purposes by operators who descend directly underwater. This practice is now so widespread that it can be said that there is no major scientific institution in the world that does not have at least one diving section or does not use diving operators to carry out its investigation programs. Ultimately, it is a matter of bringing underwater not only the hands to sample or carry out other specific operations, and the eyes to observe, but also, and above all, the intelligence and discernment of the specifically prepared human. This possibility has led to an enormous progress in the knowledge of the underwater world and represents an approach that no instrument operated from the surface can ever match. We therefore go underwater to explore, measure, collect, observe and recognize, but above all to understand." (Colantoni, 2007)

Almost by definition, underwater scientific work means studying, investigating, verifying, monitoring, analysing and experimenting in a creative and innovative way. Scientific divers are therefore continuously facing situations that cannot, generally, be predicted in detail by any manual (Heine, 2011).
The level of safety must be guaranteed in any case by applying the general principle of prevention and protection, avoiding that the need to face exceptional situations encourages inappropriate behaviours, and leads the operator to carry out the activity by making up with his own personal experience for the lack of codified scenarios and forward planning and management that is not always well formalised. The employer must provide adequate training, coaching and specific health surveillance, as required by the consolidated law on safety at work (Legislative Decree 81/08). Furthermore, workers who perform tasks that involve diving, during their activities, could be subject to injuries and pathologies caused, in particular, by physical and mechanical agents (e.g. dysbaric pathologies), biological agents (e.g. water pollution from pathogens; poisonous or stinging organisms; large predators), chemicals (e.g. pollutants), against which special precautions must be taken.

In the discussion of occupational risks and prevention and protection measures, as well as the specific rules and limitations to be placed to the activity, it is necessary to identify the figures of responsibility and their tasks, in accordance with Legislative Decree 81/08 and subsequent amendments, with Ministerial Decree 363/98 and with the University Regulation for Occupational Safety and Health.

2. PURPOSE AND FIELD OF APPLICATION

The field of application of these procedures includes all underwater activities dedicated to the study and monitoring of aquatic environments and in particular:

- monitoring of biological elements also with the use of photographic equipment, videos, etc. (e.g.: benthic and pelagic organisms and animals);
- seabed mapping;
- specialized assessment of the aquatic environment status;
- samples collection (sediment, water, biota, etc.);
- recovery and on-site conservation of archaeological finds;
- experimental studies.

These procedures apply under the following conditions:

- with open-circuit breathing apparatus with air or oxygen-enriched mixture (NITROX) with a percentage of O_2 from 21% to 40%;
- up to a maximum depth of 40 meters;
- in any event, with a partial pressure of oxygen in the respiratory mixture not exceeding 1.3 bar (PpO_{2max} = 1.3 bar)
- in any event, with a partial pressure of nitrogen in the respiratory mixture not exceeding 4 bar (PpN_{2max} = 4 bar)
- near the seabed or other target structures within 40 m of depth;
- not in freediving.

Director of the Department: prof. Luigi Bubacco
Responsible for the administrative procedure: Dr. Simone Canesso tel.049.8276176 e-mail simone.canesso@unipd.it
Contact reference: tel.049.8276178, 049.8276335 e-mail direzione.biologia@unipd.it

- never alone;
- not in port areas, except if in agreement with the Port Authority and the Coast Guard;
- not in environments where chemical or biological contamination could supposedly be dangerous for the operator;
- not in obstructed environments, such as interiors of caves and wrecks that do not allow a constant sight and access to the way out;
- not in yo-yo mode, that is, with repeated descents and ascents during the same dive.

Dives that do not lay within these limits require further specific risk assessments, and the consequent adoption of specific and appropriate safety procedures in addiction to these procedures (see any possible addendums).

3. REFERENCES

There is no clear and official legislation in this field (especially in Italy) to refer to, therefore, for the purposes of drafting this Operating Instructions, we have relied on universally accepted guidelines and rules of good practice. In particular, we were inspired by the criteria and guidelines used in the countries of the European Community (Ponti, 2012), by those implemented by the Italian Environmental Agencies (Gini et al., 2012), by the criteria and guidelines for risk assessment and the correct behavioural methods of operators in carrying out underwater activities of the Environmental Agencies, by the Diving Operational Manual of the National Antarctic Research Program (PNRA, 2010), and the "Good practices for the safe conduct of underwater activities of ISPRA and environmental agencies" of 2013. These Guidelines have been validated by the Permanent Consultative Commission of the Ministry of Labour and Social Policies, becoming a Document of Good Practice (Law 3 August 2007, no. 123). These guidelines have been implemented by the Polytechnic University of Marche, the Alma Mater Studiorum University of Bologna and the Anton Dohrn Zoological Station, which have drafted internal management and safety procedures for underwater activities. These procedures, once the necessary changes have been made, are also applicable to diving activities carried out by workers and equivalents at the University of Padua. In addition, the recent publication and adoption by the National Research Council of its "Safety procedure in diving activities for scientific research purposes", edited by M. Sciarra, C. Barchesi, G. Sotis, M. Passera, expands the context of application of the good practices currently in use in the Italian research landscape.

4. OPERATING METHODS

4.1. ACRONYMS AND DEFINITIONS

- SCIENTIFIC DIVE: those dives conducted exclusively in the context of scientific research activities, conservation and protection activities, as well as training activities, the purpose of which is the achievement of scientific, scientific learning, educational and protection of the environmental and/or historical-archaeological heritage goals, through, for example, sampling, measurements, surveys, monitoring, experimentation, prospecting, stratigraphic excavations, polls and recoveries.
- SCIENTIFIC DIVING OPERATORS: those who, in possession of adequate qualifications certifying the specific training required by the specific operational context, carry out scientific dives, including students in the context of their underwater scientific training course.
- PROFESSORS: for the purposes of this document, all full professors, permanent researchers, fixed-term researchers and lecturers.
- TECHNICIANS: for the purposes of this document, all technical staff hired on a permanent or fixed-term basis.
- NON-STRUCTURED STAFF: PhD students, research fellows, scholarship holders, thesis students and trainees, also from other institutions, as part of agreements, exchange and internationalization programs.
- GUESTS: permanent and non-permanent staff, students belonging to other universities and both public and private institutions.
- ESDP: European Scientific Diving Panel.
- ESD: European Scientific Diver (minimum training standard for scientific divers defined by the ESDP).
- AESD: Advanced European Scientific Diver (minimum training standard for Head of Mission or scientific dive supervisor defined by the ESDP).
- AIOSS: Italian Association of Underwater Scientific Operators, is the Italian professional association for underwater scientific operators (http://www.aioss.info/), to which many Italian research institutions and universities comply, including the Department of Biology of the University of Padua; AIOSS represents ESDP in Italy and plays the role of certifying body for the

ESD/AESD minimum training standards arranged by ESDP.

- PDD: Decompression diseases.
- DIVE WITHIN THE SAFETY CURVE: for each diving depth there is a maximum time of staying that allows the diver to ascend without having to do decompression stops and without incurring, for this reason, in a risk of PDD, according to the decompression model and profile adopted. A dive carried out respecting these parameters, which therefore does not involve the need to make any stops during the ascent, is defined as a dive within the "safety curve".
- DIVE OUTSIDE THE SAFETY CURVE: a dive that requires, due to the depth and the time spent at that depth, according to the decompression model and profile adopted, the observance of decompression stops during the ascent to the

Surface. The depth and duration of the stops will be a function of the time spent at different depths, and will be calculated by means of decompression algorithms implemented on underwater instruments (underwater decompression computers).

- SUBSEQUENT OR REPETITIVE DIVE: any dive carried out after a minimum of 10 minutes and within the following 12 hours or more (according to the decompression tables or decompression algorithms in use), after a previous dive. The time spent on the surface between one dive and the next is called surface interval and is used to calculate the correct decompression procedures for the next dive. Dives at altitudes above 700 m on sea level, and before an adaptation period of 48 hours, have decompression issues similar to those of repetitive dives, as well as peculiarities typical of altitude diving, all this must be predicted by the decompression algorithms adopted.
- BCD: buoyancy control device.
- EMERGENCY: unforeseeable event that endangers the health and/or safety of the diver during the diving activity.
- DIVING PHYSICIAN or HYPERBARIC DOCTOR: a physician who has the training as "Medical Examiner of Divers (MED)" (Level 1 competence), or higher, according to the "Educational and Training Standards for Physicians in Diving and Hyperbaric Medicine" defined in 2011 by the Joint Medical Subcommittee of the European Committee for Hyperbaric Medicine (ECHM) and the European Diving Technology Committee (EDTC). A useful address book of doctors who meet these requirements is available at the website https://www.edmd.eu/.
- PERSONAL PROTECTIVE EQUIPMENT IN THE UNDERWATER FIELD: according to the provisions of Legislative Decree 4 December 1992, n. 475, PPE in the underwater field are classified in the third category (section 4.5).

4.2. TRAINING REQUIREMENTS FOR SCIENTIFIC DIVING OPERATORS (OSS)

The personnel assigned to diving activities must be in possession of a specific preparation for the activity itself and on diving techniques, as well as possessing the psycho-physical conditions required to be able to practice this activity.

4.2.1 QUALIFICATION

The enablement required for the OSS is distinguished on the base of the subject engaged in the activity and on the type of scientific diving planned, and refer to the minimum skills required, the training courses and the maintenance of the qualification requirements compatible with the minimum ESD/AESD standards (information available on the http://scientific-diving.eu/wiki and http://www.aioss.info/certificazione.asp websites, as well as briefly summarized in ANNEX 7). These certifications are issued by the competent organizations in the various Member States of the European Community, specifically in Italy by the Italian Association of Underwater Scientific Operators (http://www.aioss.info/). Alternatively, the RDRS can independently ensure, under their own responsibility, the verification of the level of training before authorizing the personnel to perform the planned dives (authorization form in ANNEX 3).

Referring to the different roles:

• HEAD OF MISSION: minimum reference competences AESD level;

• OSS: minimum reference competences ESD level;

• STUDENTS OR STAFF IN TRAINING AND GUESTS, attending educational courses and/or engaged in training exercises in diving, specific and temporary exemptions are granted for them from the possession of the ESD/AESD certifications, under the responsibility of the RDRS, in agreement with the Head of Mission, and with the least possible risk: it's enough if they are in possession of a second level certification for scuba diving (equivalent to 2 CMAS stars and qualifying at -30 m depth) issued by a national or international school certified by EUF (http://www.euf-certification.org/) or by other certifying bodies that fully apply the EN 14153/ISO 24801 and EN 14413/ISO 24802 standards; they will be able to dive only for the purpose of obtaining the necessary training useful for the achievement of the minimum ESD/AESD requirements, and only with regards to the minimum experience of

scientific diving required (as specified in clause 4.3.1.1).

Notes:
• if the dives for the achievement of diving licenses issued by schools/educational agencies external to the University take place during trips or educational stays organized by the University, these are not to be considered scientific dives organized by the University, but rather by the school/agency where they take place, which will adopt its own teaching procedures and will take on full responsibility of them
• if the scientific dives, including those of students, take place at other facilities with dissimilar regulations, agreements must be made for complying with and applying the most precautionary procedures in terms of safety

4.2.2. FITNESS FOR THE SPECIFIC TASK

The fitness for the specific task, in accordance with the Legislative Decree 81/08, of the OSS (Scientific Diving Operator) is assessed and certified through the same procedures both for students in training (i.e. students who carry out dives for educational activities and in order to achieve their training objectives) and for structured and equivalent personnel (PhD students, scholarship holders, thesis students, etc.). Fitness must be certified by the Competent Physician at least annually through appropriate specialistic and diagnostic tests, carried out according to the provisions of the health surveillance protocol and seeking the opinion of a Diving or Hyperbaric Doctor. After a diving accident, or illness or non-diving accident that has resulted in an absence of more than 60 days, it is necessary for the Competent Doctor, possibly after consulting a Diving or Hyperbaric Doctor, to renew the fitness for the job. During medical examinations, any previous accidents must be checked in the dive logbook.

4.2.3. AUTHORIZATION TO DIVE

Workers and equivalent people must be explicitly authorized in writing to carry out scientific dives, also with indication of any possible limitation or prescription (ANNEX 3). The authorization is issued by the RDRS considering the qualifications, the fitness for the job, and the degree of experience and training of the operators assigned to him or her. However, it remains at the discretion of the RDRS or the Head of Mission, the right to suspend the authorization of the diver to carry out any single dive for justified safety reasons.

4.2.4 DIVE ACTIVITY LOGGING DOCUMENTS

Generally speaking, it can be said that a clear codification of the responsibilities and roles assigned, together with a perfect knowledge of the specific tasks involved and of the degree of training and education possessed, can reduce the basic risk related to diving operations. This helps to ensure that, in the event of an accident, the emergency system

planned for the assistance of the injured or distressed diver, can be activate without delay and effectively.

In addition to sending the required forms to the competent authorities (see next section), the start and end of the diving activities will be communicated via VHF, telephone or other means that ensure the reception from the Operations Room of the Harbour Master's Office of the concerned area, as well as any information related to the occurrence of any emergency/danger situation, even if only potential.

4.2.4.1. Diving activities program

All scientific dives must be planned, considering the skills of the diver with lower experience, and the planning must contain at least the following entries:

- Name and contact details of the organizing institution;
- Purpose of the activities to be carried out;
- Technical report on the aforementioned activities, with particular reference to the type of equipment used, if any;
- Verification of the documents of any support boats used;
- Areas interested by the activities;
- Days and times of the activities;
- Working groups composition and qualifications of divers;
- Place of departure;
- Boundary marine weather conditions;
- Prediction of dive depth(s) and time(s);
- Responsible for Underwater Teaching and Research Activities (RDRS);
- Type of work, equipment and support boat to be used;
- Head of Mission;
- A emergency plan must be provided with the following information:
    - list of OSS. During the activities, at least two operators in possession of CPR (BLS) and oxygen administration (Oxygen Provider) certifications must be operational, on board or on the ground;
    - a contact in case of emergency, for each individual diver, including: name, surname, telephone number and kinship of the person to contact;
    - unique number for health emergencies and for the coordination of rescue operations on the national territory, verifying its operativity in the place of interest (118);
    - number for emergencies at sea (1530) or marine VHF radio channel (16);
    - address and telephone number of the nearest hyperbaric chamber, verifying its operativity in the period of interest and the time to reach it;
    - nearest hospital;
    - any vehicles that can be used for emergency transport.
- Declaration, edited by the RDRS, that all participants have the required habilitations/qualifications and are covered by a suitable insurance policy for accidents at work for diving activities in the workplace;
- Any expected risky condition.

This program, signed by the RDRS, is drawn up in accordance with the requirements of the competent bodies (Port Authority, Water Magistrate, etc.) and is sent, at the discretion of the DL, as statement of the diving activity to be carried out (ANNEX 4).

In the case of dives in non-European countries, the RDRS will have to proceed with a similar planning in accordance with the local procedures and possibly make use of assistance provided by insurance schemes such as DAN EUROPE.

4.2.4.2. Planned dive file

Before the dive, the Head of Mission fills in the "Planned Dive File" as reported in (ANNEX 5).

The "Planned Dive File", once the activity has been carried out, is countersigned by the Head of Mission, who archives it.

All OSS, during the preliminary meeting and at the end of the dive, are required to read the "Planned Dive File", sign it and possibly draw up their observations in writing.

4.2.4.3. Dive record

The Dive Record, in paper or electronic format, is filled in at the end of the dive by the Head of Mission and kept by the RDRS, and specifies and contains at least the following information relating to the diving group:

- dive number as shown in the "Planned dive file" (ATTACHMENT 5);
- actual dive start and end time;
- maximum depth reached;
- indication of the presence or absence of accidents and a brief description of what happened, if applies;
- detailed description of any significant event that has occurred or is in progress.

The record book can be made up of the collection of the planned dive files.

Director of the Department: prof. Luigi Bubacco
Responsible for the administrative procedure: Dr. Simone Canesso tel.049.8276176 e-mail simone.canesso@unipd.it
Contact reference: tel.049.8276178, 049.8276335 e-mail direzione.biologia@unipd.it

4.2.4.4. Personal diving logbook

It consists in a personal paper or electronic logbook in which all the data of the dives carried out by the individual operator are recorder. It represents the individual diving and decompression history and, for healthcare reasons, it is necessary that it also includes diving activities conducted outside the ones carried out for the University.

It is care and duty of every diver to keep the personal logbook in perfect order, to take care of the compilation in all its parts and to guarantee the proofs. The logbook must be presented to the Competent Physician and to the Diving or Hyperbaric Physician during the examination for fitness to dive and in the examinations for the habilitation to return to diving after illness/injury. Each scientific diver must be equipped with an individual logbook showing:

- surname, first name and address;
- place and date of birth;
- sex;
- employer;
- In addition, for each individual dive carried out, the following data must be indicated:
    - progressive dive number;
    - place, date and time of diving;
    - percentage of O2;
    - cylinder volume, initial pressure and final pressure;
    - maximum depth;
    - dive time;
    - safety stop performed and any decompression procedure;
    - type of activity carried out;
    - detailed report on each accident or potential hazardous situation;
    - possible observations.

4.3. DIVING PROCEDURES

4.3.1. DIVE GROUP COMPOSITION AND SURFACE ASSISTANCE

The dive and assistance group must consist of a minimum of three people: two divers and a surface assistant. Of the divers, one is designated Head of Mission. There is no maximum number of members of the dive group, but the members of the same group must operate in close eye contact. It is possible to create several teams diving at the same time, each with its own Head of Mission. Several dive teams can refer to the same surface assistant by agreement with the different dive leaders involved.
Operating conditions and limitations must always be commensurate with the skills and qualifications of the less experienced diving group member. Special cases:

4.3.1.1. Training dives

Training activities, as part of teachings or training courses for students and staff, must be guided while diving by the RDRS and/or by the Head of Mission with qualified training as a divemaster, assistant instructor or diving instructor, attested by a certification issued by a national or international school certified by EUF (http://www.euf-certification.org/) or by other certification bodies that fully apply the EN 14153/ISO 24801 and EN 14413/ISO 24802 standards. For degree thesis activities subsequent to the completion of the underwater scientific training phase, students may be accompanied by a Head of Mission with a minimum qualification comparable to AESD. Dives must still take place within 30 m and inside the safety curve.

4.3.1.2. Shallow water dives (≤ 12 m)

For diving to depths not exceeding 12 m, with self-contained air or NITROX breathing apparatus with oxygen percentage ≤27%, in a safety curve, and carried out in optimal weather and sea conditions, even in the case of students attending degree thesis activities, following the completion of the underwater scientific training phase, an OSS with a minimum qualification comparable to ESD can take on the role of Head of Mission.
For dives at depths not exceeding 5 meters, considering the risk factors significantly reduced by the proximity to the surface, the low environmental pressure and the consequent negligible absorption of nitrogen, even a diver in possession of a valid diving certification (even at the first level), but not an OSS license, is allowed to dive for purposes comparable to those of a scientific dive, even if they do not have the basic requirements demanded by this Regulation. The decision and responsibility for this derogation are up to the RDRS, after consultation and in agreement with the Head of Mission (if distinct). The presence, during the activity, of a diving buddy, also in possession of an OSS license or not, but with a valid diving certification (even level I) remains mandatory.

4.3.1.3. Dives with decompression stops

These operating procedures apply only to dives within the safety curve, i.e. without mandatory decompression stops.
For any dive that involves decompression stops, i.e. whose parameters goes outside the safety curve, all members of the dive group must have a minimum qualification comparable to AESD and a diving license that includes dives with decompression stops issued by a national or international school certified by EUF (http://www.euf- certification.org/) or by other certification bodies that fully apply the EN 14153/ISO 24801 and EN 14413/ISO 24802 standards.

4.3.2. PRE-DIVE PROCEDURES

The RDRS prepares the Diving Activities Program. Fast means of transport must be ensured in order to allow any injured person to reach the nearest Hyperbaric Center (or Hospital Presidium) in a short time (preferably within 4 hours).
The Head of Mission must notify the start and end of diving activities to the nearest hyperbaric centre. A "hyperbaric centre" is defined as a clinical environment equipped with a hyperbaric chamber located in a hospital or in an external health facility functionally connected with the Emergency Department (118), with permanent medical personnel, adequately trained in diving and hyperbaric medicine (ECHM recommendation type I, level C).
The dive program, once approved, is sent to the competent authorities before the start of the activities, unless otherwise provided, and a copy of the communication is made available on the dive site.
The Head of Mission prepares the Planned Dive File (ANNEX 5) (countersigned by the OSS concerned), according to the following indications:

- the maximum depth must not exceed 40 m or that depth imposed by the % of oxygen used and the maximum programmed oxygen pressure, in any case not exceeding 1.4 bar, it is advisable to reduce to 1.2 bar, in the case of demanding dives;
- the percentage of oxygen in the respiratory mixture must be calculated so that the partial pressure of oxygen does not exceed 1.4 bar at the maximum planned depth;
- the duration of the scientific dive must be calculated in such a way that it can be carried out without using the air reserve (50 bar);
- the calculation of the dive time inside the safety curve is performed continuously by the dive computer. However, during the briefing phase, a maximum bottom time must be calculated relative to the maximum programmed depth, which allows safe ascent in the event of a malfunction of the diving computer supplied;
- for the use of respiratory mixtures greater than 27% oxygen, specific training of the OSS in the use of NITROX mixtures is required, attested by a patent issued by a national or international school certified by EUF (http://www.euf-certification.org/) or by other certification bodies that fully apply the EN 14153/ISO 24801 and EN 14413/ISO 24802 standards. Except in the case of cylinders filled with compressed air, and therefore for any mixture with a percentage

of O2 greater than 21%, each diver must personally check the percentage of oxygen in the tank assigned to him/her.
Each OSS must comply with the provisions of point 4.5.

4.3.2.1. Dive site Assessment

The Head of Mission, within the scope of his competence, assesses the safety conditions in relation to the predictions of the Diving Activities Program (ANNEX 4) and the Planned Dive File (ANNEX 5), also taking into account the possible worsening of marine weather conditions as well as visibility, and the possible presence of currents. In particular, for dives from shore, the conditions for easy and safe entry and exit from the water must be carefully evaluated.

4.3.2.2. Equipment evaluation

Each diver, with the support of the RDRS, must ensure that his gear and equipment are in order, overhauled and appropriate for the type of dive to be performed. In particular, he/she will have to check that the tank is full, the operation of the regulators and of the BCD, and the state of operation and charge of the batteries of the dive computer.
As regards the refilling of cylinders and the quality of the breathing mixture, please refer to point 4.5.3. For cylinders refilled with mixing systems that handle gases other than air, the amount of oxygen in the cylinders must be checked using suitable analysers.
In addition, the presence (in the immediate vicinity of the diving site) and the completeness of the emergency devices must always be checked (cf. 4.4.).

4.3.2.3. Preparation of surface assistance

At least one surface assistant must always be present to support the operations of entry and exit from the water of the OSS and able to activate the emergency procedures, even when the dive takes place from the shore.
When the use of the boat is envisaged, the captain and the crew necessary for the manoeuvres must always be present on board. The surface assistant and captain can be the same person only in the case of small boats that remain anchored or moored with the engines off during the entire dive.
There must be 1 emergency cylinder of at least 10 liters on the boat for every 5 divers. The cylinder must be equipped with two complete regulators with a first stage with a DIN connection, kept closed and with the regulators under pressure, and can be either kept in the boat when the seabed is very shallow, or, where the depth allows it, lowered into the water at a depth between 3 and 5 m.
The support boat raises the signal of underwater operations in progress (red flag with white diagonal band, in national waters ≤ 12 nautical miles off the coast, flag A of the International Nautical Code for international waters).
If the group plans to move more than 50 meters away from the support boat, it is necessary to prepare a balloon with a signal flag following each diving or snorkeling group, and possibly a small support tender boat, the latter is particularly recommended in the case of dives from ships of such size as to present limited manoeuvrability and/or difficulty in allowing divers to get back onboard, according to the commander's judgment.
All divers, the surface assistant and the captain of the boat must participate in the coordination meeting (briefing) conducted by the Head of Mission before each dive, in which the organization of the work, the tasks assign to each member and the diving parameters to be respected must be summarized and any contingent situations are evaluated.

4.3.3. DIVING PROCEDURES

All scientific diving activities must be carried out by a group consisting of at least two similarly equipped OSS who must be in continuous visual contact. The Head of Mission, in charge of safety, is generally the OSS with the most skills and longer experience, unless otherwise provided by the RDRS. In the event of loss of contact between group members beyond the time set in the Planned Dive File, divers must resurface.
Particular attention must be paid to the dangers related to the entry and exit of divers from the water in order to avoid bruises, grazes, traumas and physical exertion.
The descent, until the maximum depth is reached, must be continuous and fast, compatibly with the compensation capacity of all the OSS belonging to the group, and in any case at a speed not exceeding 23 meters/min.
The dive profile must not have repeated descents and ascents ("yo-yo" pattern).
The dive time, on which the no-decompression limit is calculated, starts from the moment the divers leave the surface.

The OSS while submerged must keep within 50 meters from the vertical of the support boat or from their buoy and signal flag (if diving from the shore, a marker buoy is essential for each dive group). Do not exceed the depth and duration limits set out in the Programmed Dive File, as well as the limit of 50 bar of respiratory mixture reserve.
The dive must be planned for reaching the maximum depth at the beginning of the dive and then progressively ascent towards the surface, without redescending during the same dive. For this reason, if you start from the shore, the working point must preferably be reached still on the surface.
During the dive, the diver must pay close attention to his breathing, taking care that it is slow, deep and continuous. He must also try to limit muscular effort and periodically check air consumption. The ascent speed

must not exceed 10 m/minute, reducing it to 6 m/minute from 6 meters to the surface, taking care that pulmonary ventilation is complete and constant.
The diver must normally emerge along the line lowered from the boat or along the line of the signal buoy. For dives from the shore, it is advisable to approach the exit point following the profile of the seabed.
Before resurfacing, it is advisable to make a 3-minute precautionary stop at a depth of 6 meters. This precaution also allows the diver to resurface without risking of being run over by the propellers of any boats that, despite all the warnings and the special care that the surface assistant will have, could transit in the area.
The use of the dive computer for decompression calculation during scientific diving is mandatory, and must not disregard the following good practices:

- be trained on its operation and correct use;
- consult and understand the instructions for use;
- each diver must have an individual dive computer (he/she must know the type of decompression algorithm used by it, e.g.. Buhlmann ZH 16 ADT, RGBM or other), the instrument cannot be used by others until repetitive dives are in progress, i.e. until the calculation of the decompression pattern is finished;
- scrupulously respect the maximum ascent speed;
- the maximum depth must be reached at the beginning of the dive;
- never make comparisons with tables;
- for dives scheduled inside the safety curve, maintain a minimum margin of 2-3 minutes before breaking the no-decompression time (NDT) limit. If, for unforeseen reasons, you fall below this limit, it is good practice, and as a precautionary measure, to wait for the activation of the ascent mode with decompression, and then scrupulously follow the ascent plan proposed by the computer, adding the three-minute precautionary stop at 6 meters at the end of the calculated decompression pattern;
- in all cases, scrupulously follow the decompression instructions provided by the computer.
- for dives deeper than 12 meters, it is mandatory to respect the maximum bottom time established during the pre-dive briefing.

4.3.4. POST-DIVE PROCEDURES

Each OSS must comply with the provisions of point 4.3.3.
A verification meeting is mandatory, at the end of the dive, to analyse the critical situations that may have occurred. Everyone will report any physical problems, any suspected symptoms of PDD, or any equipment malfunction. For prevention purposes, in the event of injury, accident and near miss, a detailed report must be submitted to the RDRS, which will transmit it to the Employer (by mean of sending it to the RSPP), and must be signed by the Manager (Director) (Planned Dive File, ANNEX 5).
At the end of the diving day, each OSS must provide for the routine maintenance of the DPI in use (see 4.5.2).

4.4. EMERGENCY PROCEDURES

4.4.1. **EMERGENCY PROCEDURES WHILE DIVING**

The diver must stop diving when he/she feels that the safety conditions have failed and notify this to the rest of the dive group. Under no circumstances a diver can surface on his own but must always be accompanied to the surface by at least one other diver, ensuring the minimum number of members of the diving group.
The scientific dive must be interrupted, starting the ascending procedures, when the pressure of 50 bar in the cylinder is reached. The use of the reserve must be an emergency measure to ascend, to be used only in the event of unexpected consumption due to the most diverse causes.
In the event of an ascent far away from the support boat or signal balloon, the DSMB must be used, which is mandatory piece of equipment for each OSS, launched from a depth of no more than 10 m and using a free line, not bounded to the diver.
Requests for early termination of the dive by the surface assistant must be communicated by means of a suitable underwater horn (compressed gas siren type, etc.).
In diving, each situation is different from the other but, if analysed according to the why, how and when to intervene, prevention and intervention will be easier. For each situation the following will be described, in order:

A. Circumstances, causes and prevention
B. Behaviour of the subject
C. First intervention of diving colleagues

Compensation problems and eardrum rupture
A. Determined by incorrect or late compensatory manoeuvres, both descending and ascending, avoidable with adequate training and always maintaining the availability of one hand, for this reason any tool must be fixed, with quick coupling/release systems, to be let go in any circumstance.
B. Under no circumstances should you force the variations in depth, warn your colleagues of the difficulty.
C. Provide assistance, if necessary and possible, notify the other operators and proceed with the resurfacing of all or part of the diving group.

Missing Operator
A. It may happen that one or more operators lose contact with colleagues due to reduced visibility, group management problems or, more simply, due to a distraction:
- during a dive, especially in the case of poor visibility, it is necessary that the whole group is united and tidy, where it is considered necessary it is possible to assign a junction or coordination task to one of the operators not engaged in other activities, or to employ communication systems (e.g.: full-face with ultrasound communicators);
- often it is the current the cause of dispersion of the group, especially during the ascent; this is why it is necessary to maintain very close eye contact amongst colleagues.
B. As soon as you realize the loss, if the last eye contact was recent, it should be possible to identify the rest of the group by looking 360 degrees around you, up and down, trying to spot the bubbles of the companions or some coloured element of their equipment, after the time limit for searching, agreed and defined in the planned dive file, everyone must get as close as possible to the point of resurfacing and initiate the correct resurfacing procedure.
C. As soon as you resurfaced, together with the surface assistant, check the presence of all the members of the group and, in case of absences, try to identify the rising bubbles of the missing person(s) while a recovery dive is arranged.

Panic
A. During the dive, a sudden and unexpected event can cause a diver to be anxious or even panicked, which situation, especially in the presence of other contributing causes such as lack of air, can generate aggression towards companions looking for irrational help.
B. In the event of the onset of states of anxiety and before they can lead to panic, it is necessary to intervene by stopping and interrupting activities in progress, breathe calmly, reflect on what happened and possibly take action to remove the cause of panic.
C. Once a panic situation is detected, communicate with the subject while maintaining a safe distance, approach to provide assistance only if the situation appears controllable, otherwise intervene only if confident with the necessary techniques of intervention, release and immobilization while diving.

Small leaks of respiratory mixture
A. Generally due to poor maintenance, aging or manufacturing defects, they can be minor and not cause particular concern, even if they can increase consumption or cause gradual changes in buoyancy.

B. It is often difficult to notice small leaks alone, it is necessary to pay attention to small bubble noises and buoyancy loss of the BCD, once detected, ask colleagues for a verification of the extent, try to stem it and evaluate whether it is appropriate to interrupt the dive.
C. Be careful and report small gas leaks to colleagues from their DPI.

Blockage of the regulator in continuous delivery and/or conspicuous loss of respiratory mixture
A. Poor maintenance of the regulator, hoses and connections is the most frequent cause of this type of inconvenience, but other causes can be related to the entering of sand or dirt into the regulator or delivery button, freezing, etc. Prevention consists in careful maintenance and the choice of high quality DPI.
B. Stay calm, call for help, switch to your or your buddy's alternative air source, and end the dive.
C. Once a continuous column of bubbles is observed, approach quickly to offer assistance, and if necessary an alternative air source, in the latter case notify the other operators and proceed with the resurfacing of all or part of the diving group.

Block of delivery of respiratory mixture
A. The cause is a malfunction of the regulator, preventable with careful maintenance and with frequent control of consumption, except as a result of unforeseeable conspicuous gas losses.
B. If the air supply stops, remain calm, call for help, switch to the dive buddy's alternative air source, and end the dive.
C. At the air request signal, immediately provide your alternative air source, then notify the other operators and proceed with the resurfacing of all or part of the dive group.

Sudden upward push (blow)
A. The cause can be an ascent without deflating the BCD, the malfunction of the BCD loading valves or of the dry suit, the loss of the weight belt or tools, the incorrect use of lifting balloons and signal buoys, the presence of updrafts. Prevention consists in adequate maintenance, and correct fixing and use of the equipment, and also in a constant buoyancy control during the dive.
B. Immediately activate the quick deflating valve placed in the highest position, if possible hold on to something fixed, identify and immediately intervene on the cause:

- if it is a blocked inflating valve, disconnect the relative hose
- If it is a lifting balloon or signal buoy, let go of the grip immediately
- use emergency weights (e.g. stones)

C. Intervene promptly by providing assistance and negative buoyancy by deflating your BCD, try to intervene on the causes without risking to be dragged upwards. Notify the other operators and proceed with the resurfacing of all or part of the dive group.

Flooding of the drysuit or BCD
A. The most common causes are cuts, breaks of the zip or of the valves, especially due to aging and/or poor maintenance. Good prevention also consists in correct and not excessive number of weights on the weight belt.
B. Ask for assistance and DO NOT remove the weight belt. The BCD can make up for the lack of upward push of the drysuit and vice versa.
C. Provide assistance, notify the other operators and proceed with the resurfacing of all or part of the dive group.

Loss of mask
A. Very rare event, caused by an impact or breaks of the straps, which must be checked if in good condition.
B. If you are near the seabed, check the possibility of recovering the mask, possibly holding it with your hands or with spare elastic bands, if available switch to the spare mask or attract the attention of colleagues to be accompanied back to the surface.
C. Provide assistance, check the possibility of recovering the mask, notify the other operators and proceed with the resurfacing of all or part of the diving group. It is always recommended to bring a spare mask

Dive computer failure

A. The main causes of malfunctioning of a dive computer are due to manufacturing defects, poor maintenance (e.g.: low batteries, etc.), or accidental impacts during diving. Maintenance includes carefully checking the state of charge of the batteries that power the instrument, and of the band that, by breaking, could lead to the loss of the instrument.

B. In the event of a shutdown, flooding, loss or obviously incorrect data output (check maximum depth and dive time with colleagues), use your spare instruments, which, at a minimum, must include a clock, a depth gauge and decompression tables, plan the rest of the dive and ascent accordingly. In the total absence of instruments, follow the ascent of colleagues who have carried out the most similar dive profile. In the absence also of possible assistance for loss of the colleagues, climb slowly without exceeding the speed of the smallest bubbles emitted by the regulator during exhalation. and make a precautionary stop as long as possible at an estimated depth of between 6 and 3 meters. It will not be possible to do any more dives in the next 12 hours, if it was the first dive, or 24 hours, if it was a repetitive dive.
C. Provide assistance, notify the other operators and proceed with the resurfacing of all or part of the dive group.

Hypothermia
A. Determined by inadequate thermal protection and/or prolonged stay in the water, preventable with correct planning of activities and adequate clothing.
B. In the presence of early symptoms, like trembling and numbness, notify colleagues and get out of the water.
C. Provide assistance, if possible notify the other operators and proceed with the resurfacing of all or part of the working group. On the surface, help remove wet suit, dry, cover evenly and not excessively, and shelter the victim in a sheltered, dry and comfortable place. For winter shore dives, consider the proximity of rooms, vehicles in which to shelter. For dives from boats, evaluate the availability of cabins and the duration of navigation. It should be remembered that it is absolutely contraindicated to make a person in hypothermia drink alcohol.

Hyperthermia
A. It's the consequence of an excessive exposure in a hot environment (for example when you remain with the wetsuit worn in the sun for some time, a behaviour to be avoided at all costs), and the body is no longer able to compensate for the increase in internal temperature. In these cases, symptoms such as dizziness, headache, excessive sweating or interruption of sweating, difficulty in breathing, up to loss of consciousness may occur.
B. Notify colleagues from the first symptoms, proposing the interruption of activities, if it happens before the start of the dive, propose to postpone the dive until you are completely recovered, or to give up the planned activities for the day.
C. Provide assistance, notify the other operators and proceed with the resurfacing of all or part of the work group. On the surface, the recommended treatment is to undress the subject, transport him to a cool place, make him drink plenty of water and, when possible, apply ice packs.

Breathlessness
A. Caused by excessive physical activity, for example to fight the current, and/or breathing difficulties, also due to malfunctioning of the regulator. Irregular breathing leads to the accumulation of carbon dioxide which at the same time promotes breathlessness, resulting in a dangerous vicious circle. This is preventable with adequate physical training, servicing of the equipment, adequate planning of the dive and the planned activities, as well as with a correct and controlled breathing throughout the dive.
B. At the first sensations of irregular breathing or loss of breathing control, stop any physical activity, if possible lean on the seabed or support yourself on a stable handhold, breathe as deeply as possible favouring expiratory acts until normal breathing conditions are restored, call the attention of colleagues and report the difficulty.
C. Provide assistance, notify the other operators and proceed with the resurfacing of all or part of the dive group. Diving can resume only if normal conditions have been restored and the problem that originally triggered the breathlessness is resolved.
Breathlessness is a symptomatology that can prelude to serious accidents, and for this reason it should not be underestimated. In these cases, it is advisable to promptly activate the resurfacing procedures.

Muscle cramps
A. Determined by excessive physical activity, poor training and cold.
B. Stop physical activity, if possible lean on the seabed or support yourself on a stable handhold, call the attention of colleagues and report the difficulty, intervene by stretching the muscle involved
C. Provide assistance. The dive should be interrupted if the cramps continue or recur after the appropriate manoeuvres, in this case notify the other operators and proceed with the resurfacing of all or part of the diving group.

Nitrogen narcosis and alternobaric vertigos

A. The planned depths must not be such as to determine conditions of high narcosis, despite the fact there could be a certain individual predisposition, the cold conditions, other states of distress in progress and excessive descent speeds that are able to determine temporary states of narcosis, dizziness or alteration/slowing down of perceptual and decision-making abilities of the individual.

B. Check your condition carefully, especially during the descent and the first minutes of diving. In case of any altered sensation, stop the descent, breathe regularly, go up a few meters while waiting for normalization. Notify the nearest colleague of the difficulty and in case of persistence of symptoms, propose the interruption of the dive.

Director of the Department: prof. Luigi Bubacco
Responsible for the administrative procedure: Dr. Simone Canesso tel.049.8276176 e-mail simone.canesso@unipd.it
Contact reference: tel.049.8276178, 049.8276335 e-mail direzione.biologia@unipd.it

C. Provide assistance. If the problem is prolonged beyond a couple of minutes, notify the other operators and proceed with the resurfacing of all or part of the diving group.

Injuries and stings

A. Mostly due to inattention or excessive confidence with the habitat and the organisms present. They are prevented by moving carefully, regularly checking the surrounding environment and using appropriate protection (e.g. mandatory use of suitable gloves).
B. Stop, breathe regularly and analyse the extent of the incident, immediately notify the nearest colleague and ask for assistance.
C. Provide assistance and with other colleagues evaluate whether to proceed with the resurfacing of all or part of the diving group.

Loss of work tools

A. Tools, as far as possible, should be secured with quick coupling/release systems.
B. The search for lost instruments must be limited to the time and maximum depth decided in the planned dive file, without making repetitive descents and notifying the nearest colleague.
C. Provide assistance and with other colleagues evaluate whether to proceed with the resurfacing of all or part of the diving group.

4.4.2. EMERGENCY PROCEDURES AT SURFACE FOR DIVING ACCIDENTS

If any of the divers had any health problems, the surface attendant should contact the public emergency health service (telephone: single emergency number 112 or medical emergency telephone number 118) or if it is not possible to make a radio emergency call on VHF emergency radio channel 16 or sea rescue (telephone: 1530), as a secondary alternative, contact the nearest hyperbaric centre, specifying in all cases that it is a diving emergency, in order to be assisted in choosing the most suitable assistance procedures for the case, or operators who guarantee diving accident specific assistance such as DAN.
If it is suspected that the symptoms are linked to decompression pathologies, the conscious and consenting diver must be administered water by mouth and 100% normobaric oxygen, by trained and competent personnel, until help arrives. If necessary, stabilize the injured person's cardiorespiratory condition by cardiopulmonary resuscitation (CPR or BLS – including the use of a defibrillator if available).

4.4.3. EMERGENCY DRILLS

Workers shall participate in exercises, carried out at least once a year, to put into practice the emergency management procedures referred to in this chapter.
A following drill must also be implemented as soon as an exercise has revealed a series of deficiencies and after the necessary actions have been taken.

4.5. DIVING EQUIPMENT

4.5.1. CHARACTERISTICS AND REQUIREMENTS OF DIVING EQUIPMENT

The diving equipment management is entrusted to the individual person, who assumes responsibility for it. The diving equipment must:

- possess requirements and characteristics such as to guarantee maximum functionality of use and the highest level of safety to those who use it;
- be in good condition and functioning;
- be in possess of approved and valid inspections certificates (when required);
- be used for the specific purpose for which they were designed.

Equipment and gear include devices intended for dressing, protection and breathing and also any communication systems between operators.

The diving equipment supplied to the OSS must comply with the specific regulations and bear the approval certifications (CE EN) when available.

The expected diving equipment includes:

- protective wetsuit: wet or semi-dry/dry (also including hood, socks and gloves) and any suitable undersuit;
- mask and snorkel for breathing on the surface;
- fins;
- weight belt and related quick release fastening system;
- dive computer;
- knife or other cutting tool suitable for cutting lines and fishing lines;
- buoyancy control device (BCD) with suitable attachment points and pockets, depending on the tools and equipment provided;
- underwater shaker or other acoustic signalling system;
- two complete double-first stage regulators, equipped with a DIN connection, one of which must have a hose connecting to the second stage at least 1.5 meters long and yellow or, in any case, suitably marked so as to be immediately recognizable by a diving buddy in difficulty;
- high pressure gauge connected to a first stage;
- cylinder with double taps with DIN connections;
- DSMB or inflatable signal buoy for emergency ascent situations while diving, complete with a line of at least 12 m;
- a reel with a line of at least 40 m;
- underwater slate and pencil for writing;
- orientation compass.

The boats used must be equipped with both a device to facilitate the ascent of the OSS on the boat and an underwater acoustic beacon (e.g. compressed gas siren) used to communicate the interruption of the dive.

Whenever useful or necessary, the use of a full-face mask and wireless audio communication systems between divers and/or surface assistants may be authorized, for the use of which the OSS must be appropriately trained.

In addition to the aforementioned diving equipment, the OSS will use the appropriate tools and equipment required by the specific activity (e.g.: cameras, video cameras, metric cords, callipers, squares, instruments for taking samples and containers for collecting samples).

4.5.2. MAINTAINANCE AND VERIFICATION OF DIVING EQUIPMENT

Each specific piece of equipment must be regularly serviced, and the service can be:

- **ordinary**, after use and carried out by the diver who has been provided with it;
- **specialized periodical**, at regular intervals by a specialized company:
- **extraordinary,** after particularly intensive use under unfavourable conditions, by a specialized company.

Similarly, each piece of equipment must be subjected to regular checks:

- **ordinary**, before use, by the diver who has been provided with it;
- **specialized periodic**, at regular intervals (depending on the equipment), by a specialized company;
- **extraordinary,** before particularly intense use or after rather long periods of activity, by a specialized company.

Director of the Department: prof. Luigi Bubacco
Responsible for the administrative procedure: Dr. Simone Canesso tel.049.8276176 e-mail simone.canesso@unipd.it
Contact reference: tel.049.8276178, 049.8276335 e-mail direzione.biologia@unipd.it

Regarding the maintenance of the general gear and of safety and personal protective equipment necessary for diving, the employer is responsible for:
a) replacing, at the justified request of the diver and controlled by the Head of Mission, wetsuits, boots, gloves, masks, fins, belts, knives and straps that are too worn out to be able to be used with safety and comfort;
b) replacing any other diving device which, due to long use or reasons of force majeure, no longer give sufficient guarantees of functionality and safety;
c) maintaining and, when necessary, entrusting the servicing or reparation of diving devices to qualified personnel.

Director of the Department: prof. Luigi Bubacco
Responsible for the administrative procedure: Dr. Simone Canesso tel.049.8276176 e-mail simone.canesso@unipd.it
Contact reference: tel.049.8276178, 049.8276335 e-mail direzione.biologia@unipd.it

Indications for ordinary maintenance

Equipment	Maintenance	Checks
protective wetsuit	wash in fresh water, dry away from heat sources, lubricate the zipper.	check seams, zippers, inflating and deflating valves of drysuits, any possible tears
mask	wash in fresh water	condition of gaskets, holding of the glass, strength and elasticity of the strap
fins	wash in fresh water	state of materials, holding of the foot pocket and straps
weight belt	wash in fresh water	correct weight as required by optimal trim, buckle holding and functioning of the fast release system
depth gauge, watch and computer	wash in fresh water	correct operation, battery charge status
knife or cutting tools	wash in fresh water and blade lubrication	holding of the scabbard stopper, resistance of the hooking straps, strength of attachment of the handle on the blade, state of the blade edge
buoyancy control device (BCD)	wash in fresh water	operation of inflating and deflating valves, belts and straps, presence of accessories for localization and surface recall
regulators	wash in fresh water, internal cleaning of the second stage	operation, air leaks, wearing of parts including mouthpiece and hoses, calibration
manometer	wash in fresh water	air leaks, correct measurement and indicator that actually indicates 0 when the cylinder is closed
cylinder	wash in fresh water, refill	check pressure and date (not earlier than 3 months before use) of charge, check functioning

Indications for specialized periodic maintenance, to be carried out at regular intervals by qualified personnel;

Equipment	Periodicity
cylinder	according to current legislation, the first test, starting from the date of manufacture of the cylinders, is carried out after 4 years, while the subsequent tests are carried out every two years
regulator	annual revision (no kind of testing is required by current legislation)
manometer	annual revision (no type of testing is required by current legislation)

In addition, following particularly intense use in unfavourable conditions, the equipment must be subjected to extraordinary maintenance by qualified personnel. Maintenance after breakdown must always be carried out by experienced personnel.

4.5.3. CYLINDER REFILL SYSTEM AND QUALITY OF THE BREATHING MIXTURE

The cylinder refill system, both belonging to the university and provided by external services, must ensure compliance with the

characteristics of the breathing mixtures intended for underwater use, according to current legislation. For reference:

Oxygen	from 21% to 40%
Carbon dioxide	not more than 0.1%
Carbon monoxide	not more than 0.0002% (20 parts per million)
Oily vapours	No more than 130 millionths of a gram per liter of air (0.00013 grams per liter of air)
Rust, solid particles, soot, etc.	total absence

In the event that external recharging services and/or rented cylinders used, the recharging station must in any case comply with the above specifications, in compliance with current legislation.

Director of the Department: prof. Luigi Bubacco
Responsible for the administrative procedure: Dr. Simone Canesso tel.049.8276176 e-mail simone.canesso@unipd.it
Contact reference: tel.049.8276178, 049.8276335 e-mail direzione.biologia@unipd.it

4.5.4. EMERGENCY AND FIRST AID DEVICES

The Responsible for Underwater Teaching and Research Activities (RDRS) must ensure the presence in the immediate proximity of emergency devices, including medical and instrumental equipment, which must include at least:

- 1 emergency cylinder of at least 10 liters for every 4 divers, equipped with two complete regulators with a first stage equipped with DIN connection, and which can be either kept onboard, when the depth of the seabed does not allow it, or lowered to a depth of 5 m;
- a watch;
- an underwater acoustic beacon (compressed gas siren or equivalent system);
- binoculars;
- an adequate and functioning system for distress calls (marine VHF, mobile phone);
- unique number for health emergencies and coordination of rescue operations on the national territory (112 or 118);
- unique number for emergencies at sea (1530) or DAN assistance number if in location outside Europe;
- the telephone number of the nearest hyperbaric Centre (prior verification of operativity and after sending via fax or e-mail the start and end dates of operations);
- an emergency oxygen kit with cylinder of at least 3 liters full with at least 150 bar; multifunctional regulator that allows the supply of oxygen on demand or in continuous flow; mask for 100% administration (is recommended to have available a mask with high adherence to the face for the delivery of oxygen on demand and a non-rebreather mask with a bag for the recovery of the exhaled mixture, for continuous delivery);
- first aid kit in accordance with the law (ministerial decree n. 388/2003 and subsequent ones), possibly supplemented according to operating conditions (e.g. distance from medical facilities).

4.6. GENERAL PREVENTION CRITERIA AND OPERATING METHODS IN DIVING ACTIVITIES

Dives performed using air as breathing mixture, regardless of the license held, must not exceed 40 meters in depth.
The employer must assess all the risks and prepare the document provided for by art. 17 paragraph 1 letter a) of D.lgs. 81/08 accordingly.
The activity under discussion differs sharply from the main types of work commonly subject to occupational risks assessment and, above all, there are no formally validated checklists available that allow a systematic assessment of this activity.
It should also be pointed out that it is impossible to identify a single and fixed place of work since the latter, being represented by the underwater world, does not allow a scientific adequacy of the Risk Assessment. Therefore, the prevention and protection measures refer only partially to the legislation on the protection of health and safety currently in force but refer instead to the rules of good practice dictated by the most authoritative treaties in the field of underwater activities.

The operational methods of prevention do not have the prerogative of identifying completely and exhaustively the behaviours to be implemented to prevent the main types of risk reported below, but represent a brief summary of these behavioural rules.
The main characteristics of individual prevention methods capable of reducing the risks associated with diving activities can be divided into four groups: those related to physical and dietary prevention, those related to organizational prevention, those related to training prevention, and finally those related to health prevention.

1. **Physical prevention** is implemented through a sober lifestyle that is attentive to healthy behaviours with particular reference to physical fitness, periodic training, proper nutrition, moderate use of alcoholic beverages, the use of which is prohibited in the twelve hours before and after the dive. The state of physical fitness and the ability to perform diving activities is verified by the competent doctor, after consulting the hyperbaric doctor, during the examination for fitness to dive certification and during the visits for the enabling to return to diving after illness/injury.
2. **Organisational prevention** is implemented through the analysis of work-related stress events and labour ergonomics, according to the provisions and procedures issued by the Ministry of Labour and incorporated into the guidelines of the State-Regions Permanent Conference, implementing all measures to prevent and protect against accidents and occupational diseases.
3. **Educational and training prevention** is achieved through the transfer of the most advanced knowledge on diving techniques, of the preventive decompression tables and of dangers that a diver may face. The employer is obliged to provide periodic and specific training on:
    - risk assessment and protection of workers from accident risks and occupational diseases;
    - correct procedures and methods for carrying out activities, including the use and management of safety equipment and devices;
    - health protection and health surveillance.

The OSS are also required to participate in all education and training activities provided by the employer.
The Manager and the responsible for safety are obliged, each according to their own powers and responsibilities, to report any violations, also in order to sanction operators who derogate from the obligation.
4. **Periodic health prevention** is an employer's obligation in relation to the specific risks to which the OSS is associated, and consists of: preventive, periodic and extraordinary medical examination.

It is necessary to underline that the improvement and/or corrective actions do not refer either to interventions in the workplace, or to the substances used or even to the work equipment as diving is, in itself, a high-risk activity which therefore involves the use of equipment and means of maximum safety, that cannot be improved or corrected. These actions may instead be aimed at creating greater professional qualification of the operators themselves through refresher or advanced courses, thus acting within the concept of "permanent training" of the operators themselves.

Risks from chemical causes	
Oxygen poisoning (02)	Observe the depth/time limits recommended by the dive tables in use and the type of certification held. Regardless of the type of certification held, air dives must not exceed 40 m. The limit will be lower with mixtures enriched in oxygen ('nitrox') above 27% of oxygen.
Carbon dioxide poisoning (C02)	Observe correct breathing (inspiratory pauses).
Nitrogen poisoning (N2)	The descent must be controlled and not exceeding 23 meters/minute, it must be slowed down or interrupted at the onset of dizziness or nausea. Regardless of the type of certification held, air dives must not exceed 40 m. The limit will be lower with oxygen-enriched mixtures ("nitrox").
Carbon monoxide poisoning (C0)	Check that the suction outlet of the cylinder refilling station is away from possible sources of pollution and production of harmful gases.
Risks from mechanical causes	
Barotrauma (ear, sinuses, teeth, pressure squeeze events, dry suit squeeze)	Correct and prompt compensation manoeuvres, slow descent, descent stop and possible ascent in the event of ineffective compensation, vice versa in the event of problems during the ascent.
Arterial gas embolism (EGA)	Regular and constant inhalation and exhalation during the ascent, never hold your breath during the ascent, respect the speed of ascent.
Pulmonary overexpansion	Same as above.
Gastrointestinal overexpansion	Avoid immersion just after eating and/or drinking carbonated drinks. Report any gastrointestinal problems that occurred during or after diving (colitis, bowel disorder: stubborn constipation, diarrhoea)
Alternobaric vertigos	Avoid sudden changes in depth, make descents and ascents in an upright position, carry out correct and frequent compensation manoeuvres. In case of alternobaric vertigos, it is strongly recommended to wait a couple of minutes before changing the depth (p.es. starting the ascent) to facilitate the process of balancing of pressures in the middle ear.
Risks from physical causes	

Director of the Department: prof. Luigi Bubacco
Responsible for the administrative procedure: Dr. Simone Canesso tel.049.8276176 e-mail simone.canesso@unipd.it
Contact reference: tel.049.8276178, 049.8276335 e-mail direzione.biologia@unipd.it

Hypothermia	Plan the dive considering thetemperature and the duration of the work, and then select the most appropriate type of suit.
Hyperthermia	Especially in summer, wear the hood as a last thing before diving and put on your wetsuit as late as possible. Do not wear the wetsuit for too long while being exposed to cold or heat before and after diving.
Decompression disorders (PDD)	Observe the decompression tables and the ascent speed. Avoid long physical exertion during and immediately after diving, long exposure to cold and ingestion of alcohol and carbonated beverages before diving. Keep as much as possible possibly hydrated. Adopt a 3-minutes safety stop at a depth of 6 m. From 6 meters to the surface, slow down the ascent to 6 meters/minute (rise to the surface in one minute).
Risks from environmental causes	
Traumas (bruises – wounds)	Always use gloves in the case of works where the use of sharp tools is required, always use boots and a wetsuit, at least 3 mm even in the case of diving in shallow waters and during the summer and also during transfers to the diving spot. The propellers of the boat must be stationary at all times during the dive.
Accident due to a fall with effects up to drowning	The surface assistant must wear an approved type of life jacket with automatic inflation. Divers must wear wetsuits or approved life jackets.
Injuries from marine animals (jellyfish, etc.)	Acquire information on any staff allergies, check for animal presence in the water and have adequate protective clothing (wetsuit, boots, gloves, hood).
Biohazard	If possible, do not dive in the port area, near sewage discharges or at the mouths of rivers or streams carrying unhealthy water and if such dives must be carried out, use suitable protective equipment (drysuit and full-face mask to avoid direct contact of the mouth with water). Typhoid vaccination mandatory.
Manual handling of loads	Use equipment that does not require the handling of heavy and bulky parts, if necessary use suitable devices for lifting and transporting following the appropriate procedures.

5. SUMMARY OF RESPONSIBILITIES

Without prejudice to the obligations of all the figures identified in Legislative Decree 81/08 and Ministerial Decree 363/98 (concerning the university), better defined in the "Actors and Processes Scheme" of the UniPd SGSS, the following organisational scheme defines tasks and responsibilities of the subjects and their specific functions. For each scientific diving operation, a chain of responsibilities and tasks must be defined as set out below. The following figures with an operational role are therefore identified, regarding the safe execution of underwater activities:

1. Rector: duties and responsibilities are those indicated in the Occupational Health and Safety Management System (SGSS), available at the link https://www.unipd.it/sgss;

2. Director of the Department as defined by Ministerial Decree 363/98 is considered Manager for Legislative Decree 81/08:
3. Responsible for Underwater Teaching and Research Activities (RDRS), fixed term or permanent professors in charge of the research line or teaching activity. They are appointed by the Manager;
4. Head of Mission: teachers/technicians/contract staff (research fellows, scholarship holders, etc.) accompanying the group employed in the diving activity with adequate minimum training requirements. The Head of Mission is appointed by the Director and is the de facto responsible for diving safety. The role of the Head of Mission may coincide with that of RDRS;
5. Scientific Diving Operator (OSS): personnel employed in diving activities (structured and not) with adequate minimum training requirements;
6. Students and staff in training: enrolled in University training courses of any level, including thesis students and trainees, including those of other institutions as part of agreements, exchange and internationalization programs, including staff

Director of the Department: prof. Luigi Bubacco
Responsible for the administrative procedure: Dr. Simone Canesso tel.049.8276176 e-mail simone.canesso@unipd.it
Contact reference: tel.049.8276178, 049.8276335 e-mail direzione.biologia@unipd.it

(structured and unstructured), in training for the achievement of the requirements for the OSS certification, only with regard to the development of the scientific diving experience necessary to obtain the above mentioned qualification;
7. Surface Assistant: personnel (structured and unstructured) with adequate minimum training requirements, appointed by the Manager and in charge of surface safety for diving support activities.

5.1. Director of the Department
He is a manager pursuant to Legislative Decree 81/08 art. 2 c.1 letter d) and in line with the provisions of the "Actors Processes" Scheme of the SGSS of UniPd. He identifies, on the basis of the organization of the Department, the Heads of Underwater Teaching and Research Activities (RDRS), also ensuring, within the available resources, adequate financial and material support so that diving activities can be carried out in compliance with current legislation and the procedures adopted, based on art. 77, Legislative Decree 81/08. He must be informed about the planning of dives that must be indicated in the requests for authorization for missions and ensures that the RDRS correctly carries out the delegated tasks.

5.2. Responsible for Underwater Teaching and Research (RDRS)
He/She is responsible for all aspects related to the organization of the diving activity. He/She implements the provisions of the employer and has the primary function of coordinating scientific diving activities and ensuring that operators carry out their activities with respect to their state of health, as well as of the level of education and training received, and that they are equipped and supervised in order to operate at the highest level of safety, efficiency and effectiveness. He must possess adequate technical and scientific experience in diving for research purposes and have in-depth knowledge of diving procedures in order to correctly carrying out the function of supervisor to which he/she is called. He/she does not need to participate in the dive.

Identification of RDRS.
All the **Professors** who, within the activities carried out for the Department's educational courses, promote, manage or carry out training in scientific diving for attending students.
All **Professors** who promote, manage or carry out a research activity, employing permanent and non-permanent staff (professors, technicians, thesis students, scholarship holders, trainees, PhD students), that involves scientific diving in the planning.

The RDRS must:
a) identify the Head of Mission for the specific activity to be carried out. The RDRS itself can assume this role, if in possession of the necessary qualifications;
b) identify one or more surface assistants;
c) prepare the “Diving activity program” (ANNEX 4), delegating its implementation to the Head of Mission, but supervising its correct execution;
d) propose the purchase and arrange the use of the PPE necessary for the diving activity;
e) ensure the regular maintenance, and verify that all PPE are kept in working order;
f) ensure that the equipment used for the diving activity is efficient and that it has been properly maintained and verified;
g) verify that all staff possess the minimum training standards provided for in this document, and grant any exceptions during the training phase, under the direct supervision of the identified tutor;
h) verify that all personnel involved in diving activities are perfectly instructed on the operations they must perform, and on each individual work schedule;
i) ensure that the tasks assigned to each member of the diving group are commensurate with the education and training possessed;
j) verify that all necessary resources for the correct conduct of the diving program are available;
k) ensure that all diving personnel employed in the diving activity are in possession of the appropriate certification of fitness for the specific task, for the purposes of health surveillance;

l) verify that all the personnel employed in the diving activity are perfectly trained and informed on the operations they must perform and on each individual phase of work;
m) authorize in writing the personnel involved in the diving activity to carry out the planned dives.

5.4. Head of Mission

The Head of Mission is a diving operator, identified among teachers, technicians and non-structured personnel, to whom the RDRS entrusts the responsibility for the underwater activity in its operational phase, and must be present throughout the duration of the specific activity. He is present in the actual dive, playing the role of OSS and of de facto responsible for safety (workplace).
His/her minimum training level must be equivalent to that required by the AESD standards, and he/she must also have technical experience in diving activities and knowledge of the relevant procedures for the purposes of a correct conduct of the supervisory role to which he/she is called.
The Head of Mission is appointed before each dive and has the obligation to supervise and oversee all activities related to the safe conduct of the dive, and also ensures the implementation of the guidelines received from the Responsible for Underwater Teaching and Research Activities (RDRS). He/she also has full operational responsibility for the underwater expedition.

The **Head of Mission**, in particular, is obliged to:

a) Implement the “Diving activity program”;
b) Draft the “Planned dive file” (ANNEX 5);
c) Coordinate the dive with other activities in progress nearby, that may interfere with diving operations;
d) Check and remind all operators to use the appropriate equipment and PPE;
e) Make sure that each diver follows the instructions of the “Diving activity program”;
f) Conduct a briefing with the dive group and surface assistant on the following matters:
   - Objectives of the dive
   - Maximum planned depth
   - Maximum planned dive time
   - Type of work to be carried out
   - Special hazards or environmental conditions that may affect the safety of diving operations
   - Diving modifications or specific procedures required for a particular dive
   - Verification of the equipment of each individual diver
g) If special procedures or techniques are required, ensure that each diver is properly trained;
h) Ensure the recording of dive data for each individual OSS;
i) Report to the RDSR all anomalies that have occurred and have been notified during the dive, with particular regard to accidents, failures and physiological problems;
j) Ensure the presence and proper functioning of safety and emergency equipment;
k) Conduct a de-briefing with the dive group and surface assistant after the dive;
l) Ensure that the compressors on the boat, used to fill the cylinders of the divers, are placed in healthy areas, not contaminated by toxic atmospheric pollutants and/or exhaust gases produced by combustion and/or processing of industrial products;
m) Suspend diving activities in the event of serious and immediate danger;
n) Arrange surface assistance for diving operators;
o) Setup the exit from the water procedure for people in difficulty, agreeing it with the captain in the case of boat dives;
p) Notify the maritime authority for the purpose of any possible rescue interventions, as far as their competence is concerned;
q) In the case of group dives, appoint a "dive responsible", among the diving operators, acting as a dive guide who manages the safety profiles during the diving activity.

The tasks of the Head of Mission are detailed in the Checklist (ANNEX 1 - checklist for Head of Mission: verification of tasks). In addition, being an OSS him/herself, he/she must also comply with the below reported requirements for the OSSs.

5.5. Scientific Diving Operator (OSS)

Is a worker or equivalent (in accordance with Legislative Decree 81/08 art. 2 c.1 letter a, and Ministerial Decree 363/98), authorized to carry out scientific diving as part of teaching, research or service activities. His/her minimum training must be equivalent to that required by ESD standards. Exceptions to the minimum level of training may be defined by the RDRS, under its own responsibility, for students and staff (both permanent and non-structured) for the sole purpose of training useful for the achievement of the minimum ESD requirements. These derogations concern only the scientific experience component, while the minimum requirements for diving certification must already be previously owned. The OSS has the duty to comply with the provisions issued by the Employer, the Manager and the RDRS without ever exceeding in the execution of the task with respect to his/her own abilities, state of health, education

and training. Each worker such identified has the obligation to guarantee his/her own safety and the safety of others during the exercise of the work. He/she is also obliged to inform his/her superior of any anomalies and inconveniences that may affect the safety of operators during the dive.
In particular, the operator must:

a) Not dive under any circumstances if not feeling in perfect physical condition. Considering that the OSS is the main responsible for its own safety, it is its duty to refuse to dive if the diving conditions are unsafe or not compatible with the education and training received;

b) Observe the provisions and instructions given by the RDRS and/or the Head of Mission regarding the performance of the task with respect to their abilities, state of health, education and training;

c) Inform the RDRS and the Head of Mission of any anomalies and inconveniences that may affect the safety of operators during the dive, and immediately report any deficiencies in the procedures and instructions regarding individual or collective prevention and/or deficiencies in the safety of work vehicles and working equipment;

d) Check before each dive and keep its own diving equipment efficient;

e) Eat and keep hydrate properly in the 12 hours before diving, avoiding full meals in the 2-3 hours before;

f) Not make physical effort while exiting the water and in the first 30 minutes after diving;

g) Rehydrate properly at the end of the dive (at least half a liter of water in the first half hour after surfacing);

h) After diving, refrain for at least two hours from smoking and performing sports activity. If necessary to dive again, the dive should be programmed to stay within the safety curve;

i) Do not fly or climb to altitudes that are more than 700 m above the dive site in the 16 hours following a single dive within the safety curve or in the 24 hours following subsequent dives (intended as carried out less than 16 hours apart);

j) Notify the Head of Mission of any dives or activities performed at an altitude above 700 meters from sea level, and flights in the previous 24 hours;

k) To strive directly, in the event of an emergency, under its competences and possibilities, to eliminate or reduce situations of serious and immediate danger;

l) Undergo education and training necessary for the performance of the activities to which he/she is called to dive;

m) Undergo the health protocol provided by the competent doctor respecting the deadlines;

n) Arrange for regular routine maintenance and verification of the diving equipment as required by the checklist (ANNEX 2 - Checklist for the verification of diving equipment);

o) Ensure the update of the individual dive log, including non-work diving activities.

5.6. SURFACE ASSISTANT

A person appointed for surface assistance duties must always be present at the dive site. The Surface Assistant is identified among the staff (structured and not structured) by the Head of Mission and reported on the "Planned Dive File" (ANNEX 5). This person must be aware of the dive program, countersign the planned dive file for which he/she performs this task, and have skills in the management of diving emergencies, including marine VHF radio communication, administration of norm baric oxygen and in the procedures for exiting the water of people in difficulty. During the dives, he/she will make sure to follow the diver's path and the ascent phases, keeping an eye and continuously monitoring the diver through the surface marker buoy, properly tied to the diver itself.

ANNEX 1 - CHECK-LIST FOR HEAD OF MISSION: VERIFICATION OF TASKS

ACTIVITY	*YES/NO*	*NOTES*
1. The Diving activities program has been drawn up (Annex 4);		
2. The Planned dive file has been drawn up (Annex 5);		
3. The relevant authority has been notified for the purposes of any possible intervention of rescue at sea;		
4. The Planned dive file has been shared with the interested divers (in particular highlighting: maximum depth to be reached during the dive; maximum dive time, considering from the moment when the descent to the bottom starts to the moment in which the surface is reached; verification of the adherence of the dive; verification of the match between depth and dive time with the safety curve, allowing the possibility to ascend with no need for decompression stops and safety stops);		
5. Are there any special procedures or techniques necessary for the work?		
6. If yes to point 5: have you ensured that each diver is an expert in these types of activities?		
7. Divers' logbook has been verified, checking any diving activity in the previous 24 hours?		
8. Has the equipment useful for the dive been checked?		
9. Has the validity (in terms of deadlines) of the fitness for the specific task, related to the divers interested in the activity, been verified?		
10. Have the diving activities carried out been recorded (taking note in case of any decompression practices followed)?		
11. All anomalous events occurred/noticed during the Diving activity (accidents, breakdowns and abnormal physiological events) have been noted?		
12. The knowledge of divers regarding the equipment, the methodologies and the signals of communication between divers and between divers and the surface has been verified?		
13. Have all participants been reminded not to dive under any circumstances if they do not feel in perfect physical condition? (ultimately, the diver is the first responsible for his own safety, it is his/hers duty to refuse to dive if the diving conditions are not safe or favourable, or in contrast with safety regulations)?		
14. The procedure for exiting the water for people in difficulty has been arranged, agreeing it with the captain in the case of dives from a boat?		

Date:_____

Name of the Head of Mission:_____ Signature: _____

ANNEX 2 - CHECK LIST FOR THE VERIFICATION OF DIVING EQUIPMENT

Aware of the criminal responsibilities provided for by articles 75 and 76 of Presidential Decree 445/2000 for the hypotheses of falsity in deeds and false declarations, the undersigned declares to have carried out the following maintenance and verification:

Equipment	*Maintenance*	*Verification*	*YES/NO*	*NOTES*
Protective wetsuit	*Wash in fresh water, dry away from heat sources, lubricate the zipper with paraffin without overdoing it with lubricant.*	*check seams, zippers, any tears*		
Protective drysuit	*Wash in fresh water, dry away from heat sources, lubricate the zipper with paraffin without overdoing it with lubricant.*	*neck checked, cuffs, seams, watertight zipper, loading and unloading valves, any tears*		
Mask	*Washing in fresh water*	*condition of the seals, tightness of the glass, strength and elasticity of the Strap*		
Fins	*Washing in fresh water*	*condition of materials, tightness of the foot pocket and of the straps*		
Weights	*Washing in fresh water*	*weight corresponding to that required for optimal trim, buckle hold and quick release functioning*		
Depth gauge, clock and computer	*Washing in fresh water*	*Proper functioning, battery charge status*		
Knife or cutting tool	*Washing in fresh water and blade lubrication and sharpening*	*tightness of the sheath stopper, resistance of the hooking straps, solidity of the handle on the blade, sharpening of the blade*		
Buoyancy control device (BCD)	*washing in fresh water outside and inside*	*operation of inflating and deflating valves, belts and straps, and presence of accessories for localization and recall on the surface (whistle etc.)*		
Emergency buoy	*washing in fresh water outside and inside*	*if present, inflating and deflating valve functioning*		
Regulators	*Fresh water washing, second stage internal cleaning*	*good operation, wear and tear of parts, including mouthpiece, o-ring and hoses, calibration*		

Director of the Department: prof. Luigi Bubacco
Responsible for the administrative procedure: Dr. Simone Canesso tel.049.8276176 e-mail simone.canesso@unipd.it
Contact reference: tel.049.8276178, 049.8276335 e-mail direzione.biologia@unipd.it

Manometer	*Washing in fresh water*	*air leaks, hose wear, correct measurement, indicator that marks 0 when cylinder is closed*		

Cylinder	*Fresh water washing, refilling*	*filling pressure and date of refill check (not earlier than 3 months before use), tap operation check, testing date check*		

Date: _____ OSS Name _____ Signature _____

Director of the Department: prof. Luigi Bubacco
Responsible for the administrative procedure: Dr. Simone Canesso tel.049.8276176 e-mail simone.canesso@unipd.it
Contact reference: tel.049.8276178, 049.8276335 e-mail direzione.biologia@unipd.it

ANNEX 3 - AUTHORIZATION TO DIVE FORM

AUTHORIZATION TO DIVE FORM

The undersigned ..., in the role of ..., Responsible for Underwater Teaching and Research activities, authorizes ..., in the role of .., to carry out Scientific Diving Activities on behalf of the University of Padua, from the date ... to the date ..., limited to his/her level of training and competence, in full compliance with the *Diving Activities Program* and the related *Planned Dive File* approved.

The authorized one:

- ☐ meets the minimum AESD/ESD requirements according to the standards of the European Scientific Diving Panel;
- ☐ does not meet the minimum requirements according to the standards of the European Scientific Diving Panel; therefore, the authorization is valid exclusively for educational and training activities aimed at the achievement of these standards, under the supervision of his/her teachers and qualified AESD staff, or as a temporary derogation for the performance of this specific mission, on the dates indicated above;
- ☐ has obtained medical fitness for the specific task issued on ... by the competent doctor Prof. Angelo Moretto.

Date ...

Signature of the Responsible for Underwater Teaching and Research Activities

_____

(First Name Last Name)

Director of the Department: prof. Luigi Bubacco
Responsible for the administrative procedure: Dr. Simone Canesso tel.049.8276176 e-mail simone.canesso@unipd.it
Contact reference: tel.049.8276178, 049.8276335 e-mail direzione.biologia@unipd.it

ANNEX 4 – DIVING ACTIVITIES PROGRAM

DIVING ACTIVITIES PROGRAM

The University of Padua – Hydrobiological Station of Chioggia, Department of Biology, headquartered in Palazzo Grassi, Calle Grassi Naccari 1060, 30015 Chioggia (Ve), programs scientific diving activities in the area of ..., coordinates WGS84 ..., in the period from ... to ..., and in the hours from ... to ..., departing from ..., and with the following purposes: ....
The Responsible for Underwater Teaching and Research activities is ..., available at the telephone number ....
The Head of Mission is ..., available at the telephone number ....
The working group(s) include the following scientific divers and are composed as follows:

WORKING GROUP	OPERATOR	DIVING CERTIFICATION LEVEL	QUALIFICATION	TASK

It is hereby declared that all participants are in possession of the required qualifications/licensing and are covered by an insurance policy for accidents at work for diving activities in the working environment.

Dipartimento di Biologia

Università degli Studi di Padova

TECHNICAL REPORT

For the planned activity, self-contained air or NITROX breathing apparatus (% O2<40%) and the following equipment will be used:

- …
- …

Dives will take place from the shore/boat ..., equipped with regular navigation documents.

The dives will have a maximum depth of ... m and maximum diving time of ... minutes, and will take place in calm to slightly rough sea conditions. The boundary conditions for conducting the scientific diving activity are ....

Any foreseeable risk conditions can be: ....

Notes and observations:

None

Date ...

Signature of the Responsible for Underwater Teaching and Research activities

(First Name Last Name)

Director of the Department: prof. Luigi Bubacco
Responsible for the administrative procedure: Dr. Simone Canesso tel.049.8276176 e-mail simone.canesso@unipd.it
Contact reference: tel.049.8276178, 049.8276335 e-mail direzione.biologia@unipd.it

EMERGENCY PREPAREDNESS AND RESPONSE PLAN

The contacts to call in case of a medical emergency are as follows:

- The nearest **first aid** operations center is at the **ULSS3 Serenissima - Chioggia District, Madonna della Navicella Hospital**, and answers the health emergency telephone number **118**, active 24 hours a day, 7 days a week;
- The nearest **hyperbaric chamber** suitable for the treatment of divers is by **O.T.I. Services, Via delle Macchine 51/3, 30175 Venice (VE),** and answers to the telephone number **041 5381182 from 08:30 to 16:30**, but can be reached **on call 24 hours a day, 7 days a week,** at the health emergency number **118**. The **time to reach** the structure from the Hydrobiological Station is **50 minutes**;
- The nearest **hospital first aid** is at the ULSS3 Serenissima – Chioggia District, Madonna della Navicella Hospital, Strada Madonna Marina 500, 30015 Chioggia (VE), and answers to the telephone number **041 5534300**, **active 24 hours a day**, **7 days a week**;
- The nearest **Coast Guard** office is in Chioggia, Piazzetta Marinai d'Italia 1290, 30015 Chioggia (VE), it responds to **VHF radio channel 16** and to the telephone number **041 550 8211**, **active 24 hours a day**, **7 days a week**, as well as to the Coast Guard emergency number **1530**.

Other means that can be used for emergency transport are: none.

Director of the Department: prof. Luigi Bubacco
Responsible for the administrative procedure: Dr. Simone Canesso tel.049.8276176 e-mail simone.canesso@unipd.it
Contact reference: tel.049.8276178, 049.8276335 e-mail direzione.biologia@unipd.it

The operators present in the workplace with first aid qualification are:

OPERATOR	FIRST AID QUALIFICATION	PHONE NUMBER

The emergency contacts for each operator are:

OPERATOR	EMERGENCY CONTACT	KINSHIP	PHONE NUMBER

Date ...

Signature of the Responsible for Underwater Teaching and Research activities

_____

(Name and Surname)

Director of the Department: prof. Luigi Bubacco
Responsible for the administrative procedure: Dr. Simone Canesso tel.049.8276176 e-mail simone.canesso@unipd.it
Contact reference: tel.049.8276178, 049.8276335 e-mail direzione.biologia@unipd.it

ANNEX 5 – PLANNED DIVE FILE

PLANNED DIVE FILE

Dive n. __ of the day: _____ dive site: _____.

Estimated time: _____ estimated duration min: _____.

Oxygen percentage: _____ Maximum planned depth m: _____.

Purpose of the dive: _____.

Pre-dive weather conditions: _____.

Search time limit in case of loss of eye contact of a group member before interrupting the dive: _____.

Material and equipment to be used for the dive, in addition to the basic equipment:

_____

_____.

OSS employed in diving:

Group	Name	Assigned role/task	Signature for acceptance

Support staff:

Name	Assigned role/task	Signature for acceptance
	Surface assistant	

Dipartimento di Biologia

Università degli Studi di Padova

Notes and pre-dive observations:
None

Date _____

Signature of the Head of Mission

_____
(Name and Surname)

Director of the Department: prof. Luigi Bubacco
Responsible for the administrative procedure: Dr. Simone Canesso tel.049.8276176 e-mail simone.canesso@unipd.it
Contact reference: tel.049.8276178, 049.8276335 e-mail direzione.biologia@unipd.it

ANNEX 6 – DIVE RECORD

DIVE RECORD

Dive n. __ (planned dive file).

Actual dive start time: _____ actual dive end time: _____.

Maximum depth reached m: _____.

Accidents	Yes	No

In the event of an accident, please describe the incident in detail: _____

_____

_____ .

Notes and any relevant events:
_____

Date _____

Signature of the Responsible

for Underwater Teaching and Research activities

_____

(First Name Last Name)

Director of the Department: prof. Luigi Bubacco
Responsible for the administrative procedure: Dr. Simone Canesso tel.049.8276176 e-mail simone.canesso@unipd.it
Contact reference: tel.049.8276178, 049.8276335 e-mail direzione.biologia@unipd.it

ANNEX 7 - TRAINING COURSES

1. REQUIREMENTS FOR SCIENTIFIC DIVERS

Operators assigned to diving activities must possess minimum standards of theoretical / practical knowledge and a general understanding that guarantee to carry out the diving activity in complete safety; for this purpose, the minimum ESD (European Scientific Diver, for Underwater Scientific Operator (OSS)) and AESD (Advanced European Scientific Diver, for Head of Mission) standards prepared by the ESDP (European Scientific Diving Panel of the Marsnetwok, the European network of marine research institutes and stations) are identified as a reference.

The training course defined below aims to ensure a level of knowledge of diving techniques such as to guarantee adequate training for the OSS during the performance of the planned activities.

1.1 Basic Diving Training

Basic diving training can be achieved through courses attested by the respective patents issued by national or international organizations certified by EUF (http://www.euf-certification.org/) or by other certifying bodies that apply all the EN 14153/ISO 24801 and EN 14413/ISO 24802 standards within their training courses.

The minimum recreational/sports diving licences required must be 2nd level (qualifying at 30 m depth, corresponding to CMAS 2 stars) for the OSS and 3rd level (qualifying at 40 m depth, corresponding to CMAS 3 stars) for the Head of Mission.

1.2. Emergency Management Training

First aid training, including cardio-pulmonary resuscitation (CPR), and underwater rescue is required, which can be achieved with specific courses organized by diving schools for recreational and sports activities and/or training centres for first aid, such as those of the Red Cross. The minimum training for emergency management is summarized in Table 1.

***Table 1. -** Training required for emergency management*

Figure individuate	***Certificates/patents***
Surface Assistant	*First aid* *Oxygen administration*
OSS	*Underwater first aid* *Oxygen administration*
Head of Mission	*Underwater first aid* *Oxygen Administration* *Underwater rescue*

1.3 Training for the specific activity

Underwater Scientific Operators (OSS)

They must be able to manage specific risks in carrying out scientific activities such as:

--- search and recovery;

--- surveys, both surface and submerged, to locate and mark the position of objects and sites precisely;

--- basic use of lifting balloons for controlled ascents, excavation and sampling methods;

--- basic use of metric ropes and cords, including the construction of transects and search grids;

--- underwater navigation and orientation with the use of appropriate techniques;

--- writing and recording data;

--- sampling appropriate to the purpose of the activity.

1.4 Hands-on experience

A minimum number of dives is required as required by ESD/AESD standards. To achieve these requirements, diving is allowed as a training activity under the supervision of the Professor and Head of Mission.

For Underwater Scientific Operator (OSS)

70 open water dives, including a minimum of:

--- 10 dives between 15 and 24 m;

--- 5 dives over 25 m;

--- 20 scientific dives under the responsibility of a Professor/Head of Mission;

For Head of Mission (CI)

100 open water dives, including a minimum of:

--- 10 dives between 20 and 29 m;

--- 10 dives over 29 m.

--- 50 scientific dives, of which at least the first 20 under the responsibility of a Professor/Head of Mission.

2. MAINTAINING REQUIREMENTS

Maintaining the requirements requires the performance of 12 dives performed in the last 12 months with at least 6 scientific dives or the performance of a verification dive.

Knowledge of emergency procedures is subject to verification and annual updating.

Workers must participate in exercises, carried out at least once a year, to put into practice the health emergency procedures.

3. TRAINING ART 37 D.LGS. 81/08

Appropriate training must be provided in accordance with Article 37 of Legislative Decree 81/08 and subsequent state-regions agreement on safety training - rep. 221 (workers, supervisors, managers) published in the Official Gazette no. 8 of 11 January 2012.

This training concerns the entire process of the activity and must be done for workers, managers and supervisors.

In addition to the hours of training provided for by Legislative Decree 81/08 and subsequent State-Regions Agreement (4 hours of general training to which are added another 8 hours of specific training for workers who carry out activities in "medium risk" Ateco (Education) sectors), at least another 4 hours of training are provided on this Operating Procedure for diving activities and on the operation and correct use of the underwater computer.

4. PERIODIC UPDATE

The periodic update is carried out in accordance with the provisions of Legislative Decree 81/08 and the State-Regions agreements connected to it.

ANNEX 8 - ESD / AESD MINIMUM COMPETENCIES

This document represents a summary summary of the ESD (European Scientific Diver) and AESD (Advanced European Scientific Diver) minimum standards prepared by the ESDP (European Scientific Diving Panel). The original text, in English, on the websites:

- *http://scientific-diving.eu/wiki.*
- *http://www.aioss.info/*

These standards (common practices for recognition of European competency levels for scientific diving at work) define the minimum basic training of a scientific diver in response to the national and international mobility needs of workers (European Directive 2005/36/EC), and constitute a basic level of training with respect to which the employer can implement continuous training modules. The possession of the certificate attesting to the ESD/AESD standards, issued by the competent offices in one of the Member States of the European Community (in Italy, the Italian Association of Underwater Scientific Operators, AIOSS), is valid for 5 years and does not exempt from compliance with all national and local regulations on insurance, medical fitness, safety at work, nor by possible requests for practical or theoretical demonstration of the requirements indicated. This certification only indicates the minimum guaranteed level of training, and not the current level of diving proficiency. Please also note that, regardless of the level of training, all training, recreational and work dives must be properly documented in the dive logbooks.

European Scientific Diver (ESD)

The European Scientific Diver is a ***diver who is able to act as a member of a group of scientific divers****. They can reach this level by following a specific course or by gaining experience in the field with adequately supervised training or by combining these two methods.*

ESD must:

1. Demonstrate that you have theoretical knowledge and a general understanding of:

1.1. physics and physiology of diving, causes and effects related to decompression pathologies and their management;

1.2. specific problems associated with dives carried out above 20 m depth, calculations relating to air consumption and the correct use of decompression tables;

1.3. equipment, including dive computers and guidelines regarding their safe use;

1.4. emergency procedures and management of diving accidents;

1.5. Principles of dive planning.

2. Be fully competent in:

2.1. underwater first aid techniques, including cardio-pulmonary resuscitation (CPR) and management of oxygen administration in diving accidents;

2.2. underwater rescue techniques and accident management;

2.3. appropriate use and maintenance of diving equipment;

3. Be fully competent in:

3.1. methods of finding;

3.2. survey methods, both surface and submerged, to locate and precisely mark the position of objects and sites;

3.3. basic use of lifting balloons for controlled ascents, excavation and sampling methods;

3.4. basic use of metric ropes and cords, including the creation of transects and search grids;

3.5. methods of navigation and underwater orientation with the use of appropriate techniques;

3.6. data recording techniques;

3.7. surface support techniques for a tethered diver while diving;

3.8. sampling techniques appropriate for the purpose of scientific research.

4. Demonstrate that you have performed 70 open water dives, including a minimum of:

4.1. 20 dives for scientific purposes supervised by a recognized research center;

4.2. 15 dives deeper than 15 m of which 5 are deeper than 25 m;

4.4. 12 dives performed in the last 12 months with at least 6 scientific dives.

Advanced European Scientific Diver (AESD)

The European Advanced Scientific Diver is a diver capable of organizing and managing a group of scientific divers. They can reach this level by following a specific course or by gaining experience in the field with adequately supervised training or by combining these two methods.

*L'**AESD** deve:*

1. Demonstrate that you have theoretical knowledge and a general understanding of:

1.1. physics and physiology of diving, causes and effects related to decompression pathologies and their management;

1.2. specific problems associated with dives carried out above 30 m depth, calculations relating to air consumption and the correct use of decompression tables;

1.3. equipment, including dive computers and guidelines regarding their safe use;

1.4. emergency procedures and management of diving accidents;

1.5. theory and practice of dive planning and assessment of a diver's skills;

1.6. legal aspects and responsibilities related to scientific immersion in Europe and worldwide;

1.7. planning of an underwater scientific project.

2. Be fully competent in:

2.1. underwater first aid techniques, including cardio-pulmonary resuscitation (CPR) and management of oxygen administration in diving accidents;

2.2. underwater rescue techniques and accident management;

2.3. appropriate use and maintenance of diving equipment, including drysuit and full-face mask;

2.4. basic use of small boats, hints of seafaring and electronic navigation;

2.5. supervision of diving-related operations.

3. Be fully competent in:

3.1. underwater scientific research methods, including those using free paths and towing from the surface together with those of remote surveying suitable for both surface and submerged activities;

3.2. survey methods, both surface and submerged, to locate and precisely mark the position of objects and sites;

3.3. basic use of lifting balloons for controlled ascents, excavation and sampling methods;

3.4. basic use of metric ropes and cords, including the creation of transects and search grids;

3.5. methods of navigation and underwater orientation with the use of appropriate techniques;

3.6. data recording techniques;

3.7. constrained diving techniques or with the use of ropes, whirlpools, etc., and various types of underwater communication such as those using visual, sound, physical and electronic methods;

3.8. sampling techniques appropriate for the purpose of scientific research.

4. Demonstrate that you have performed 100 open water dives, including a minimum of:

4.1. 50 dives for scientific purposes;

4.2. 20 dives deeper than 20 m of which 10 are deeper than 29 m;

4.4. 12 dives performed in the last 12 months with at least 6 scientific dives.

4.5. 20 dives in adverse conditions e.g. in currents, cold water, poor visibility.

4.6. 20 dives carried out as coordinator of a group.

In summary

Summary (not exhaustive) of minimum requirements	ESD	AESD
Diving certification for independent diving up to a depth of	**30 m**	**40 m**
Minimum number of logged dives	70	100
Minimum number of logged scientific dives	20	50
Knowledge of underwater scientific techniques of its own sector	√	√
Usage and maintenance of diving gear	√	√
Usage of small lifting bags (max 30 kg)	√	√
First aid	√	√
Oxygen provider	√	√
Rescue diver		√
Basis of navigation		√
Usage of full-face masks and dry suit		√
Communication systems between divers and the surface		√
Experience in diving expeditions organization and supervision		√
Minimum number of logged dives in the last year	12	12

Notes on the recognition of diving certifications provided by AIOSS

In recent years, the panorama of recreational diving certifications has become particularly complex and heterogeneous, so much so that establishing exact equivalences is almost impossible. The introduction of EN/ISO standards has further complicated the landscape because they are completely misaligned with previous certifications. In particular, the first level standards EN14153-1/ISO24801-1 refer to a non-self-sufficient diver, while the second level EN14153-2/ISO24801-2 standards refer to a self-sufficient diver with skills ascertained up to 20 m deep, in practice corresponding to the first level of many educational agencies (e.g.: PADI/SSI Open Water Diver, CMAS 1 star, FIAS Base, etc.). The latter level is not sufficient to carry out professional underwater scientific research activities, even if completed with the minimum number of dives and with the other required skills. On the other hand, the third level standards EN14153-3/ISO24801-3 refer to a diver with high skills (dive leader), corresponding to the level of diving guide of many educational agencies (e.g.: PADI Divemaster, SSI DiveCon, CMAS 3 star, FIAS Diving Guide, etc.). The latter level exceeds the minimum requirements for both ESD and AESD, if appropriately supplemented by the other requirements. Many organizations issue intermediate-level certifications that can be adjusted to access ESD/AESD certifications, e.g. certifications for 30 m depth (e.g.: PADI/SSI Advanced Open Water Diver; FIAS ARA, etc.) allow access to ESD certification,

while those for 40 m (e.g.: PADI/SSI Deep; FIAS ARA Extension, etc.) allow access to AESD certification, of course if complemented by the other requirements. In order to ensure the quality of diving training, patents issued by national or international organizations certified by EUF (http://www.euf-certification.org/) or other certification bodies that apply all the EN 14153/ISO 24801 and EN 14413/ISO 24802 standards within their training courses are considered valid.