

University of Victoria  
Scientific Diving Safety Manual  
For Open Water Diving

Last revised November 2018



University  
of Victoria

**UVMIC**

# Table of Contents

<b>SCOPE AND APPLICATION</b> .....	4
<b>Statement of Authorization</b> .....	5
<b>1. INTRODUCTION</b> .....	6
<b>2. UNIVERSITY SCIENTIFIC DIVING SAFETY PROGRAM ORGANIZATION</b> .....	6
a. Diving Safety Committee .....	6
b. Diving Safety Officer .....	6
<b>3. ORGANIZATION AND RESPONSIBILITY OF PERSONNEL</b> .....	7
a. Project level: Diving Project Directors .....	7
b. Operations level: On-site Diver-in-Charge .....	7
c. Operations level: Dive Team Members .....	8
d. Operations level: Surface Safety Attendants .....	8
<b>4. GENERAL REQUIREMENTS</b> .....	8
a. Minimum Entry Requirements .....	8
b. Scientific Diver Competency.....	9
c. Diving Theory .....	9
d. Swimming and Watermanship .....	9
e. General Diving Skills .....	10
f. Diver Rescue and Accident Management Techniques.....	10
g. Oxygen Provider Proficiency.....	11
h. Scientific Diving Techniques.....	11
i. Scientific Diver Categories .....	11-13
j. Special Circumstances and Equipment.....	13
k. Project Description and Approval .....	14
l. Waiver of Specific Requirements .....	14
m. Maintenance of Authorization .....	14
n. CPR Certification & Diver Rescue Training .....	15
o. Recertification .....	15
p. Revocation of Authorization .....	15
q. General Equipment Requirements.....	15-17
r. Diving Records.....	17
<b>5. OPERATING REGULATIONS</b> .....	18
a. Authorization Required .....	18
b. Maximum Depth.....	18
c. Maximum Depth – Emergencies.....	19

d. Communication .....	19
e. Special Modes and Conditions .....	19
TABLE 1 - Special Environmental Conditions.....	20
TABLE 2 - Special Diving Modes and Equipment.....	20
f. Underwater Power Tools.....	21
g. General Diving Procedures.....	21
h. SCUBA Diving Equipment.....	21
i. Snorkel Diving Equipment.....	22
j. Air requirements .....	22
k. Dive Tables .....	22
l. First Aid Kit .....	22
m. Inspection of Equipment in Preparation for Diving.....	23
n. Pre-Dive Check.....	23
o. Identification of Dive Site.....	23
p. Adherence to Planned Time/Depth Procedures.....	23
q. Termination of a Dive .....	23
r. Diving Logs.....	23
s. Logs.....	24
t. Medic Alert Tags.....	24
<b>6. EMERGENCY AND DECOMPRESSION PROCEDURES AND REPORTING.....</b>	<b>24</b>
a. Diver's Responsibility for Safety.....	24
b. Emergency Deviation from this manual .....	24
c. Emergency Procedures.....	24
d. Decompression Procedures .....	25
e. Incident and Accident Reports.....	26
<b>APPENDIX 1 – Diving Safety Committee Terms of Reference.....</b>	<b>27</b>
<b>APPENDIX 2 – Diving Registration Form.....</b>	<b>29</b>
<b>APPENDIX 3 – Annual Project Description and Approval Form .....</b>	<b>30</b>
<b>APPENDIX 4 – Diving Operations First Aid Kit Contents .....</b>	<b>34</b>
<b>APPENDIX 5 – Emergency Services .....</b>	<b>35</b>
<b>APPENDIX 6 – CSA Air Purity Allowable Limits .....</b>	<b>36</b>
<b>APPENDIX 7 – Diver in Charge Field Checklist.....</b>	<b>37</b>
<b>APPENDIX 8 – Departmental Hazard &amp; Incident Report.....</b>	<b>38</b>

## SCOPE AND APPLICATION

The University of Victoria Scientific Diving Safety Manual has been written to meet the requirements of the Canadian Association for Underwater Science Standard of Practice for Scientific Diving (revised ed. May 2017). The CAUS is a self-regulating body dedicated to safety in underwater research through the establishment and continual peer review of standards of practice for scientific diving.

Scientific diving is defined as diving performed to collect specimens or data for scientific use under the auspices of an educational or research institute operating in accordance with the CAUS Standard of Practice for Scientific Diving.

The UVic Scientific Diving Safety Manual for Open Water Diving provides the guidelines for all open water diving under University of Victoria auspices. University auspices include all open water diving by University employees or registered students as part of their research, occupation or education, and diving funded by the University or using University diving equipment or facilities. Commercial diving under contract with the University is not covered by this manual and must meet the requirements of the Workers Compensation Board of BC Occupational Health and Safety Regulations. University divers should contact the University Diving Safety Officer (DSO) to see if they also fall under Part 24 of the WorkSafeBC Occupational Health and Safety Regulation.

The UVic Scientific Diving Safety Manual also covers requirements for snorkel diving and open-circuit air SCUBA diving. Other modes and forms of diving are not covered by this Manual and are not permitted under University auspices without special authorization from the DSO, the UVic Diving Safety Committee and endorsement by the CAUS Standards and Procedures Committee.

All diving under UVic auspices must be conducted in a manner that will minimize risks and provide adequate protection for scientific divers from accidental injury or illness. This manual sets forth requirements and procedures which allow a working reciprocity with other CAUS institutions and related organizations in other countries.

## Statement of Authorization

The University of Victoria Scientific Diving Safety Manual for Open Water Diving has been developed over several years, making use of field experience gained during that time. It meets the current requirements of the Canadian Association for Underwater Science (CAUS) Standard of Practice for Scientific Diving and has been officially endorsed by the CAUS Standards and Procedures Committee.

The procedures have been prepared by the UVic Diving Safety Committee for the use of personnel diving under university auspices. University auspices include diving by university employees or registered students as part of their research, occupation or instruction.

Compliance with the Scientific Diving Safety Manual is a shared responsibility of individuals engaging in diving activities and their supervisor, and the Diving Safety Committee as part of the University's Occupational Health and Safety Program.

Authorized by the Vice-President Finance & Operations \_\_\_\_\_

## **1. INTRODUCTION**

The Scientific Diving Safety Manual sets forth the policy for the organization and conduct of the University of Victoria scientific diving program and the regulations and procedures for safety in scientific diving operations. This manual covers snorkel diving and open-circuit air SCUBA diving. Other modes or forms of diving are not covered and require special authorization. This manual complies with the requirements for scientific diving of the Canadian Association for Underwater Science (CAUS Standard of Practice for Scientific Diving, 2017 edition).

The purpose of the University scientific diving safety program is to ensure that all diving under the auspices of the University of Victoria is conducted in a manner that will maximize protection of divers from accidental injury and occupational illness. University auspices include all open water diving by University employees or registered students as part of their research, occupation or education and diving funded by the University or using University diving equipment or facilities.

This document is designed to ensure safe diving and to provide a framework for reciprocity between organizations with similar standards.

## **2. UNIVERSITY DIVING SAFETY PROGRAM ORGANIZATION**

### **a. Diving Safety Committee**

Diving safety will be under the purview of the Diving Safety Committee. The current membership of the Diving Safety Committee and terms of reference are available on the Occupational Health, Safety & Environment (OHSE) website and in Appendix 1 of this document.

The Diving Safety Committee shall:

- Recommend the issue, reissue or revocation of diving authorization
- Recommend procedures and policy for safe diving under University auspices
- Review and approve diving projects and diving practices and restrict or prohibit diving operations it considers unsafe
- Act as a board of review and appeal

### **b. Diving Safety Officer**

The University shall appoint a DSO to supervise and administer the scientific diving safety program.

The DSO shall be an experienced scientific diver and shall:

- Serve as a member of the Diving Safety Committee
- Act as operational authority and administrator of the scientific diving safety program

- Be responsible for all aspects of the program including but not limited to:
  - Diver authorization, competency and training
  - Diving project review and field evaluation of projects and personnel
  - Maintenance of diving records
  - General oversight of the diving safety program and compliance with this manual

The DSO shall have authority to restrict, prohibit or suspend any diving operations, programs or practices which they consider unwise or unsafe.

The DSO shall report to the Director, UVic OHSE.

### **3. ORGANIZATION AND RESPONSIBILITY OF PERSONNEL**

Personnel involved with diving operations conducted under the auspices of The University of Victoria shall be responsible and accountable for the health and safety of those operations in accordance with the following organizational plan.

#### **a. Project level: Diving Project Directors**

Directors of research or study projects or programs, instructors of courses, field trips or like instructional components and persons in charge of any other scientific, research or educational undertaking, any of which use or involve diving, shall be responsible for ensuring that all individuals engaging in diving in conjunction with their project are aware of and comply with this Manual.

Personnel in charge at this level shall be designated as Diving Project Directors and shall have the authority and responsibility to restrict, prohibit or suspend diving operations under their charge based on a risk assessment of the diving conditions and the health and fitness of a diver while in the field, or any information received from the field or DSO that would necessitate such actions.

#### **b. Operations level: On-site Diver-in-Charge**

Each diving operation undertaken as part of a diving project shall have a designated person-in-charge, the Diver-in-Charge, who will remain at the dive site at all times during diving operations and who will supervise the conduct the dive operations. The Diver-in-Charge shall have experience and training in the conduct of the planned operation.

The Diver-in-Charge must be approved by the DSO The Diver-in-Charge shall ensure that all diving and related activity under their charge is conducted in a safe and healthy manner and in compliance with the procedures and requirements set forth in this Manual. Criteria for assigning a Diver-in-Charge and a field checklist of responsibilities is provided for on pages 14-15 and Appendix 7, respectively.

The Diver-in-Charge shall have the authority and responsibility to restrict, prohibit or suspend diving and related activities under their charge based on a risk assessment of the diving conditions and the health and fitness of a diver while in the field. When appropriate, the Diving Project Director can be the Diver-in-Charge.

**c. Operations level: Dive Team Members**

Divers and immediate support personnel who are involved in a diving operation shall be considered members of the dive team(s) of that operation.

It shall be each dive team member's right, responsibility, and duty to refuse to dive or engage in dive support activities if they:

- Feel unfit or in any other way unprepared for the activity.
- Judge that the conditions are unsafe or unfavourable.
- Feel that engaging in the activity would violate the precepts of their training or the requirements set forth in this manual.

No member of a dive team may overrule a decision of the Diver-in-Charge or P.I. (Project Director) to suspend diving operations.

It is the dive team member's responsibility to report to the DSO any significant change in their health or medication.

**d. Operations level: Surface Safety Attendants**

The Surface Safety Attendant is part of the Dive Team and provides surface support for the diving operation. The Surface Safety Attendant is a person who remains on the surface during a scientific diving operation and who monitors top-side hazards and who has the authority to abort the dive if there is any risk to the health and safety of the divers. The Surface Safety Attendant must hold a current first aid, CPR and O2 administration certification and be trained in dive accident management. The Surface Safety Attendant must be approved by the DSO.

**4. GENERAL REQUIREMENTS**

**a. Minimum Entry Requirements**

All personnel or students involved in diving under University auspices must register with the DSO (see Appendix 2) and meet all criteria herein described.

Prior to commencing scientific diving activities or scientific diver training, the candidate must be 18 years of age or older, or must be of legal age in the province or have signed authorization form from a parent or legal guardian. In addition, the following documents must be submitted to the DSO prior to or during a training program for scientific diving, as appropriate, and must be submitted by those divers who have demonstrated competency prior to scientific diving activities.

- SCUBA diving certification (with at least 5 logged open water dives and 2.5 hours underwater time)
- Medical evaluation declaring medical fitness to dive
- Dive registration form (Appendix 2)
- Current CPR and emergency first aid certification
- Current open water diving evaluation
- Personal diving log
- Signed waiver and release forms
- Current project description and approval, if applicable (Appendix 3)
- Equipment list and service record

Medical evaluation must be carried out by a WorkSafeBC-approved physician with experience in diving medicine. The certificate of medical fitness to dive must be renewed every two years up to age 39, annually from age 40 onward, and more frequently if clinically indicated.

#### **b. Scientific Diver Competency**

Prior to commencing operations as a scientific diver, the candidate must demonstrate competency in accordance with sections 4.c -4.h, including the minimum entry requirements of section 4.a. Competency evaluation will be conducted initially and annually by the DSO or a designate (preferably at Instructor level). The scope of re-evaluation on an annual basis will be the responsibility of the DSO.

#### **c. Diving Theory**

Prior to taking part in scientific diving activities the candidate must demonstrate knowledge in, and understanding of, diving theory by completing a written exam with a mark of 80% or higher. Topics must include but not limited to:

- Diving physics
- Diving physiology and medical considerations
- Diver communication
- Underwater hazards
- Problems with contaminated air
- DCIEM Diving Tables
- The diving environment
- Diving equipment
- Problem management
- Legislation and standards
- Scientific diving techniques

#### **d. Swimming and Watermanship**

Prior to taking part in scientific diving activities the candidate will perform a rescue tow of 100 m with both participants fully geared with the appropriate thermal protection. The participant will also complete one of the following four tasks:

- Demonstrate a survival swim/float without any aids for not less than 20 minutes

- Swim 200 m without swim aids
- Snorkel 400 m using mask, fins and snorkel
- Conduct a head-first surface dive to retrieve an object in 3 m of water

#### **e. General Diving Skills**

Prior to participating in scientific diving activities the diver must demonstrate the ability to perform basic diving skills in an open water environment. A performance evaluation must include but is not limited to:

- Pre-dive planning including emergency contingencies and evaluation procedures  
Local environment orientation and hazard assessment
- Dive planning procedures to be implemented to counter any known hazards
- Briefing procedures
- Appropriate dressing in and equipment assembly procedures
- Pre-dive safety check
- Appropriate entry techniques
- Maintenance of the buddy system
- Underwater navigation skills
- Diving skills circuit – may be conducted in a confined or open water setting and must include:
  - Proper weighting
  - Proper descent/ascent techniques
  - Proper buoyancy techniques
  - Mask removal and replacement
  - Regulator recovery and clearing
  - Weight belt removal and replacement
  - SCUBA unit removal and replacement
  - Options for out-of-air emergencies
  - Dealing with and breathing from a free-flowing regulator
  - Dry suit/BCD over-inflation procedures
  - Appropriate exit techniques
  - Appropriate dressing down and equipment disassembly procedures
  - Post-dive debriefing
  - Dive log requirements

#### **f. Diver Rescue and Accident Management Techniques**

The candidate must demonstrate proficiency in diver rescue and accident management procedures specific to location, mode, and condition of diving to be undertaken. A performance evaluation must include but is not limited to:

- Site management and accident prevention
- Self-rescue skills
- Diver rescue skills at surface
- Diver rescue skills underwater
- Missing diver procedures
- Recognition and treatment of diving-related injuries

- Accident management and evacuation procedures
- Accident and incident reporting

### **g. Oxygen Provider Proficiency**

The candidate must possess current certification in the provision of therapeutic oxygen to an injured diver.

### **h. Scientific Diving Techniques**

Scientific divers performing specialized tasks underwater must be properly instructed, trained and equipped to conduct these tasks in a safe manner. Training may include, but not be limited to, techniques such as:

- Transects and quadrats; other census or assessment techniques with a variety of organisms and habitats, underwater sampling design
- Photography/video
- Specimen collecting; handling and transport of equipment underwater
- Small object search and recovery (using lift bags)
- Surveying and mapping, use of lines

### **i. Scientific Diver Categories**

#### Scientific Diver-in-training

This certification is a limited permit authorizing diving in a training or on-the-job training capacity only and requires that a diver must fulfill all minimum entry requirements.

A diver-in-training must dive under authorized supervision and under the following restrictions:

- Maximum diving depth of 20 m
- Must dive with the DSO or an authorized Scientific Diver I or II
- Diving only during daylight hours
- Diving must not include use of special modes or be performed under special conditions (see Tables 1 and 2 on pages # and #)

#### Scientific Diver I

To achieve the Scientific Diver I rating, the diver must:

- Pass the CAUS Level 1 Exam with at least 80%
- Fulfill all minimum entry requirements
- Demonstrate competency as outlined, and plan and execute a minimum of 4 working dives to the anticipated depth under the direct supervision of the DSO or a designate
- Accumulate a minimum of 25 logged dives and 15 hours bottom time as a Diver-In-Training or demonstrate to the DSO's satisfaction equivalent knowledge, training and experience as a scientific diver

A Scientific Diver I is limited to a maximum diving depth of 20 m and may act as a Surface Safety Attendant for dives shallower than 20 m.

## Scientific Diver II

To achieve a Scientific Diver II rating, the diver must:

- Be a certified Scientific Diver I
- Complete an exam with a minimum grade of 75% on the physics and physiology of deeper diving
- Plan and execute a minimum of 4 dives to the anticipated depth under the direct supervision of the DSO
- Demonstrate proficiency in areas including but not limited to:
  - Deep diving pre-dive planning including breathing gas consumption calculations
  - Selection and use of redundant air systems
  - Briefing procedures including narcosis awareness, gas and time monitoring, diver termination criteria
  - Appropriate dressing in and equipment assembly procedures for deep extended dives
  - Pre-dive and in-water safety checks
  - Maintenance of the buddy system
  - Ascent rates, safety stops, post-dive activities

A Scientific Diver II must observe the following restrictions:

- Maximum diving depth of 40 m
- Must dive with DSO or another Scientific Diver II when deeper than 20 m

A Scientific Diver II may act as a Surface Safety Attendant for dives deeper than 20 m.

## Surface Safety Attendant

A surface safety attendant shall attend the dive team at the dive site and must:

- Possess a current, nationally recognized first aid and CPR certification
- Possess current certification in the provision of therapeutic oxygen to an injured diver
- Have knowledge of the diving equipment, systems and procedures in the conduct of the planned operation
- Have knowledge of emergency accident management protocols and procedures

## Diver in Charge

To achieve the level of Diver in Charge rating, the diver must:

- Have been a minimum level 1 Scientific Diver for at least one year
- Have logged a minimum of 50 dives as a Scientific Diver or equivalent
- Have conducted a minimum of 3 mock or sham incidents involving decompression sickness, burst lung syndrome, and lost diver.
- Demonstrate proficiencies in areas including but not limited to:
  - Legal responsibilities under provincial and federal diving legislation and regulations.
  - Dive planning using DCIEM tables

- Role of the diving supervisor
- Site emergencies and accident investigation
- Dive accident prevention and management planning
- Control of the dive operation
- Describe the definition of competency under applicable provincial law.
- Describe the due diligence of a diving supervisor
- Describe the legal requirements of maintaining a supervisors daily diving log
- Understand worker's rights under health and safety law
- Ensure that all personnel follow compliance practices.
- Ensure all personnel have read and understand the diving manual and have received a briefing on diving site safety procedures and profiles.
- Be familiar with the actions related to the follow up that the supervisor should take in the event of an accident at a dive site.
- Describe potential hazards associated with dive operations and the controls to be used to eliminate or minimize them.

#### Visiting Diver / Reciprocity

Visiting divers from other CAUS member organizations, or those of the American Association of Underwater Sciences (AAUS), may be eligible to dive at UVic by providing a [letter of reciprocity \(LOR\)](#) from their home institute's DSO. Authorizations are on a temporary basis for personnel who do not normally and would not otherwise dive under the auspices of the University. Before being authorized to dive, visiting divers must provide evidence of certification, medical clearance, and experience. Visitor authorization shall be valid under the restrictions stipulated by the UVic DSO, and based on diver competency as outlined in this manual.

#### SCUBA Certification Deeper than 40 m

Certification for SCUBA diving shall not normally be given for depth greater than 40 m.

#### Snorkel Diver

Snorkel Divers shall have completed an approved course with at least 3 open water dives and 1.5 hours in water, unless otherwise specified by the DSO. An open water evaluation of skills may be required under the supervision of the DSO or designate.

Snorkel depth certification shall be limited to a maximum depth of 10 m.

#### **j. Special Circumstances and Equipment**

Attention shall be given to the development of proficiency under the specific environmental conditions relevant to the research project or in using any mode other than SCUBA or snorkel. Special environments and equipment may require special training and specific approval of the DSO. Special environments and equipment may include but not be limited to:

- Overhead environments or diving in the vicinity of ice or under ice

- Current/surge diving
- Kelp bed diving
- Boat diving
- Low visibility diving
- Night diving
- Full-face masks and helmets
- Voice-transmitting communication devices
- Extreme water or surface temperatures
- Diving in the vicinity of nets or cages

Special equipment may include but not limited to:

- Surface supply
- Hookah
- Nitrox or other mixed gases
- Rebreathers

#### **k. Project Description and Approval**

All diving projects shall be approved by the Diving Safety Committee prior to starting of diving activities. Applications must be submitted in writing to the DSO and include details of the project, proposed locations, and emergency plans (see Appendix 3). Educational dives on course field trips which may not be part of a research project shall nevertheless require approval. Course instructors or divers anticipating such dives must indicate their plans to the DSO.

Approved project descriptions are valid for one year.

#### **l. Waiver of Specific Requirements**

If an applicant for certification can show evidence of previous qualifying experience or training, he/she may be granted a waiver for specific requirements of training and experience. The requirements for a medical evaluation shall not in any case be waived. Under normal circumstances experienced divers will be required to be checked out by the DSO.

#### **m. Maintenance of Authorization**

##### Term of Authorization

All diving certificates shall expire one year from the date of the last annual check out or upon expiration of their diver medical, whichever comes first.

##### Diving Activity

During any 12 month period, each certified diver shall log a minimum of 12 dives. At least one dive to the depth of certification shall be made during each six month period. Failure to log dives to the depth of certification as above may be cause for revocation or restriction of a certificate.

### Monthly Logs

All certified divers must normally submit monthly diving logs to the DSO summarizing their diving activity. Failure to do so shall be a positive indication that the diver has not been diving for that month. All dives must be recorded in a diver's daily log and should be summarized in a monthly log and the record for all months submitted on an annual basis.

### **n. CPR Certification & Diver Rescue Training**

All certified scientific divers are responsible for maintaining current CPR certification and diver rescue training. Proof of CPR certification and diver rescue training must be filed with the DSO. Divers must also have training in emergency first aid and oxygen administration.

### **o. Recertification**

If a diver's certificate expires or is revoked, he/she may be re-certified after complying with such conditions as the Diving Safety Committee may impose.

### **p. Revocation of Authorization**

Failure to comply with the standards set out in this manual will result in revocation of certification. The diver shall be informed of the reasons for revocation, and will be given an opportunity to present a case to the Diving Safety Committee.

### **q. General Equipment Requirements**

#### Diving Equipment

All diving equipment including cylinders, regulators, buoyancy compensators, compressors, valves, pressure gauges, reserve gas-supply systems, umbilicals, helmets and all accessories necessary for the safe conduct of the diving operation must be:

- Of approved design, sound construction, adequate strength, free from patent defect and maintained in a condition that will ensure its continuing operating integrity for the purpose and depths for which it was originally designed or subsequently used
- Of a standard acceptable to the Diving Safety Committee
- Used in an unmodified form unless the modification is specifically approved by an agency acceptable to the Diving Safety Committee
- Examined, tested, overhauled, and repaired in accordance with the manufacturer's recommended procedures and as directed by the diving safety committee. Records of equipment maintenance and testing must be kept for a period of 5 years.
- Adequately protected against malfunction at low temperatures caused by ambient air or water and expansion of gas

#### Checking of Gauges and Metering Equipment

Gauges and metering equipment must have a functional check every 12 months. When a discrepancy is indicated it shall be rectified without delay. If gauges and metering equipment are removed from service, such equipment shall be tagged as defective.

### Cylinder and Compressor System Requirements

Cylinders and compressor systems used to supply air to a diver must meet the requirements of CSA Standard Z275.2-04, Occupational Safety Code for Diving Operations and CSA Standard Z180 Compressed Breathing Gas. Air analysis from an accredited independent laboratory must be performed every 6 months and meet the requirements in Appendix 6; and

All tanks, fixtures and fittings must meet the appropriate requirements of the CSA Standard B51-03 (R2007) Boiler, Pressure Vessel, and Pressure Piping Code.

### Lifelines

Lifelines must:

- Be secured at the surface to a safe point of anchorage
- Be tended at all times by a diver's tender
- Be secured in a manner that will prevent loss of contact with diver
- Be affixed securely to a diver's safety harness
- Be of sufficient length and free of knots and splices
- Have a breaking strength appropriate to the diving operation

### Maintenance and Inspections

Each SCUBA tank must receive a visual inspection including testing every year and hydrostatic testing every 5 years in accordance with Canadian Transport Commission Regulations. Tank valves must be serviced every two years and regulators must be serviced every year. Gauges (depth and pressure) and buoyancy devices must have a functional check every 6 months or whenever a discrepancy is indicated. Any malfunction shall be rectified without delay. The DSO shall be informed of new equipment to be employed in diving.

### Communications

An effective two-way means of communication must be provided between the underwater site of a diving operation and any person in control of equipment that supports or otherwise assists diving operations at the work site (surface supply, tethered SCUBA). Where voice communications are required, the standard of sound reproduction shall be adequate to enable the diver's breathing to be clearly heard.

In surface supply diving operations, in addition to the primary communication system, an emergency signal system must be employed.

### Surface Equipment

When diving is in progress, the following equipment must be present at the dive location:

- First-aid kit appropriate for the diving operation (Appendix 4) and oxygen with sufficient supply to last until EMS can be reached

- Such other equipment as may be required for the safe conduct of the diving operation

#### Digital Dive Computers

- Digital dive computers must not be used in place of Defense and Civil Institute of Environmental Medicine (DCIEM) diving tables.
- Personnel using dive computers have thoroughly reviewed the manufacturer's manual and are familiar with the features and limitations of the computer

#### Use of Diving Equipment

Diving equipment must be used and maintained in accordance with the manufacturer's recommendations. At no time shall equipment be used in modified form unless the modification has been specifically approved by the Diving Safety Committee or by an agency acceptable to the Diving Safety Committee.

### **r. Diving Records**

#### Diver's Personal Logbook

Each diver shall maintain and retain in his possession for a five-year period a personal logbook that records the following information:

- Diver's name
- Date
- Diving mode
- Gas media breathed (if other than air)
- Bottom time
- Maximum depth attained
- Surface interval
- Pressure group if repetitive dive
- Dive team signature(s)
- Dive table and schedule used
- Any unusual incident or condition

#### Daily Record

An additional daily record of each dive shall normally be kept by the Diver-in-Charge or the Surface Safety Attendant on site. Such records shall normally be separate from the log owned and maintained by the individual diver, e.g., Diver's Personal Log.

The daily record shall be available at any time for inspection, if required, by the DSO.

The DSO shall retain all diving records for a minimum period of 5 years.

### Training Record

An individual training record must be maintained by the DSO for each diver, including all diving certifications, depth and specialty endorsements. The training record must be retained as part of the organization's diving records for at least 5 years.

### Equipment Record

A record of equipment maintenance and testing shall be kept by individual divers.

### Annual Project Description and Approval

All diving projects must be outlined on the Annual Project Description and Approval Form (Appendix 3) and submitted to the DSO for review by the Diving Safety Committee before the beginning of any diving operations. All divers involved should have the appropriate depth and environmental certifications for the planned dives and should sign the submitted project approval form.

### Period of Records Maintenance

All records shall be maintained for a period of at least 5 years.

## **5. OPERATING REGULATIONS**

### **a. Authorization Required**

No persons shall engage in diving under the auspices of The University of Victoria unless he/she holds a valid certificate issued by the DSO as approved by the Diving Safety Committee pursuant to the provisions of this document, or is engaged in training as prescribed by the document.

SCUBA diving applies to diving operations in which divers use self-contained underwater breathing apparatus.

SCUBA diving may be performed in either a free-swimming or a tethered mode.

When SCUBA diving is accomplished in a free-swimming mode, the divers must employ the buddy system and have a surface safety attendant.

When SCUBA diving is accomplished in a tethered mode, the diver must be:

- Secured by a lifeline
- Tended by a diver's tender

### **b. Maximum Depth**

Divers breathing air on SCUBA must not exceed 40 m (130 ft) depth.

### **c. Maximum Depth – Emergencies**

Divers breathing air on SCUBA may dive to depths greater than 40 m (130 ft) for the purpose of saving a life but must exercise extreme caution, have sufficient air and no decompression time and must, where conditions permit:

- Be secured by a lifeline
- Be tended by a diver's tender

### **d. Communication**

#### Buddy Divers

Free-swimming divers using SCUBA must maintain effective two-way communication with each other at all times while in the water and must be in a position to render assistance in case of need.

#### Tethered Divers

Tethered Divers employing SCUBA shall have effective two-way communication with the surface. Line signals are acceptable.

#### Surface Safety Attendants

One or more surface safety attendants shall be present at the dive site during all diving operations. *Minimum crew size* is three (3) for dives at depths of less than 20 m (i.e., two divers and a surface safety attendant).

#### Stand-By Diver

A stand-by diver must be present at the dive site during SCUBA diving operations as follows:

- During operations involving decompression diving
- Where there is danger of diver entrapment
- Where there are special hazards (such as under ice)
- When the depth of 40 m is exceeded
- Where required by the Diving Safety Committee, DSO or Diver-in-Charge

Stand-by divers must not dive or be required to dive except in the event of an emergency.

#### Snorkel Diving

Snorkel diving, as approved under this manual, includes diving operations in which divers utilize a snorkel for surface swimming or breath-hold diving. Snorkel diving shall be accomplished in a free-swimming mode only. Snorkel diving shall not be permitted where there is danger of entrapment.

### **e. Special Modes and Conditions**

Personnel who have an operational need to dive under the special conditions listed in Table 1 or to use the special diving modes and equipment listed in Table 2, excluding

non-crew observers in one-atmosphere submersibles, are required to obtain written permission from the Diving Safety Committee prior to undertaking such activity. In all cases, the special modes and conditions listed below require training, certification and operating expertise beyond the general requirements already stated in this manual. Application for permission must be made in writing to the Diving Safety Committee and must describe the rationale and purpose of the proposed diving project. The Diving Safety Committee may seek advice from other diving agencies in considering an application outside the specified regulations.

**TABLE 1 - Special Environmental Conditions**

Diving under ice
Altitude diving
Deep diving (deeper than 40 m/130 feet)
Decompression diving
Diving in zero visibility
Diving in contaminated water
Night diving
Diving in caves, shipwrecks, pipes, tunnels or other enclosed spaces
Blue-water diving (no bottom)
Diving in strong currents

**TABLE 2 - Special Diving Modes and Equipment**

Umbilical diving
Rebreathing apparatus (closed and semi-closed circuit)
Mixed gas diving (includes use of oxygen)
Bells (open and closed)
Saturation diving
Habitats
Chamber diving
Submersible vehicles (includes atmospheric diving systems)
Diver lock-out vehicles
Compressors
Power tools
Explosives
Electrical equipment

#### **f. Underwater Power Tools**

Where power tools are to be used underwater in diving operations, they shall be specifically approved for this purpose by the Diving Safety Committee.

Hand-held electrical tools and equipment supplied with power from the surface shall be de-energized before being placed into or retrieved from the water.

Hand-held power tools shall not be supplied with power from the dive site until requested by the diver.

#### **g. General Diving Procedures**

##### Planning of Diving Operation

A general plan of the diving operation shall be discussed in detail and accepted by the Diver-In-Charge, divers and any non-diving support personnel.

Diving operations must be carried out in strict accordance with tables and procedures published or approved by the Defense and Civil Institute of Environmental Medicine (DCIEM).

The plan of the diving operation shall include safety and health aspects of the following as appropriate to the conditions:

- Surface and underwater conditions and hazards
- Dive team assignments
- Diving equipment
- Breathing gas requirements and supply
- Thermal protection
- Residual inert gas status of dive team members
- Dive profiles and altitude corrections
- Emergency procedures including procedures that are to be followed in the event of an equipment or system malfunction

A listing (including addresses, telephone numbers and radio frequencies, as appropriate) of locally operational recompression chambers, medical facilities and emergency evacuation agencies shall be available at the dive site.

For each dive location, a procedure shall be established for transporting a diver to an operational recompression chamber or medical facility in the event of an accident.

#### **h. SCUBA Diving Equipment**

As appropriate for the dive operation, each SCUBA diver shall be equipped as follows:

- Open-circuit SCUBA, complete with demand regulator, alternate air source (octopus) easily accessible and tank with quick-release harness
- Face mask
- Swimming fins

- Suitable knife
- Weight system with a quick-release closure
- Submersible pressure gauge
- Exposure suit or protective clothing appropriate for the condition of work and the temperature of the water
- Orally and manually inflatable buoyancy device
- Elapsed-time indicator and depth gauge (or the equivalent)
- An auditory signalling device (e.g., whistle)
- A surface marker buoy (i.e., safety sausage)

#### **i. Snorkel Diving Equipment**

Each snorkel diver shall use that portion of the following equipment appropriate to the conditions:

- Face mask
- Snorkel or breathing tube
- Swimming fins for the feet
- Suitable knife
- Exposure suit or protective clothing appropriate for the condition of work and the temperature of the water
- Orally and manually inflatable buoyancy device
- Weight belt and a quick-release closure
- Auditory signalling device (e.g. whistle)

#### **j. Air requirements**

No SCUBA diving operation shall be permitted unless each diver carries a sufficient quantity of the appropriate breathing gas to complete the planned dive with an adequate reserve.

The Diver-In-Charge must ensure that all breathing gases used in conjunction with a diving operation meet the minimum purity requirements as outlined in Appendix 6 as set by the CSA 275.2 Occupational Safety Code for Diving Operations.

#### **k. Dive Tables**

DCIEM (Defence and Civil Institute of Environmental Medicine) Air Diving Tables and procedures will be followed as a minimum requirement during all diving operations. Diving activity shall be restricted to no-decompression diving unless specifically approved by the DSO or Diving Safety Committee.

#### **l. First Aid Kit**

A first aid kit, approved by the Diving & EMPU Safety Committee and meeting IFA regulations and appropriate to the location and nature of the diving operation, shall be located at the dive site. The contents of the kit shall be as described in Appendix 4.

**m. Inspection of Equipment in Preparation for Diving**

Before commencing a diving operation, the Diver-In-Charge shall ensure that all diving systems and equipment used in connection with the diving operation are of an approved type and design and are in operating condition.

**n. Pre-Dive Check**

Immediately before each dive, each diver shall check that he/she has all the required equipment and that such equipment is properly fastened in place and all apparatus functioning. Before descent, the same check shall be conducted in the water.

**o. Identification of Dive Site**

When diving operations are in progress, warning devices shall be displayed as follows:

- Buoys, flags, lights, lamps or flares to define the limits to be kept clear of by any equipment other than that connected with the diving operation
- In navigable water, flags and lights in accordance with the requirements of the appropriate regulatory authority
- Flags and signals employed for dive site identification shall only be displayed while diving operations are in progress

**p. Adherence to Planned Time/Depth Procedures**

Except in the case of accident or unavoidable circumstances, a diver must not be permitted to remain at any depth longer than the maximum time planned for that depth during that dive nor shall the planned maximum depth be exceeded.

**q. Termination of a Dive**

A dive shall be terminated in accordance with the dive plan or when:

- The Diver-In-Charge requests termination
- A diver or Surface Safety Attendant requests termination
- A diver loses contact with or fails to respond correctly to communications from a buddy team member
- A diver fails to respond correctly to communications from the tender
- A diver goes on diver-carried reserve breathing gas supply
- A diver is aware of any sign of malfunction of gear or sign or symptom of distress
- Any diver team member is aware of any unusual or unplanned situation which threatens the health or safety of any dive team member

Note: As appropriate to the conditions, diving activity may be resumed in Item (c) given restoration of proper communication between buddy team members.

**r. Diving Logs**

Personal diving logs must be maintained for all dives.

#### **s. Logs**

Service logs must be maintained by individual divers or teams indicating the dates and results of servicing of tanks, valves, regulators, gauges, and buoyancy devices.

#### **t. Medic Alert Tags**

Each diver should have a medical alert tag stating they are a diver and the possibility of DCS. These tags must be worn by the diver for 24 hours after leaving the dive site.

### **6. EMERGENCY AND DECOMPRESSION PROCEDURES AND REPORTING**

#### **a. Diver's Responsibility for Safety**

Ultimate responsibility for safety rests with the individual diver. It is clearly the diver's responsibility and duty to refuse to dive if, in his/her judgment, conditions are unsafe and unfavourable, or if he/she would be violating the precepts of his/her training or this manual.

#### **b. Emergency Deviation from this manual**

In emergencies when danger to life exists or is probable, divers may, at their own discretion, deviate from the requirements of this manual to the extent necessary to prevent or minimize the situation. The DSO and Diving Project Director shall be notified as soon as possible after the onset of the incident and a Departmental Incident & Hazard Report (Appendix 8) shall be submitted to the DSO and Occupational Health, Safety & Environment, explaining the circumstances and justifications for actions taken.

#### **c. Emergency Procedures**

In the event of an accident which warrants it, the Diver-In-Charge shall identify the location of the nearest emergency medical facility and operational hyperbaric facility suitable for his/her diving operations and shall make arrangements for emergency notification of and transportation to the facilities. Should the Diver-in-Charge be incapacitated, another dive team member, including divers and/or surface safety attendants, shall contact rescue personnel and carry out appropriate first aid and emergency procedures in accordance with information contained in the diving first aid kit and the precepts of their training.

A list of emergency phone numbers for BC is contained in Appendix 5. The DSO and Diving Project Director shall be notified as soon as possible after the onset of the emergency, and a written report of the emergency shall be submitted to the DSO.

## **d. Decompression Procedures**

### General

Diving operations, repetitive dives and treatment of divers must be carried out in strict accordance with decompression tables and procedures that have met with the approval of the DSO.

### Hyperbaric Chambers

A hyperbaric chamber, Class A (double-lock type), in operable condition, must be located within 4 hours of travel time by available means of transportation from the dive site when:

- Planned dives exceed the no decompression limit
- The depth of 40m (130 ft) is exceeded

Hyperbaric chambers must conform to CSA Standard Z 275.1, Hyperbaric Facilities, and shall be operated in accordance with the requirements of CSA Standard Z275.1, Hyperbaric Facilities.

### Stand-by Diver

A Stand-by Diver shall be present at the dive site when:

- Planned dives exceed the no decompression limit
- Depth of 40 m (130 ft) is exceeded

### Pressure-Related Illness

When a diver shows any indication of pressure related illness or requires therapeutic recompression for any reason, treatment and transportation to a hyperbaric facility must be initiated immediately and medical personnel alerted.

### Air Transportation of Distressed Diver

If transportation is required, the altitude and in-flight conditions must not exceed 300 m (960 ft) above dive site whenever possible.

### Diving After Treatment for a Pressure-Related Illness

Any diver who has suffered pressure-related illnesses must not dive unless approval for further diving is given by a physician experienced in diving/hyperbaric medicine.

### Post-Dive Procedures

On completion of decompression, a diver must remain awake for at least one hour in the company of a dive team member who is prepared to transport him/her to a hyperbaric chamber if necessary.

The diver(s) must not exceed an altitude or elevation 300 m (960 ft) above the dive site for 24 hours after completion of any decompression.

## **e. Incident and Accident Reports**

### Duties of Diver-In-Charge

The Diver-In-Charge of a diving operation shall notify the Diving Project Director and the DSO as soon as possible after the occurrence of any accidents or incidents involving the health and safety of diving personnel or the integrity of the environment, and shall complete and submit to the DSO a Departmental Incident & Hazard Report of such accident or incident within 48 hours of the occurrence.

### Scope

For the purposes of this manual, accidents and incidents warranting reporting shall include but not be limited to the following:

- Death
- Injury, including squeezes, lacerations, and fractures
- Convulsions, or serious impairment of consciousness during or after a dive
- Decompression sickness
- Dysbaric gas embolism, pneumothorax, subcutaneous emphysema or mediastinal emphysema
- Any serious illness which results from a diving operation
- Any serious mishap (entrapment, entanglement, etc.) even though the dive team member escapes actual injury, or any series of incidents prior to, during or after a diving operation which make approved procedures or equipment suspect
- Any serious mishap or series of incidents which threaten the integrity of the environment or the general health and safety of personnel

### Content of Report

The facts shall be established with care and recorded as soon after the accident or incident as possible. The report shall include the following information:

- The place, date and time of the accident or incident
- The names and duties of persons involved, including any injured
- The names of witnesses
- A detailed description of the accident or incident including the dive profile (as appropriate) and all relevant details, however remote
- A statement of the sequence of events which preceded the accident or incident
- Identification of any unsafe conditions, acts or procedures which contributed in any manner to the accident or incident
- Any further comments including (if appropriate) any corrective actions which might prevent similar accidents or incidents

### Disposition of Records

Copies of the report shall be kept on file in the University diving records for a period of 5 years. A copy of the report shall be forwarded by the DSO to the President of the Canadian Association for Underwater Science.

**APPENDIX 4**  
**The University of Victoria Diving Safety Program**  
**DIVING OPERATIONS FIRST AID KIT CONTENTS**

**LEVEL 1 FIRST AID KIT**

Except for blankets, these items must be kept in a container that can readily be taken to the scene of an injury. The container must be weatherproof if necessary to keep the items clean and dry. Blankets must be readily available to the first aid attendant.

- (3) blankets (space blankets okay)
- (24) 14 cm x 19 cm antiseptic towelettes, individually packaged
- (60) hand cleansing towelettes, individually packaged
- (100) sterile adhesive dressings, assorted sizes, individually packaged
- (12) 10 cm x 10 cm sterile gauze dressings, individually packaged
- (4) 10 cm x 16.5 cm sterile pressure dressings with crepe ties
- (2) 7.5 cm x 4.5 m crepe roller bandage
- (1) 2.5 cm x 4.5 m adhesive tape
- (4) 20 cm x 25 cm sterile abdominal dressings
- (6) cotton triangular bandages, minimum length of base 1.25 m
- (4) safety pins
- (1) 14 cm stainless steel bandage scissors
- (1) 11.5 cm stainless steel sliver forceps
- (12) cotton tip applicators
- (1) pocket mask with a one-way valve
- (6) pairs of latex gloves
- (1) first aid record book and pencil or pen

## **APPENDIX 5**

### **The University of Victoria Diving Safety Program**

#### **Recompression Chambers/Emergency Services**

Recompression chamber availability and emergency contact information are subject to change. Please confirm the active status and phone numbers for those facilities/services appropriate to your diving operations prior to each field season.

#### **Emergency Services in British Columbia**

- 911 on the telephone
- VHS radio channel 16 (PAN PAN, PAN PAN, PAN PAN, THIS IS A DIVING EMERGENCY)
- Vancouver General Hospital  
855 West 12th Ave  
Vancouver, B.C.  
24 hour number (604) 875-4111  
Direct Line to Hyperbaric Chamber (604) 875-4033
- D.A.N. Divers Alert Network (1-919-684-4DAN)

## APPENDIX 6

### CSA Air Purity Allowable Limits

**Table 1**  
**Allowable concentrations of components for compressed breathing air**  
**(by volume, measured at 21 °C (69.8°F) and 101.3 kPa (14.7 psia))**  
 (See Clauses 4.8.2, 4.9.1.1, 4.9.1.6, 4.9.3, 4.9.3.9.1, 4.9.3.10.1, 4.9.3.13, 4.9.3.14, A.7.1, A.7.3, and A.12.2, Table 7, and Figure C.2.)

Component	Allowable concentration
Oxygen	20–22%
Nitrogen and rare gases	78–80%
Carbon monoxide	≤ 3 mL/m <sup>3</sup> (ppm)
Carbon dioxide	≤ 600 mL/m <sup>3</sup> (ppm)
Methane	≤ 10 mL/m <sup>3</sup> (ppm)
Volatile non-methane hydrocarbons	≤ 5 mL/m <sup>3</sup> (ppm) as methane equivalents
Volatile halogenated hydrocarbons	≤ 5 mL/m <sup>3</sup> (ppm)
Oil, particulate, and condensates	≤ 1 mg/m <sup>3</sup>
Water — compressed breathing air pipelines or breathing apparatus at pressures less than 15.3 MPa (2216 psig)	The pressure dew point of compressed breathing air at pressures less than 15.3 MPa (2216 psig) shall be at least 5 °C (9°F) below the lowest temperature to which any part of the compressed breathing air pipeline or the breathing apparatus can be exposed during any time of the year at that geographic location. [Refer to Tables 3 and 4 for typical pressure dew point requirements from 344.8 to 2069 kPa (50 to 300 psig)]
Water — cylinders and piping at or above 15.3 MPa (2216 psig)	Compressed breathing air in cylinders and piping operating at pressures equal to or greater than 15.3 MPa (2216 psig) (a) shall have an atmospheric dew point not exceeding –53 °C (–63°F) or a water vapour concentration not exceeding 27 mL/m <sup>3</sup> (ppm) ± 10%; and (b) should have a pressure dew point not exceeding 5 °C (9°F) below the lowest temperature to which the cylinder or piping can be exposed during any time of the year at that geographic location (see Table 5).
Odour	Odour-free

**Notes:**

- (1) 1 mL/m<sup>3</sup> = 1 ppm by volume.
- (2) The values in this Table have been chosen to ensure the quality of compressed breathing air would be comparable to that of normal air (see Table 2).
- (3) Refer to the National Building Code of Canada for temperature conditions in Canada.

## APPENDIX 7

### Diver in Charge Field Check List

#### Documentation

- Project approval from DSO
- Divers clearance letters, log books and medicals
- Supervisor log
- Complete copy of DCIEM manual
- DAM plan including emergency number for evacuation, closest hospital, recompression chamber, rescue coordination centre, coast guard, DAN, as approved in the project approval by the DSO
- A copy of the UVic diving manual

#### Equipment

- Ability to communicate with emergency services (cell phone, radio, satellite phone)
- First aid kit
- O<sub>2</sub> kit with sufficient supply to last until EMS arrives
- A means for entering/exiting the water including a means for rescuing an incapacitated/injured diver
- A means to recall the divers
- Dive flag
- Personal dive gear
- Medic alert tags for each diver, worn when the diver leaves the dive site for 24h

#### Crew Briefing

The Diver in Charge must provide a crew briefing and risk assessment prior to each dive including the following;

- Assess the health and readiness of each diver
- Max depth for the dive and next greater
- Max time of the dive and time for next greater
- NOTE any diver with a RF>1.0 must have no-D limits, and planned EBT detailed within the dive plan.
- Current flow and change, tide times and environmental assessment
- Potential hazards including marine life
- Location of emergency equipment
- Diver recall signals
- Assessment of all divers equipment prior to descent
- Scope of work to be completed
- Lost diver procedures review