

# Scientific Diving and Snorkelling Technical Document

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*Disclaimer: This document has been written for Department of Conservation (DOC) staff. As a result, it includes DOC-specific terms and makes reference to internal documents that are only accessible to DOC staff. It is being made available to external groups and organisations to demonstrate Departmental best practice. As these procedures have been prepared for the use of DOC staff, other users may require authorisation or caveats may apply. Any use by members of the public is at their own risk and DOC disclaims all liability in reference to any risk. For further information, please email [scooper@doc.govt.nz](mailto:scooper@doc.govt.nz).*

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This technical document contains supporting information to the compulsory standards in the Scientific Diving onepage SOP ([DOCDM-743136](#)) or the Snorkelling onepage SOP ([DOCDM-750303](#)). It also includes recommendations and best practice that staff and managers must follow.

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## Contents

1.	Purpose	4
2.	Terminology and definitions	5
3.	General	10
3.1	Scientific diving standards	10
3.2	Operational control	12
3.3	Consequences of violation of regulations by scientific divers	14
4.	Scientific diver competencies	14
4.1	Competencies for scientific SCUBA divers	14
4.2	Competencies for restricted SCUBA divers	15
4.3	Competencies for snorkellers	15
4.4	Medical clearance	16
4.5	Certificate of Competence Occupational Diving – Scientific	16
4.6	Annual emergency drill test	18
4.7	Reciprocity	18
5.	Procedures for SCUBA diving (open circuit, compressed air)	19
5.1	Dive team roles and responsibilities	19
5.2	Pre-dive procedures	23
5.3	Diving procedures	26
5.4	Post-dive procedures	26
5.5	Ascending to altitude after diving, including flying	27
6.	Procedures for snorkelling	28
6.1	Snorkel team roles and responsibilities	28
6.2	Pre-snorkelling procedures	30
6.3	Snorkelling Procedures	30
7.	Diving and snorkelling equipment	31
7.1	Equipment for divers	32
7.2	Equipment for snorkellers	34
7.3	Equipment for surface support	35
7.4	Air quality standards	36
8.	Record keeping requirements	37
8.1	Record of diver and snorkeller certifications	37
8.2	Employee’s record of diving activity	37

8.3	DOC's record of diving activity	37
8.4	Maintenance of equipment record	38
8.5	Required incident reporting	38
9.	Diving activities requiring special considerations	39
9.1	Night diving	39
9.2	Diving at altitude	39
9.3	Diving in remote locations	40
9.4	Nitrox diving	40
9.5	Tethered diving	44
9.6	Surface supplied breathing apparatus (SSBA)	44
10.	Activities not permitted by DOC divers	46
10.1	Solo diving	46
10.2	Cave, cavern and wreck diving	47
10.3	Staged decompression diving	47
10.4	Mixed gas diving	47
10.5	Rebreathers	47
10.6	Other diving technology	47
11.	Related documents	47
11.1	Standards	47
11.2	Diving practice	48
11.3	Dive medicine	48
11.4	Forms and templates	48
11.5	US Navy Tables	50

# 1. Purpose

There are six categories of occupational diving: Construction, Aquaculture, Scientific, Film/Photographic, Recreational Instructor/Tutor and Tourism. Only Scientific Occupational Diving (and snorkelling) is covered by this technical document. Permission to undertake diving other than scientific diving (e.g., construction or aquaculture diving) under the auspices of the Department of Conservation (DOC) must be sought from the Department's Diving Control Board (DCB).

For the purposes of this technical document, the term 'scientific diving' includes diving using Self-Contained Underwater Breathing Apparatus (SCUBA) and Surface Supplied Breathing Apparatus (SSBA).

The purpose of the Scientific Diving and Snorkelling technical document is to ensure that all scientific diving and snorkelling under the jurisdiction of DOC is conducted in a manner that maximises protection of scientific divers and snorkellers from accidental injury and/or illness. It sets forth minimum standards for diver and snorkeller training, evaluation, and certification that are consistent with expectations of WorkSafe New Zealand and the furtherance of research and safety.

All scientific diving and snorkelling conducted under the auspices of DOC, including that undertaken by DOC employees, volunteers, visiting researchers and contractors, shall comply with the standards set forth in this technical document.

This technical document must be used in conjunction with the Scientific Diving SOP ([DOC-673798](#)) or the Snorkelling SOP ([DOC-673820](#)).

## 2. Terminology and definitions

**Air sharing**<sup>†</sup> - Sharing of an air supply between divers.

**AGE**<sup>†</sup> – Arterial Gas Embolism, or a bubble of gas that forms in an artery and blocks the flow of blood.

**ATA(s)**<sup>†</sup> - “Atmospheres Absolute”, Total pressure exerted on an object, by a gas or mixture of gases, at a specific depth or elevation, including normal atmospheric pressure.

**Bottom Time (BT)**\* – The total elapsed time from when a diver leaves the surface to the time (next whole minute) at which the final ascent to the surface is commenced, measured in minutes.

**Breath-hold Diving**<sup>†</sup> - A diving mode in which the diver uses no self-contained or surface-supplied air or oxygen supply.

**Buddy Breathing**<sup>†</sup> - Sharing of a single air source between divers.

**Buddy Diver**\* – A member of a group of two or three divers.

**Buddy System**<sup>†</sup> - Two comparably equipped scuba divers in the water in constant communication.

**Buoyant Ascent**<sup>†</sup> - An ascent made using some form of positive buoyancy.

**Burst Pressure**<sup>†</sup> - Pressure at which a pressure containment device would fail structurally.

**Certificate of Competence (CoC)** - a certificate issued by WorkSafe New Zealand that authorises the holder to dive in the category of diving in which the employee will be diving.

**Certified Diver**<sup>†</sup> - A diver who holds a recognised valid certification from an internationally recognised certifying agency.

**Competent Person**\* – A person who has acquired, through training, qualifications or experience (or a combination of these), the knowledge and skills enabling that person to safely perform a specified task.

**Compression (recompression) Chamber**\* – A pressure vessel at the surface designed and equipped for human occupancy which enables persons to be subjected to increased pressure for therapeutic, recompression or training purposes.

**Controlled Ascent**<sup>†</sup> - Any one of several kinds of ascents including normal, swimming, and air sharing ascents where the diver(s) maintain control so a pause or stop can be made during the ascent.

**Cylinder**<sup>†</sup> - A pressure vessel for the storage of gases.

**Decompression Illness (DCI)**\* – Term used to describe injuries or illness related to breathing compressed gases. This includes AGE and DCS.

**Decompression Sickness (DCS)**<sup>†</sup> - A condition with a variety of symptoms, which may result from gas, and bubbles in the tissues of divers after pressure reduction.

**Decompression Stop**\* – The specific length of time that a diver must spend at a specified depth to allow for the elimination of sufficient inert gas from the body to allow safe ascent to the next decompression stop or the surface.

**Dive**<sup>†</sup> - A descent into the water, an underwater diving activity utilizing compressed gas, an ascent, and return to the surface.

**Dive Computer**<sup>†</sup> - A microprocessor based device which computes a diver's theoretical decompression status, in real time, by using pressure (depth) and time as input to a decompression model, or set of decompression tables, programmed into the device.

**Dive Coordinator**\* - A person who supervises and coordinates any dive and is responsible for dive team safety.

**Dive Leader**\* - A person in charge of a specific part of a diving operation.

**Dive Plan** – a pre-dive briefing to ensure all involved in the dive operation are aware of the intended activities, intended depths and durations, individual roles and responsibilities, and the contents of the Dive Proposal and Safety Plan.

**Dive Proposal** – a document prepared by the Dive Coordinator that outlines the intended dive operation, including the roles of the dive team, intended activities, dive location, depth and durations.

**Dive Site**<sup>†</sup> - Physical location of a diver during a dive.

**Dive Table**<sup>†</sup> - A profile or set of profiles of depth-time relationships for ascent rates and breathing mixtures to be followed after a specific depth-time exposure or exposures.

**Diver**\* - A person who performs diving work underwater and who, for the purposes of this technical document, is trained and experienced as a scientific diver.

**Diver-Carried Reserve Breathing Gas**<sup>†</sup> - A diver-carried independent supply of air or mixed gas (as appropriate) sufficient under standard operating conditions to allow the diver to reach the surface, or another source of breathing gas, or to be reached by another diver.

**Diving Control Board (DCB)**<sup>†</sup> - Group of individuals who act as the official representative of the Department in matters concerning the scientific diving programme (see Section 3.2.1).

**Diving Mode**<sup>†</sup> - A type of diving requiring specific equipment, procedures, and techniques, for example, snorkel, scuba, surface-supplied air, or mixed gas.

**Diving Safety Officer (DSO)**<sup>†</sup> - Individual responsible for the safe conduct of the Department's scientific diving programme.

**EAD**<sup>†</sup> - Equivalent Air Depth (see below).

**Emergency Ascent**<sup>†</sup> - An ascent made under emergency conditions where the diver exceeds the normal ascent rate.

**Enriched Air (EANx)**<sup>†</sup> - A name for a breathing mixture of air and oxygen when the percent of oxygen exceeds 21%. This term is considered synonymous with the term "nitrox".

**Equivalent Air Depth (EAD)**<sup>†</sup> - Depth at which air will have the same nitrogen partial pressure as the nitrox mixture being used. This number, expressed in units of feet seawater or saltwater, will always be less than the actual depth for any enriched air mixture.

**fN<sub>2</sub>**<sup>†</sup> - Fraction of nitrogen in a gas mixture, expressed as either a decimal or percentage, by volume.

**fO<sub>2</sub>**<sup>†</sup> - Fraction of oxygen in a gas mixture, expressed as either a decimal or percentage, by volume.

**FFW**<sup>†</sup> – Feet of freshwater, or equivalent static head.

**FSW**<sup>†</sup> - Feet of seawater, or equivalent static head.

**Hookah**<sup>†</sup> - While similar to Surface Supplied in that the breathing gas is supplied from the surface by means of a pressurised hose, the supply hose does not require a strength member, pneumofathometer hose, or communication line. Hookah equipment may be as simple as a long hose attached to a

standard scuba cylinder supplying a standard scuba second stage. The diver is responsible for the monitoring his/her own depth, time, and diving profile.

**Hyperbaric Chamber** - See compression chamber.

**Hyperbaric Conditions**<sup>†</sup> - Pressure conditions in excess of normal atmospheric pressure at the dive location.

**Lead Diver**<sup>†</sup> - Certified scientific diver with experience and training to lead the diving operation.

**Lifeline** – A line attached to a diver which is capable of being used to haul the diver to the surface. This may be a cordage line, a combined communications/cordage line, a diver's hose or umbilical.

**Maximum Working Pressure**<sup>†</sup> - Maximum pressure to which a pressure vessel may be exposed under standard operating conditions.

**Medical clearance** - issued by the Diving Hyperbaric Medicine Services, stating the diver's medical fitness to perform underwater work; valid for 12 months.

**Medical examination** - an examination carried out by a designated diving doctor in accordance with AS/NZS 2299 – Part 1.

**Mixed Gas** – breathing gas mixtures containing proportions greater than 1% by volume of an inert gas other than nitrogen.

**MOD**<sup>†</sup> - Maximum Operating Depth, usually determined as the depth at which the pO<sub>2</sub> for a given gas mixture reaches a predetermined maximum.

**MBIE** – Ministry of Business, Innovation, and Employment

**MSW**<sup>†</sup> - Meters of seawater or equivalent static head.

**Nitrox**<sup>†</sup> - Any gas mixture comprised predominately of nitrogen and oxygen, most frequently containing between 21% and 40% oxygen. Also be referred to as Enriched Air Nitrox, abbreviated EAN.

**No-Decompression limits (nDL)**<sup>†</sup> - Depth-time limits of the “no-decompression limits and repetitive dive group designations table for no-decompression air dives” of the U.S. Navy Diving Manual or equivalent limits.

**Normal Ascent**<sup>†</sup> - An ascent made with an adequate air supply at a rate of 30 feet per minute or less.

**Occupational diving**\* - diving performed in the course of employment for gain or reward (irrespective of whether or not diving is the principal function of employment or merely an adjunct to it) and comprising all diving as carried out as part of a business; as a service; for research; or for profit.

**Oxygen Clean**<sup>†</sup> - All combustible contaminants have been removed.

**Oxygen Compatible**<sup>†</sup> - A gas delivery system that has components (o-rings, valve seats, diaphragms, etc.) that are compatible with oxygen at a stated pressure and temperature.

**Oxygen Service**<sup>†</sup> - A gas delivery system that is both oxygen clean and oxygen compatible.

**Oxygen Toxicity**<sup>†</sup> - Any adverse reaction of the central nervous system (“acute” or “CNS” oxygen toxicity) or lungs (“chronic”, “whole-body”, or “pulmonary” oxygen toxicity) brought on by exposure to an increased (above atmospheric levels) partial pressure of oxygen.

**PCBU** - means a Person Conducting a Business or Undertaking whether the person conducts a business or undertaking alone or with others. In other words, where the Department engages a contractor for diving both are PCBUs and have a duty to consult, cooperate and collaborate with each other

**Pressure-Related Injury**<sup>†</sup> - An injury resulting from pressure disequilibrium within the body as the result of hyperbaric exposure. Examples include: decompression sickness, pneumothorax, mediastinal emphysema, air embolism, subcutaneous emphysema, or ruptured eardrum.

**pN<sub>2</sub>**<sup>†</sup> - Inspired partial pressure of nitrogen, usually expressed in units of atmospheres absolute.

**pO<sub>2</sub>**<sup>†</sup> - Inspired partial pressure of oxygen, usually expressed in units of atmospheres absolute.

**Psi**<sup>†</sup> - Unit of pressure, “pounds per square inch.

**Psig**<sup>†</sup> - Unit of pressure, “pounds per square inch gauge.

**Rebreather**<sup>†</sup> – When the breathing gas is recycled through the breathing loop. The breathing loop maybe fully or partially closed.

**Recompression Chamber** - see compression chamber.

**Repetitive Dive** – Any dive conducted within 12 hours of a previous dive, as defined by the US Navy dive tables.

**Residual Nitrogen**\* – Nitrogen that is still dissolved in a diver’s body tissues after the diver has surfaced.

**Scientific Diving**\* - Scientific diving is defined (AS/NZS 229.2.2002) as diving performed for the purpose of professional scientific research, natural resource management or scientific research as an educational activity. Also includes training dives for the purpose of maintaining scientific diving capability and certification.

**Self-contained Underwater Breathing Apparatus (SCUBA)**\* – Open-circuit diving equipment that supplies the wearer with breathing gas from cylinders carried by the wearer.

**Snorkeller**<sup>†</sup> - any person who is wholly or partially submerged in water and is equipped with a face mask and snorkel, with or without swim fins.

**Standby Diver**<sup>†</sup> - A diver at the dive location capable of rendering assistance to a diver in the water.

**Surface Interval (SI)**\* – The time which a diver has spent on the surface following a dive, beginning as soon as the diver surfaces and ending upon commencement of the diver’s next decent.

**Surface Marker Buoy (SMB)** – A buoyant line connecting the diver to a highly visible float on the surface of the water, enabling the approximate location of the diver to be known at all times.

**Surface-supplied Breathing Apparatus (SSBA)**\* – Diving equipment that supplies breathing gas at the required pressure for depth, through a diver’s hose to a diver from plant at a surface.

**Swimming Ascent**<sup>†</sup> - An ascent, which can be done under normal or emergency conditions, accomplished by simply swimming to the surface.

**Tethered mode**\* – Scuba diving in which a diver is secured by a lifeline and tended by a diver’s attendant, or is secured to a tended float line.

**Umbilical**<sup>†</sup> - Composite hose bundle between a dive location and a diver or bell, or between a diver and a bell, which supplies a diver or bell with breathing gas, communications, power, or heat, as appropriate to the diving mode or conditions, and includes a safety line between the diver and the dive location.

**Volunteer diver** – a person in a place of work who is not receiving any gain or reward (includes payment or other services, e.g. a free trip, in return for providing work) for the diving activity taking place. Does not include those receiving training or gaining work experience.



**Worker** - an individual who carries out work in any capacity for a PCBU, amongst others includes work as an employee, a contractor, an employee of a contractor, a person gaining work experience or undertaking a work trial, or a volunteer

**Working Pressure**<sup>†</sup> - Normal pressure at which the system is designed to operate.

\* Definition from AS/NZS 2299.2:2002 Occupational Diving Operations Part 2: Scientific Diving;

† Definition from American Academy of Underwater Sciences Standards for Scientific Diving 2013;

‡ Definition from AS/NZS 2299.3:2003 Occupational Diving Operations Part 3: Recreational Industry Diving and Snorkelling Operations.

# 3. General

## 3.1 Scientific diving standards

### **3.1.1 Purpose**

The purpose of the Scientific Diving and Snorkelling technical document is to ensure that all scientific diving and snorkelling under the jurisdiction of DOC is conducted in a manner that will maximise protection of scientific divers and snorkellers from accidental injury and/or illness. Fulfilment of the purposes shall be consistent with the furtherance of research and safety.

This document sets minimum standards for the establishment of the DOC scientific diving and snorkelling programme, the organisation for this programme, and the basic regulations and procedures for safety in scientific diving and snorkelling operations.

All scientific diving and snorkelling conducted under the auspices of DOC shall comply with the standards set forth in this technical document.

This technical document compiles best practice examples set forth in:

- AS/NZS 2299.1:2015 Occupational Diving Operations Part 1: Standard Operational Practice;
- AS/NZS 2299.2:2002 Occupational Diving Operations Part 2: Scientific Diving;
- AS/NZS 2299.3:2003 Occupational Diving Operations Part 3: Recreational Industry Diving and Snorkelling Operations;
- AS 2815 Training and Certification of Occupational Divers;
- AS 3848 Filling of Portable Gas Cylinders;
- Health and Safety in Employment Regulations 1995;
- WorkSafe New Zealand Guidelines for Occupational Diving 2004;
- American Academy of Underwater Sciences Standards for Scientific Diving 2013;
- NOAA (2011) Scientific Diving Standards and Safety Manual;
- Defence and Civil Institute of Environmental Medicine (DCIEM) Diving Manual - Part 1: Air Decompression Procedures and Tables;
- US Navy Diving Manual Revision 6 2008 (SS521-AG-PRO-010).

### **3.1.2 Scientific diving definition**

Scientific diving (and snorkelling) is defined (according to AS/NZS 2299.1:2015) as diving performed for the purpose of professional scientific research, natural resource management or scientific research as an educational activity.

Examples of scientific diving and snorkelling activities include:

- A survey of marine life distribution within a marine reserve;
- A survey for exotic aquatic organisms on a lakebed or in a coastal environment.

Examples of activities that are not scientific diving or snorkelling include:

- Installing, checking and maintaining moorings;
- Filming for a television documentary or media purposes.

### **3.1.3 Department of Conservation auspices defined**

All diving and snorkelling performed by individuals necessary to, and part of, a scientific, research, monitoring or educational activity in conjunction with a project, study or contract under the jurisdiction of DOC shall be considered scientific diving or snorkelling, and these individuals shall be considered workers. These workers include:

- DOC employees (permanent or temporary) or volunteers, where such persons are acting within their official capacity, or are engaged otherwise in DOC scientific diving or snorkelling operations;
- Volunteers where they are acting on agreement with DOC to undertake scientific diving or snorkelling;
- Individuals from other PCBUs such as contractors and auxiliary organisations who are engaged in scientific diving or snorkelling operations under DOC auspices;

This shall include diving or snorkelling activities that involve DOC-owned, purchased, rented, chartered, or otherwise provided facilities, equipment, or supplies. This includes the use of equipment, vessels, compressors or motor vehicles used in operational support of diving or snorkelling objectives.

### **3.1.4 Scientific diving compliance**

The following are required as part of the DOC diving programme:

- All Departmental diving must comply with AS/NZS 2299.2:2002.
- A Scientific Diving and Snorkelling technical document, which includes procedures covering all diving operations specific to the programme, including procedures for emergency care, recompression and evacuation, and criteria for scientific diver certification;
- Diving Control Board, responsible for the administration of the Department's diving programme;
- Diving Safety Officer, who serves to administer the Scientific Diving and Snorkelling technical document.

All diving and snorkelling is voluntary; that is, any worker may refuse to dive or snorkel at anytime without concern or penalty, for example, if the worker feels the conditions or procedures are unsafe, or the worker considers they are not fit or are unwell, or do not possess adequate training or experience for the diving or snorkelling operations.

### **3.1.5 Waiver of requirements**

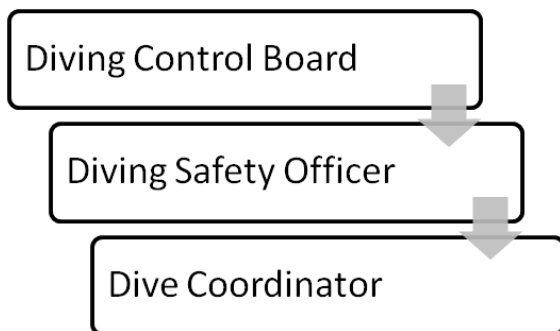
Where there is good reason or extenuating circumstances, the DCB may grant a waiver for specific requirements of the Scientific Diving and Snorkelling technical document on a case-by-case basis, and will keep a record of these waivers to ensure consistency, accountability and transparency.

### 3.1.6 Review of diving technical document

This technical document shall be reviewed annually by the Diving Safety Officer to ensure that it aligns with WorkSafe NZ requirements and industry best practice.

## 3.2 Operational control

Operational control of Departmental diving and snorkelling is overseen by a three-tier chain of command. At the highest level, the Diving Control Board (DCB) has autonomous and absolute authority over the Department's scientific diving and snorkelling programme and determines the standards and procedures outlined within the Department's Scientific Diving and Snorkelling technical document. Reporting to the DCB, the Diving Safety Officer (DSO) administers the Scientific Diving and Snorkelling technical document and ensures compliance of Departmental diving operations with the technical document. Reporting to the DSO, the Dive Coordinator acts as on-site coordinator ensuring that diving and snorkelling operations are conducted in a safe manner and that local diving and snorkelling operations are compliant with the Scientific Diving and Snorkelling technical document.



### 3.2.1 Diving Control Board (DCB)

The Diving Control Board (DCB) shall consist of a majority of active scientific divers and must include the DSO and Scientific Diving and Snorkelling SOP owner. The DSO will not be a voting member of the DCB. A list of current DCB members and terms of reference for the DCB can be found here, [DOC-2776932](#). A chairperson shall, and a secretary may, be chosen from the membership of the board. The DCB:

- Has authority over the scientific diving and snorkelling programme's operation;
- Shall review and revise this technical document;
- Shall appoint a Diving Safety Officer (DSO) to administer the Department's diving and snorkelling programme;
- Shall act as a board of appeal to consider diver-related problems;
- Shall suspend diving or snorkelling programmes that are considered to be unsafe or unwise;
- Shall suspend any persons from diving or snorkelling who are considered to be unsafe, inexperienced or do not comply with the requirements set out in this technical document;
- Shall recommend new equipment or techniques;
- Shall establish and/or approve facilities for the inspection and maintenance of diving and associated equipment;

- Shall periodically review the Diving Safety Officer's performance and programme;
- Shall support ICAM investigators in investigation into the nature and cause of diving or snorkelling accidents or violations of this technical document.

### **3.2.2 Diving Safety Officer (DSO)**

The Diving Safety Officer (DSO) shall be appointed by the DCB and will serve as a non-voting member of the DCB. The DSO should have broad technical and scientific expertise in research related diving and snorkelling.

#### **3.2.2.1 Qualifications**

- Shall be an experienced diver with qualifications set out in Section 4.1 and with experience appropriate to the type of diving and snorkelling operations undertaken;
- Shall have a minimum of 200 logged scientific dives;
- Shall be an active member of the Divers Alert Network ([www.diversalertnetwork.org](http://www.diversalertnetwork.org)) and/or American Academy of Underwater Scientists (<https://secure.aaus.org/>).

#### **3.2.2.2 Duties and responsibilities**

- Shall be responsible through the DCB to the SOP owner, for the conduct of the Department's scientific diving and snorkelling programme. The routine operational authority for this programme, including the conduct of training and certification, approval of dive and snorkelling plans, maintenance of diving records, and ensuring compliance with this technical document and all relevant regulations of the Department, rests with the DSO;
- Shall assess applications of reciprocity for visiting scientists and non-DOC personnel to dive or snorkel under the auspices of the Department;
- Shall determine the eligibility of non-CoC divers to dive under the auspices of the Department as restricted divers;
- May permit portions of this programme to be carried out by a qualified delegate, although the DSO may not delegate responsibility for the safe conduct of the diving and snorkelling programme;
- Shall be guided in the performance of the required duties by the instruction of the DCB, but operational responsibility for the conduct of the diving and snorkelling programme will be retained by the DSO;
- Shall keep up-to-date with the latest standards of practice for training, equipment and diving procedures via maintaining current membership with the Divers Alert Network ([www.diversalertnetwork.org](http://www.diversalertnetwork.org)) and American Academy of Underwater Scientists (<https://secure.aaus.org/>).
- Shall suspend diving or snorkelling operations considered unsafe or unwise until they can be reviewed by the DCB.

#### **3.2.3 SOP owner**

The SOP owner serves as a member of the DCB and is accountable for:

- Keeping on file (electronic is acceptable) completed annual check forms for the technical document and other documents owned by the work area;

- Ensuring the technical document, SOPs and templates are up to date;
- If required, gaining approval from the Senior Leadership Team for changes to the technical document;
- Informing the network of people in the work area about any changes to the technical document;
- Keeping up to date with wider issues that may affect the SOPs or technical documents;
- Acting as the official representative of the Department in matters concerning the scientific diving and snorkelling programme.

### 3.3 Consequences of violation of regulations by scientific divers

Failure to comply with the regulations of the Scientific Diving and Snorkelling technical document may be cause for the restriction of the diver or snorkeller in undertaking scientific diving or snorkelling for the Department as determined by the DCB.

## 4. Scientific diver competencies

All competency training and assessment records must be kept up-to-date in DOCLearn (see Section 8).

### 4.1 Competencies for scientific SCUBA divers

To be competent to undertake SCUBA diving activities under the auspices of DOC, the person must retain currency for the following competencies:

- A current Medical Clearance for Occupational Diving (see Section 4.4.1);
- Certificate of Competence for Occupational Diving – Scientific (see Section 4.5);
- A current First Aid certificate;
- A current oxygen First Aid Certificate;
- Annual Emergency Drill Test (see Section 4.6).

This competency is valid until any of its elements expire at which time persons are not permitted to undertake scientific SCUBA diving activities for the Department until their expired competencies have been renewed.

To be considered an active scientific diver, divers must also log a minimum of 12 scientific dives every two years.

#### **4.1.1 *Optional competencies for scientific SCUBA divers***

- Approved fillers certification;
- Nitrox certification.

While optional for diving, these certifications are required in order to fill cylinders or use nitrox.

## 4.2 Competencies for restricted SCUBA divers

The restricted scientific diver category (as specified under Section 48 of the Health & Safety in Employment Regulations 1995 and Appendix A4 of AS/NZS2299.2.2002) is specifically for persons who are involved in research requiring SCUBA diving but do not meet the competencies for DOC scientific divers detailed in Section 4.1. A person may only dive as a restricted diver for a single initial period of up to 12 months while they are training to become a holder of a certificate of competence for scientific diving.

As a minimum, a restricted scientific diver is required to maintain currency for the following competencies:

- A current Medical Clearance for Occupational Diving (see Section 4.4.1);
- Rescue diver qualification from a recognised SCUBA training and certifying organisation;
- A current First Aid certificate;
- A current Oxygen First Aid Certificate;
- Annual Emergency Drill Test for SCUBA divers (see Section 4.6).

A restricted diver must:

- Be at least 18 years of age;
- Have at least 50 logged dives of underwater experience;
- Not dive using surface-supplied breathing apparatus (SSBA) equipment;
- Not dive deeper than 18 m depth;
- Not act as a standby diver or a dive leader;
- Not use lift bags;
- Not undertake tethered diving;
- Dive under the direct supervision of another diver who holds a certificate of competence, where direct supervision means within reach, or visual contact to ensure immediate assistance can be provided in the event of an emergency. A diver who holds a certificate of competence may not supervise more than one restricted diver at a time.

This competency is valid until any of its elements expire at which time persons are not permitted to undertake restricted diving activities for the Department until their expired competencies have been renewed.

## 4.3 Competencies for snorkellers

To be competent to undertake snorkelling activities, the person must retain currency for the following competencies:

- A current Recreational dive medical or higher (see Section 4.4.2);
- A current First Aid certificate;
- Annual Emergency Drill Test for snorkellers (see Section 4.6).

This competency is valid until any of its elements expire at which time persons are not permitted to undertake snorkelling activities for the Department until their expired competencies have been renewed.

To be considered an active snorkeller, snorkellers must undertake a minimum of 12 snorkelling activities every two years.

## 4.4 Medical clearance

### **4.4.1 For SCUBA diving activities**

All persons undertaking SCUBA diving activities under the auspices of DOC must undergo a full diving medical examination every 5 years, or as determined by the Diving Medical Consultant (DMC). The full diving medical examination must be carried out by a Designated Diving Doctor (DDD) using the form in Section 11.4.2.

The completed medical examination results must be forwarded within 28 days to Diving and Hyperbaric Medical Services (PO Box 32139, Devonport, Auckland). If deemed unfit to dive, the DMC will request further evaluation by an appropriate medical specialist.

During the interim four-year period, an Occupational Diver Medical Assessment Questionnaire must be completed annually by the diver. This questionnaire is part of the medical assessment of fitness for occupational diving. It is regarded by WorkSafe New Zealand as an acceptable assessment for medical clearance of occupational divers provided a full medical examination is completed every 5 years (or as determined by the DMC). This meets the requirement of AS/NZS 2299 Part 1 2015 as well as the Health and Safety in Employment Regulations (regulation 49). The questionnaire can be filled in online, here: [www.divemedical.co.nz](http://www.divemedical.co.nz)

### **4.4.2 For snorkelling activities**

All persons undertaking snorkelling activities under the auspices of DOC must complete and pass a medical assessment as an indication of their medical fitness. It is strongly recommended that regular snorkellers (i.e., those snorkelling on an annual basis) undertake a full occupational diving medical examination as outlined in Section 4.4.1.

Alternatively, those who snorkel less regularly can complete a recreational diving medical using the form found here (<http://www.padi.com/english/common/courses/forms/pdf/10063-ver2-0.pdf>). Recreational dive medicals must be completed annually.

### **4.4.3 Injury or illness**

No person shall be permitted to dive for the duration of any known condition that is likely to adversely affect their health and safety or the health and safety of other team members. Clearance to return to diving or snorkelling must be obtained from a physician following any major injury or illness, or any condition requiring hospital care. If the injury or illness is pressure related, then the clearance to return to diving must come from a physician trained in diving medicine.

## 4.5 Certificate of Competence Occupational Diving – Scientific

A Certificate of Competency (CoC) for Scientific diving is required by any diver undertaking scientific SCUBA diving for the Department, unless they are classed as a restricted scientific diver (see Section



4.2). Other forms of restricted CoC (e.g., construction, aquaculture or film & photographic) are not acceptable for scientific diving.

The CoC is issued by WorkSafe NZ and requires renewal every 5 years. The document AS/NZS 2815.6 Training and Certification of Occupational Divers – Part 6 Restricted Occupational SCUBA Diver, details the training competencies required for obtaining a CoC. This includes formal training in:

- Diving Physics;
- Dive planning, including risk assessment, hazard identification and control;
- Accident management;
- Compression chamber theory;
- Air management and out of air procedures;
- Navigation and search techniques;
- Night, limited visibility and deep diving;
- Rescue operations.

If a diver is unable to meet the competencies as per AS/NZS 2815.6 they are unlikely to be issued a CoC by WorkSafe NZ. A CoC only remains valid while an occupational diving medical clearance is held.

The Dive Safety Officer or delegate will assess new Departmental divers and has the authority to restrict any diver if they have concerns about the diver's competency, including lack of recent or relevant experience, irrespective of whether or not they hold a current CoC.

#### ***4.5.1 Application procedure for CoC certification***

Divers wishing to apply for a scientific diving CoC are required to submit the following to WorkSafe NZ:

- Completed application for diving certification of competency form (see Section 11.4.1);
- Up-to-date Dive Medical Clearance from Diving Hyperbaric Medicine Services that is less than 6 months old (see Section 11.4.2);
- Current up-to-date dive log book;
- Letter of support as a scientific diver from the DSO;
- Evidence of scientific diver training from a recognised training provider (e.g., NIWA).

#### ***4.5.2 Renewal of CoC certification***

Existing CoCs will be renewed under criteria determined by WorkSafe NZ subject to an assessment being made of the applicant's relevant training, qualifications, and work experience.

The assessment process will be carried out by the WorkSafe NZ National Diving Coordinator and, where necessary, will be subject to a validation process to ensure consistency and fairness.

CoCs are required to be renewed prior to expiry and any expired CoCs will be treated as a new application. ANY DOC DIVERS WITH A CURRENT COC SHOULD NOT LET IT LAPSE. It is recommended that renewal applications are lodged at least 2 months prior to expiry.

The application procedure for a renewal of a scientific diver CoC is the same as for a new application, see Section 4.5.1.

## 4.6 Annual emergency drill test

All SCUBA divers must be judged to have successfully completed an annual emergency drill test by an assessor approved by the DCB. The assessment must be recorded on the Annual emergency drill test log ([DOC-2547088](#)) and kept for 7 years.

All SCUBA divers must demonstrate proficiency in the following:

- Assembly of equipment, pre-dive safety checks and water entry;
- Removal and replacement of SCUBA equipment at surface;
- Ability to remove, replace and clear mask while submerged;
- Regulator recovery and clearing;
- Removal and replacement of SCUBA equipment at bottom without leaving the bottom;
- Ability to achieve and maintain neutral buoyancy while submerged;
- Air sharing, including both buddy breathing and the use of an alternate air source, as both donor and recipient, with and without a face mask;
- The deployment of a surface marker buoy (SMB) from a minimum of 5 m depth;
- Diver rescue from a minimum of 5 m depth and towing for a minimum of 50 m.

All snorkellers must demonstrate proficiency in the following:

- Ability to remove, replace and clear mask at the surface;
- A method of snorkel clearing;
- Weight belt removal and replacement at surface;
- Duck dive to 2 metres and retrieve an item from that depth;
- Rescue procedures for a snorkeller who has suffered blackout;
- An inert diver tow. That is, in less than 5 minutes, tow or push another snorkeller a distance of 50 metres.

With approval of the DSO, emergency drills can be assessed by persons who meet any one of the following criteria:

- Dive instructor;
- Dive master (PADI, or equivalent for other organization);
- Scientific divers who meet the requirements of Section 4.1 and have a minimum of 200 logged dives.

## 4.7 Reciprocity

Applications for reciprocity shall be made directly to the DSO and will be assessed on a case-by-case basis. The DSO may also request an in-water assessment of a diver or snorkeller's skills before reciprocity is granted. The DSO may also require divers that are granted reciprocity to dive under the requirements for restricted divers as outlined in Section 4.2. Waivers to reciprocity requirements may be assessed on a case-by-case basis by the DCB.

#### **4.7.1 Visiting scientific divers from overseas**

On occasions, visitors from overseas (such as visiting scientists) may wish to be involved in diving or snorkelling work with the Department and therefore should be considered workers. It must be noted that workplace Health and Safety Regulations apply to them as well as any other occupational diver or snorkeller. Therefore, they will need to present satisfactory documentary evidence of qualifications to the DSO. Such evidence shall include but not be limited to a letter or certificate from their home organisation diving officer, diver's logbooks and a current medical certificate of fitness to dive that meets or exceeds the requirements of a full occupational medical evaluation as outlined in Section 4.1. As a minimum, visiting scientific divers from overseas must meet the requirements for a restricted diver as outlined in Section 4.2.

#### **4.7.2 Non-DOC personnel working on DOC-led dive projects**

This includes contracted and volunteer divers and snorkellers, although these are still considered workers. If a diver can demonstrate they meet the competencies listed in Section 4.1 then they may be granted reciprocity to dive under DOC dive and health and safety plans. Alternatively, non-DOC personnel can dive under the auspices of the Department if they meet the requirements for a restricted diver as outlined in Section 4.2. If a snorkeller can demonstrate they meet the competencies listed in Section 4.3 then they may be granted reciprocity to snorkel under DOC dive and H&S plans

#### **4.7.3 Diving operations run by contractors on behalf of DOC**

Contractors may run diving operations for DOC if they satisfy the DSO that diving operations will be conducted in accordance with AS/NZS 2299.2:2002. The dive coordinator will need to provide a dive safety technical document, a comprehensive risk assessment, evidence of appropriate training and current qualifications, and any other requested documentation to the DSO prior to the commencement of diving operations.

## **5. Procedures for SCUBA diving (open circuit, compressed air)**

### **5.1 Dive team roles and responsibilities**

At a minimum, the following roles must be filled within a dive team:

- One Dive Coordinator;
- Two diver team members, one of which is the Dive Leader;
- One surface Divers Attendant;
- One Standby Diver.

The Dive Coordinator may act either as the divers' attendant, dive leader or as a diver. The two buddy divers can act as standby diver for each other, in accordance with the conditions noted in Section 5.1.5. Thus, the minimum dive team for diving operations is THREE, one of who shall remain at the surface at all times and fulfil the roles of divers' attendant and Dive Coordinator.

If the Dive Coordinator enters the water, then the duties of the Dive Coordinator shall be formally transferred to another person who shall remain at the surface and is competent to recognise and manage diving emergencies (i.e., in all cases there is a Dive Coordinator at the surface). Formal transfer shall involve the outgoing Dive Coordinator briefing the new Dive Coordinator on the status of the diving operation, conditions, and potential hazards, with acknowledgement from the new Dive Coordinator that they are now taking over.

When diving operations involve more than two divers, the divers shall dive in pre-arranged groups of either two or three divers (these become dive buddies), but no more. Before divers enter the water, one member of each group of divers shall be designated dive leader for that group.

Dive buddies shall maintain effective two-way communications with each other at all times and shall be able to render assistance to one another if needed.

All dive team members must comply with the procedures in this technical document.

### **5.1.1 Dive Coordinator**

The Dive Coordinator acts as on-site coordinator and shall ensure that all diving operations are conducted in a safe manner. The Dive Coordinator must be an experienced diver with the qualifications and experience appropriate to the type of diving operation to be performed and must be able to recognise and manage diving emergencies. They must also be familiar with any legislative requirements that may be applicable to the diving operations. The Dive Coordinator's roles and responsibilities include:

- Ensuring that all requirements of this technical document are adhered to;
- Preparing and submitting the Dive Proposal and Safety Plan to the DSO ([divesafetyofficer@doc.govt.nz](mailto:divesafetyofficer@doc.govt.nz)), the Manager(s) of all team members, and the Operations Manager for the DOC District in which the work is occurring (see Section 5.3);
- Ensuring that all dives are planned according to US Navy tables (see Section 11.5);
- Ensuring that the divers are physically fit and have current certification to dive, including a current CoC and medical clearance (see Section 4 for all relevant competencies);
- Ensure hardcopies of diver certifications, the dive proposal and the safety plan are kept onsite for the duration of all diving activities;
- Ensuring surface support (e.g., vessel master, diver's attendant, Dive Coordinator) is adequately trained and resourced to identify and respond to emergency situations;
- Ensuring that all involved in the dive operation are familiar with the contents of the Dive Proposal and Safety Plan;
- Ensuring that conditions are safe for diving and to terminate the dive at any stage if it is deemed that conditions are unsafe;
- Complying with instructions from the relevant Operations Manager;
- Appointing a dive leader and dive attendant(s) as required;
- Ensuring that all 'pooled' diving and safety equipment at the dive site (e.g. tanks, oxygen kit, dive flag) is "fit for purpose";
- Scheduling and directing diving operations, including briefing the dive team and surface personnel on the dive plan, hazard management and emergency procedures;
- Keeping an accurate record of all dives using the Daily Dive/Snorkel Log ([DOC-2313398](#));

- Keeping an accurate record associated with any dive accident that may occur;
- Refusing any diver under their supervision to dive if deemed necessary;
- Signing off divers' personal log books;
- Ensuring dive team members sign daily dive log sheets;
- Ensuring that non-personal diving equipment is regularly serviced and is washed, dried and stowed in a clean, dust-free environment.

### **5.1.2 Dive Leader**

The Dive Leader, appointed by the Dive Coordinator, has operational responsibility for a dive. This responsibility may be undertaken by the Dive Coordinator. The Dive Leader will:

- Ensure other buddy diver(s) in the group are familiar with the pre-dive plan;
- Conduct the dive in accordance with this technical document and, as far as possible in accordance with the pre-dive plan.

### **5.1.3 Dive team members**

Divers will operate under the instructions of the Dive Coordinator/Dive Leader. The roles and responsibilities of all divers include:

- Ensuring they are trained, experienced and certified in diving to competency levels appropriate for the diving operation as set out in Section 4;
- Ensuring they are proficient in the use of US Navy dive tables (see Section 11.5);
- Maintaining suitable fitness and preparation for the diving activity;
- Ensuring that they have not consumed any intoxicants within 8 hours prior to diving;
- Not diving under the influence of any intoxicants that may impair their mental or physical capabilities;
- Completing, before each dive, a check of their equipment and that of their buddy, to ensure that all equipment is present, properly secured and functioning correctly;
- Ensuring that they are familiar with and dive in accordance with the Dive Proposal and Safety Plan;
- Acting as a buddy diver during the dive to others in their designated buddy group;
- Maintaining effective communication with other buddy divers and be able to render assistance if required;
- Reporting, immediately, any equipment malfunction, accident, injury or illness or hazard to the Dive Coordinator and dive buddy;
- Reporting immediately to the Dive Coordinator any variation in normal feeling of health and fitness;
- Recording all their dives, including recreational dives, in their dive log and having their dives signed by the Dive Coordinator;
- Ensuring that their personal diving equipment is regularly serviced and is washed, dried and stowed in a clean, dust-free environment.

### **5.1.4 Diver's Attendant**

One or more Diver's Attendants must be appointed when there are divers in the water, including tethered divers. The Diver's Attendant may be the Standby Diver or the boat skipper or crew. The Attendant must:

- Record the time of entry and exit of each diver;
- Maintain a constant lookout during diving operations for divers surfacing;
- Assist in the recovery of divers and all equipment and samples from the water;
- Hold current First Aid and Oxygen First Aid certifications;
- If tending a diver's lifeline or breathing gas hose, maintain the ability to communicate with the diver by means of that lifeline or breathing gas hose;
- Give all necessary attention to tending the diver whilst that diver is in the water;
- If a surface-supply compressor is in use, operate this and ensure that all equipment necessary to provide an adequate supply of air to the diver is in good working order.

### **5.1.5 Standby Diver**

The role of a Standby diver is to respond to any diving emergency that may arise. A Standby diver must be present whenever a diver is underwater and must:

- Hold current CoC for Occupational Diving and Medical Clearance for Occupational Diving certifications;
- Wherever possible, be located on the surface;
- If located on the surface, be dressed and equipped to enable rapid entry into the water for providing aid or assistance to a diver.

When located on the surface, the Standby Diver should have suitably low decompression loading to allow all necessary assistance to be given to a distressed diver without the standby diver incurring a decompression commitment and be fully ready to enter the water.

Where two or more divers are in the water at the same time, one may act as Standby Diver to another, provided that:

- The divers have no decompression commitment and must be able to respond to a situation without incurring a decompression commitment (i.e., must be at least two repetitive groups away from incurring a decompression commitment);
- The divers have visual contact with and direct access to each other;
- Dives are shallower than 18 metres and are not occurring under high current, high surge or low visibility conditions;
- The Dive Coordinator decides that the risks involved in the operation are minimal and this receives full support from all divers involved in the operation;
- For SSBA (surface-supplied breathing apparatus) operations, separate air supplies are provided.

### **5.1.6 Skipper**

The skipper of any vessel utilised during a diving operation must:

- Ensure that the operation of the boat complies with relevant Maritime Rules, and if a Departmental boat, the Department's Maritime Transport Operator Plan DOC-1408126 and the vessel's Vessel Operating Plan. Ensure that the boat is at all times manned by an appropriately licensed and competent person able to respond immediately to the skippering requirements for any diving emergency situation that may develop. If a Departmental boat, the skipper must be listed on the DOC Licensed Boat Operator database (DOC-23879);
- Be aware of the agreed system or procedure of recalling and/or retrieving divers;
- Cancel any diving operation when the safety of the vessel and/or personnel would be at risk.

The skipper can also act as the dive attendant if they meet the criteria in Section 5.1.4 and this does not impact on their ability to carry out meet their responsibilities as skipper.

## 5.2 Pre-dive procedures

### 5.2.1 Dive proposal

Dives should be planned around the competency of the least experienced diver. Before conducting any diving operations, the Dive Coordinator for a proposed operation must formulate a dive proposal using the Dive Proposal form (DOC-2546826) which must be accompanied by a Safety Plan for the operation (see Section 5.2.2).

The DSO will assess the Dive Proposal (including the Safety Plan), record their decision and then provide a recommendation to the Dive Coordinator, who will countersign the Dive Proposal if it is approved.

A copy of each approved Dive Proposal must be retained as part of the Department's diving records.

### 5.2.2 Safety plan

A Safety Plan must be developed for all diving operations and accompany the Dive Proposal for approval. Safety Plans must be developed using the Department's Risk Manager System ([www.riskmanager.co.nz](http://www.riskmanager.co.nz)), and must include General Comments, an Emergency Plan, Emergency Contacts, and Hazard Management. A copy of the Safety Plan must be maintained at the site until all diving activity has ceased.

#### 5.2.2.1 General Comments

General comments should provide an overview of the diving operations/trip, including:

- Location of the activities and dates;
- The identity of the trip leader and Dive Coordinator;
- Change-over dates and names of any personnel joining or leaving the team;
- A list of specific allergies and medical conditions of all people of the team;
- Radio schedule, including listening and emergency channel and call sign;
- Satellite phone instructions (if applicable).

#### 5.2.2.2 Emergency plan

The Emergency Plan outlines the procedures to be followed when responding to an emergency that may arise during diving operations, including identification of the location of the nearest emergency

medical and hyperbaric facility and appropriate plans for emergency notification of an accident, and transport of an injured person to such facility. In preparing the Emergency Plan, particular consideration should be given to the procedures to be followed when:

- A diver is missing;
- A diver develops decompression illness;
- A diver sustains any other diving-related injury, such as hypothermia, barotrauma, or shallow-water blackout;
- Conscious divers require assistance at the surface;
- Conscious divers require assistance underwater;
- Unconscious divers require assistance at the surface;
- Unconscious divers require assistance underwater;

And includes details of:

- Nearest operational decompression chamber and contact details;
- Nearest accessible hospital and contact details;
- Contact details of emergency authorities;
- Contact details of any local area designated diving doctor or other doctors;
- The NZ Divers Emergency contact free phone number (**0800 4 DES 111** or **0800 4 337 111**);

An example of responses to diving emergencies to be included in the emergency plan section of the Safety Plan can be found in [DOC-2547110](#).

In addition to emergencies that may arise during diving operations, the emergency plan should also outline procedures for responding to emergencies arising from existing allergies (e.g., bee stings) or medical conditions of team members as listed in the general comments section of the Safety Plan.

### **5.2.2.3 Emergency contacts**

Emergency contacts must include the following information:

- Name, telephone number, and relationship of person to be contacted for each team member in the event of an emergency;
- Name and telephone number of Departmental manager(s) responsible for the diving activity and participants;
- Contact details of local DOC offices and duty officers.

### **5.2.2.4 Hazard management**

Hazard Management is used to systematically identify diving related hazards, assess the likelihood of those hazards causing serious injury or illness, and to identify appropriate controls to reduce that likelihood. Hazard Management must be incorporated into the Safety Plan, and may draw upon pre-loaded hazards within Risk Manager ([www.riskmanager.co.nz](http://www.riskmanager.co.nz)) as well as additional hazards relevant to the diving activity and location.

### **5.2.3 Pre-dive briefing**

All dives must be well planned and organised. The pre-dive briefing will include the use of the Department's Job Safety Analysis, and must include:



- The location of the dive(s);
- An evaluation of the surface and underwater conditions and hazards at the dive site;
- Consideration of the dive team's ability to dive in the conditions at the site;
- The maximum water depth, the maximum dive depth and bottom time of the dive;
- The water temperature at the dive site;
- The roles and tasks of all members of the diving team;
- Residual inert gas status of divers;
- No decompression limits and projected dive profiles;
- Emergency procedures;
- Location of all emergency equipment, including oxygen and first aid kit;
- The agreed system or procedure of recalling divers, that is effective in recalling divers both below and above the water;
- The agreed procedure for retrieving a diver;
- An agreed system of hand signals for communication between divers underwater.

The Pre-dive briefing must be clearly communicated to all involved in the diving operation, including those that are not actually entering the water. All divers must be given the opportunity to refuse to dive or terminate a dive at any stage – the decision to dive is that of the individual diver and this decision must be respected by all involved in the operation.

#### ***5.2.4 Pre-dive safety checks***

It is the divers' responsibility and duty to conduct a functional check of their diving equipment in the presence of the diving buddy and Divers Attendant to ensure that their equipment is in proper working order and that the equipment is suitable for the type of diving operation. Immediately before each dive, each diver must check that:

- All the required equipment is present;
- Such equipment is properly secured in place;
- All equipment is functioning correctly;
- Before descent, a final check should be conducted in the water.

#### ***5.2.5 Pre-dive information logging***

To meet the legal requirement that a record of all dives is kept for seven years, all diving activities must be logged on the Daily Dive/Snorkel Log (DOC-2313398). Prior to the commencement of the dive, the following must be recorded:

- Dive location, date, identity of Dive Coordinator and Divers Attendant, emergency O2 cylinder pressure;
- Weather, air temp, water temp, visibility, entry, purpose and gas mixture of divers;

For each diver, the following must also be recorded:

- Dive number, divers name, if they are the dive leader, their repetitive factor at the start of the dive, cylinder pressure at the start of the dive and time in.

## 5.3 Diving procedures

### **5.3.1 Refusal to dive**

The ultimate responsibility for safety rests with the individual diver and the decision to dive is that of the diver. It is the diver's responsibility and duty to refuse to dive if, in their judgment, they are unwell or too fatigued to undertake the dive, the conditions are unsafe or unfavourable, or if they would be violating the precepts of their training or the regulations in this technical document. A diver may refuse to dive, without fear of penalty, whenever they feel it is unsafe for them to make the dive.

### **5.3.2 Depth restrictions**

The maximum depth of diving conducted under this technical document shall be to 39 metres. Where divers wish to undertake scientific diving operations at depths exceeding 39 metres, WorkSafe NZ needs to be consulted via the DCB.

### **5.3.3 Low visibility**

When underwater visibility is less than two metres, additional precautions should be taken to ensure divers maintain contact with each other. For example, divers could dive with a buddy line or dive in the tethered mode.

### **5.3.4 Termination of the dive**

It is the responsibility of the diver to terminate the dive, without fear of penalty, whenever they feel it is unsafe to continue the dive, unless it compromises the safety of another diver already in the water.

The dive shall be terminated while there is still sufficient cylinder pressure to permit the diver to reach the surface safely, including safety stops. All divers should surface from a dive with no less than 50 BAR of pressure left.

### **5.3.5 Emergencies and deviations from regulations**

Any diver may deviate from the requirements of this technical document to the extent necessary to prevent or minimise a situation that is likely to cause death, serious physical harm, or major environmental damage.

A written report of such actions must be submitted within two days to the DSO by the Dive Coordinator explaining the circumstances and justifications.

## 5.4 Post-dive procedures

### **5.4.1 Post-Dive safety checks**

After the completion of a dive, each diver shall report any physical problems, symptoms of decompression sickness, equipment malfunctions, hazards or health and safety or wellbeing issues encountered on the dive to the Dive Coordinator.

Decompression diving is not permitted at DOC, however if the no-decompression limits are breached and decompression stops are required, the divers should remain awake for at least 1 hour after diving, and in the company of a dive team member who is prepared to transport them to a decompression chamber if necessary.

A written report of such actions must be submitted within two days to the DSO by the Dive Coordinator explaining the circumstances and justifications.

#### **5.4.2 Post-dive information logging**

Following the dive, the Daily Dive/Snorkel Log (DOC-2313398) must be completed, including for each diver recording:

- The time out, air out, the depth and duration of any safety stops, bottom time, max depth and repetitive group at the end of the dive.

At the end of each diving day, the Daily Dive/Snorkel Log must be signed by each diver, countersigned by the Dive Coordinator and given to the DSO who must retain the log for 7 years.

### **5.5 Ascending to altitude after diving, including flying**

Altitude exposure after diving is a potent precipitator of decompression illness. Where air travel, road or rail travel to altitude following diving is a possibility, a specific plan for this shall be determined prior to diving.

The following **minimum** delays are required by Departmental divers before travelling to altitude<sup>1</sup>. In addition to these minimum delays, all Departmental divers must ensure they consult the US Navy air tables (see Section 11.5) for required surface intervals before ascent to altitude, and where they exceed those listed below, the surface delays listed in the US Navy tables must be used.

- **Following a Single No-Decompression Dive:** Divers should have a minimum 12 hours surface interval before ascending to altitude greater than 300 metres above sea level.
- **Following Multiple Dives per Day or Multiple Days of Diving:** Divers should have a minimum 18 hours surface interval before ascending to altitude greater than 300 metres above sea level.
- **Following dives requiring Decompression Stops:** Divers should have a minimum 24 hours surface interval before ascending to altitude greater than 300 metres above sea level (NOTE: decompression diving is not permitted as part of Departmental diving operations but may be required if divers accidentally exceed their no-decompression limits).

For routine diving operation at sea level, the above guidelines may be used. When diving is conducted at altitude and even further altitude exposure is required, specialist advice should be sought.

Divers who have experienced adverse events such as rapid ascent and divers who feel tired, generally unwell or otherwise not in normal health following diving are possibly suffering from pre-clinical decompression illness or high bubble load. In such instances, specialist diving medical advice should be obtained and travel to altitude should not be undertaken until it is clear that the diver is in completely normal health.

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<sup>1</sup> **NOTE:** The preface of AS/NZ2299.1.2007 indicates that the delays between diving and ascending to altitude presented in AS/NZ2299.1.2015 and AS/NZ2299.2.2002 are one indicative consensus recommendation, rather than the definitive publication on the subject and that there are other guidelines available. The delays used here are those from the American Academy of Underwater Sciences' Standards and the US Navy air tables.

# 6. Procedures for snorkelling

## 6.1 Snorkel team roles and responsibilities

The roles within a snorkel team will depend on the nature and location of the snorkelling activity, and must include:

- A Dive Coordinator;
- Rescue personnel;
- Snorkel team members;

and where practical should include:

- One or more lookouts;
- Snorkellers working in buddy pairs.

The combination of roles required within the snorkel team for any snorkelling activity should be discussed with the DSO during the preparation of the dive proposal and safety plan. The Dive Coordinator may act as the lookout, a snorkeller and/or rescue personnel. Snorkel team members may act as rescue personnel for one another.

All snorkel team members must comply with the regulations in this technical document.

### **6.1.1 Dive Coordinator**

The Dive Coordinator acts as on-site coordinator and shall ensure that all snorkelling activities are conducted in a safe manner. The Dive Coordinators roles and responsibilities include:

- Ensuring that all requirements of this technical document are adhered to;
- Preparing and submitting the Dive Proposal and Safety Plan to the DSO ([divesafetyofficer@doc.govt.nz](mailto:divesafetyofficer@doc.govt.nz)), the Manager(s) of all team members, and the Operations Manager for the Region in which the work is occurring (see Section 5.3);
- Ensuring that the snorkellers are physically fit and have current medical clearance (see Section 4 for all relevant competencies);
- Ensuring surface support is adequately trained and resourced to identify and respond to emergency situations;
- Ensuring that all involved in the snorkelling operation are familiar with the contents of the Dive Proposal and Safety Plan;
- Ensuring that conditions are safe for snorkelling and to terminate the snorkelling activities at any stage if it is deemed that conditions are unsafe;
- Complying with instructions from the relevant Operations Manager;
- Appointing lookouts and rescue personnel as required;
- Ensuring snorkellers are aware of the location of the lookout(s) and how to signal the lookout if they need assistance;
- Informing the lookout of what the rescue procedures are;

- Ensuring lookout when present is available for the whole time of the snorkelling activities, including during the time entry to and exit from the water is occurring;
- Ensuring that floatation devices are available for anyone who may request them;
- Ensuring arrangements are made for rescue procedures. When snorkelling from a vessel, part of these procedures will involve the provision of a tender for use in rescues when the main vessel is not capable of being rapidly deployed to do so;
- Ensuring that all safety equipment at the site (e.g. first aid kit, dive flag) is “fit for purpose”;
- Ensuring that all snorkel team members are familiar with procedures for responding to shallow-water blackout, see Section 6.3.2;
- Scheduling and directing snorkelling operations, including briefing the snorkel team and surface personnel on the dive plan, hazard management and emergency procedures;
- Keeping an accurate record associated with any accident that may occur;
- Refusing any snorkeller under their supervision to snorkel if deemed necessary.

### **6.1.2 Lookouts**

When required, lookouts will be appointed by the Dive Coordinator, and this responsibility may be undertaken by the Dive Coordinator. The role of a Lookout is to respond to any diving emergency that may arise. The Lookout will:

- Supervise snorkellers in the water (NOTE: the skipper of a vessel can fulfil the roles of the Dive Coordinator, Lookout and Rescuer);
- Assist in the recovery of snorkellers, equipment and samples from the water;
- Be competent to administer CPR and first aid;
- Give all necessary attention to tending the snorkeller whilst the snorkeller is in the water;
- Initiate and coordinate any rescue procedures.

### **6.1.3 Rescue personnel**

Competent personnel shall be appointed by the Dive Coordinator as rescue personnel. These persons shall be able, individually or between them, to effect a rescue, provide CPR and shall be immediately available at the snorkelling site in the event that a rescue is necessary.

### **6.1.4 Snorkel team members**

Snorkellers will operate under the instructions of the Dive Coordinator. The roles and responsibilities of all snorkellers include:

- Ensuring they are trained, experienced to competency levels appropriate for the snorkelling operation as set out in Section 4;
- Maintaining suitable fitness and preparation for the snorkelling activity;
- Ensuring that they have not consumed any intoxicants within 8 hours prior to snorkelling;
- Not snorkelling under the influence of any intoxicants that may impair their mental or physical capabilities;

- Ensuring that they are familiar with the snorkelling activities in accordance with the Dive Proposal and Safety Plan;
- Maintaining effective communication with other snorkellers and be able to render assistance if required;
- Reporting, immediately, any accident, injury, illness or hazard to the Dive Coordinator and dive buddy;
- Reporting immediately to the Dive Coordinator any variation in normal feeling of health and fitness.

## 6.2 Pre-snorkelling procedures

### **6.2.1 Dive proposal and safety plan**

Prior to undertaking snorkelling activities, the Dive Coordinator must develop a Dive Proposal and Safety plan as outlined in Sections 5.2.1 and 5.2.2 of this technical document.

### **6.2.2 Pre-snorkelling briefing**

All snorkelling must be well planned and organised. The pre-snorkelling briefing must include:

- The location of the snorkelling;
- An evaluation of the surface and underwater conditions and hazards at the snorkelling site;
- Consideration of the snorkel teams ability to work in the conditions at the site;
- The water temperature at the site;
- The roles and tasks of all members of the snorkel team;
- Emergency procedures, including location of all emergency equipment;
- The agreed system or procedure of recalling snorkellers;
- The agreed procedure for retrieving a snorkeller.

The Pre-snorkelling briefing must be clearly communicated to all involved in the snorkelling operation, including those that are not actually entering the water. All snorkellers must be given the opportunity to refuse to snorkel or terminate a snorkel at any stage for any reason – the decision to snorkel is that of the individual snorkeller and this decision must be respected by all involved in the operation.

## 6.3 Snorkelling Procedures

### **6.3.1 Buddy pairs**

All snorkelling activities must be undertaken in ‘buddy’ pairs unless otherwise approved by the DSO. Buddies should remain close enough to communicate and assist each other while undertaking snorkelling activities and should operate to the “one-up one-down” rule with constant visual contact between the snorkellers. If breath hold diving is undertaken, the minimum time at the surface between breath hold dives should be twice the duration of the breath hold time.

### **6.3.2 Shallow-water blackout**

In the event of shallow water blackout:

- Get the victim to the surface immediately, establish positive buoyancy for both of you and signal the Lookout for assistance;
- Get the victim on their back, remove their mask and snorkel, blow on their face/eyes, stimulate the face with a few gentle taps and vocalise encouragement to breathe. This should stimulate breathing;
- Get the victim to land or boat ASAP and begin rescue breathing if required.

### **6.3.3 River drift snorkelling**

All Departmental divers undertaking river drift snorkelling are subject to the following requirements:

- Each section of river to be swum should be thoroughly checked before the dive, from the bank, from the air, by rafting or by seeking local knowledge about the current state of the river;
- Snorkellers must dive the river in buddy pairs;
- If there are obstacles, a suitable bypass should be located and agreed upon and beaches or areas suitable for landing should also be located;
- A minimum of 3 metres underwater visibility is recommended.

### **6.3.4 Emergencies and deviations from regulations**

Any snorkeller may deviate from the requirements of this technical document to the extent necessary to prevent or minimise a situation that is likely to cause death, serious physical harm, or major environmental damage.

A written report of such actions must be submitted within two days to the DSO by the Dive Coordinator explaining the circumstances and justifications.

## **7. Diving and snorkelling equipment**

All diving and snorkelling equipment used must be of an acceptable standard for the category of diving work being undertaken and all equipment must meet minimum standards as outlined below.

All equipment must be maintained to the manufacturer's recommended maintenance standards (unless there is a standard specifying more regular maintenance) and a log kept of any checks completed (see Section 8.4).

All divers must have a suitable means to accurately record dive depths and times (e.g., diver computer). All equipment shall be examined by the person using them as part of the pre-dive safety check (see Section 5.2.4).

## 7.1 Equipment for divers

### 7.1.1 *Regulators*

Scuba regulators shall be inspected and tested by a certified dive industry technician prior to first use and every 12 months thereafter. Records of all service shall be logged in the maintenance of equipment record (see Section 8.4).

Regulators will consist of a primary second stage and an alternate air source (such as an octopus second stage or redundant air supply).

### 7.1.2 *Breathing masks and helmets*

Breathing masks and helmets shall have:

- A non-return valve at the attachment point between helmet or mask and hose, which shall close readily and positively;
- An exhaust valve;
- A minimum ventilation rate capable of maintaining the diver at the depth to which they are diving.

### 7.1.3 *Full face masks*

Full-face masks provide a number of benefits for scientific divers, including providing a platform for attaching voice communications allowing divers to talk to each other and the surface, providing exposure protection when diving to polluted or contaminated water, and protecting the airway if a diver loses consciousness underwater during a medical emergency (e.g., heart attack, stroke, oxygen toxicity). Full-face masks shall cover the eyes, nose and mouth and shall:

- Provide a watertight and gastight seal;
- Be able to withstand, without dislodgement of the faceplate or mask, any foreseeable conditions of water currents and pressure changes internal or external to the mask;
- Cause the least possible interference with vision;
- Be purgeable of water;
- Incorporate inlet and exhaust valves;
- Incorporate a demand gas supply device or a free flow system or a combination of both;
- Incorporate an oronasal inner-mask or a mouthpiece or other similar feature designed to minimize the build-up of carbon dioxide gas;
- Incorporate a facility for ear clearing;
- Incorporate a valve to prevent ingress of moisture into the breathing circuit;
- Incorporate an impact resistant safety faceplate;
- Be firmly positioned by a means of a head harness incapable of accidental dislodgement.



#### **7.1.4 Scuba cylinders**

All Departmental or personally-owned cylinders used on a Departmental diving activity (as defined in Section 3.1.3) must meet the following criteria and cylinders must not be used if they do not meet these criteria.

- Scuba cylinders shall be designed, constructed, and maintained in accordance with AS/NZS 2299.1:2015;
- Scuba cylinders must be hydrostatically tested in accordance with NZ MBIE standards;
- Scuba cylinders must have an internal and external inspection at intervals not to exceed 12 months;
- Scuba cylinder valves shall be functionally tested at intervals not to exceed 12 months;
- Scuba cylinders used for diving with air shall not be used for the storage of any gas mixture other than air and shall be marked with the word 'AIR' in letters not less than 50 mm high;
- Scuba cylinders containing air must be labelled with a durable UN green pictogram for 'non-flammable compressed gas';
- Where oxygen-nitrogen mixtures other than air are used in association with diving operations, cylinders used for storage of such mixtures shall be colour-coded and marked to ensure that there is no possibility of confusion regarding the contents of these cylinders;
- Cylinders that have previously contained air, shall not be relabelled and used for oxygen rich gases unless appropriate inspection, cleaning and filling procedures have been followed;
- Cylinders must be filled by a person with correct filler's certifications and with equipment that meets air quality standards,

#### **7.1.5 Thermal protection**

The temperature of water at the site should be assessed and the thermal protection provided must be adequate to maintain divers at a comfortable temperature for the duration of the dive. Diving using dry suits can be hazardous. Drysuit divers must have the ability to recover from inversion and drysuits must be fitted with automatic dump valves.

#### **7.1.6 Flotation devices**

Each diver must be equipped with and must use a buoyancy compensator device (BCD) as a means of achieving and maintaining positive buoyancy. Personal flotation systems, buoyancy compensators, dry suits, or other variable volume buoyancy compensation devices shall be equipped with an exhaust valve and where applicable a quick release device. These devices shall be functionally inspected and tested at intervals not to exceed 12 months and can be user tested.

#### **7.1.7 Weights or weight belts**

Where weights are worn, some or all must be fitted with a reliable quick-release mechanism that cannot be accidentally released. Sufficient weight must be releasable to ensure positive buoyancy regardless of the diving depth, degree of air filling of any dry suit, buoyancy compensator or any other item of variable buoyancy. Releasable weights and weight belts shall be worn in such a manner that when released, they will not foul any other piece of the diver's equipment.

### **7.1.8 Timing devices, depth, and pressure gauges**

All members of the buddy team must have an underwater timing device, a depth indicator, and a submersible pressure gauge. Gauges (including contents and depth gauges) shall be inspected and tested before first use and every 12 months thereafter and can be user tested. It is strongly recommended that all divers carry dive computers to assist in remaining within the no decompression limits.

### **7.1.9 Diver's knife**

Every diver shall carry a knife or other cutting device at all times when engaged in a diving operation. It should be worn in a position so that it will not foul any discarded equipment, such as released weights, or present a hazard to divers or equipment.

### **7.1.10 Signalling equipment**

All divers must carry a whistle and a highly visible surface-signalling device such as a safety sausage. It is strongly recommended that all divers carry a SMB and are proficient in its deployment from depth.

### **7.1.11 Determination of decompression status: dive tables, dive computers**

A set of US Navy diving tables, which are recognised by WorkSafe NZ as meeting the current industry standard, must be available at the dive location and all dives must be planned and performed in accordance with the no-decompression limits specified in these tables (see Section 11.5).

Dive computers may be utilised for recording time and depth and to assist in remaining within the no decompression limits; however, they do not remove the requirement to plan dives using approved dive tables.

## **7.2 Equipment for snorkellers**

### **7.2.1 Masks, snorkels and fins**

All snorkellers are required to wear masks, snorkels and fins.

### **7.2.2 Thermal protection**

The temperature of water at the site should be assessed and the thermal protection provided must be adequate to maintain snorkellers at a comfortable temperature for the duration of the activity.

### **7.2.3 Weights belts**

Where weights belts are worn, all must be fitted with a reliable quick-release mechanism to ensure positive buoyancy of the snorkeller. Releasable weights and weight belts shall be worn in such a manner that when released, they will not foul any other piece of the snorkeller's equipment.

### **7.2.4 Diver's knife**

Every snorkeller shall carry a knife or other cutting device at all times when engaged in a snorkelling operation. It should be worn in a position so that it will not foul any discarded equipment, such as released weights, or present a hazard to themselves or equipment.

## 7.3 Equipment for surface support

### 7.3.1 *First aid equipment*

There must be available on site first-aid equipment and facilities to ensure a successful response to any diving or snorkelling injury or illness that may occur.

All divers, snorkellers and attendants are to have current first-aid and oxygen administration training (e.g. DAN Oxygen Provider). At a minimum, they are required to be trained to:

- Control bleeding;
- Care for an unconscious patient;
- Carry out Cardio Pulmonary Resuscitation (CPR).
- Administer 100% oxygen to spontaneously breathing patients and oxygen-enriched resuscitation to non-breathing patients using the oxygen resuscitation equipment available at the dive site.

Oxygen equipment shall be capable of providing an inspired oxygen concentration of as close as practical to 100% to a patient who is breathing spontaneously and capable of providing an inspired oxygen concentration in excess of 50% to a non-breathing patient. Oxygen equipment should be tested and serviced at least every year and after every use, or as recommended by the manufacturer and only medical-grade oxygen is to be utilised.

Emergency oxygen equipment sufficient to provide recommended levels of medical oxygen to a breathing or non-breathing patient should be available until emergency services arrive or they can be transported to medical facilities and account must be taken of the location of the dive site, potential for multiple patients and access to medical facilities. For example, an E-cylinder of oxygen with 200 psi set to a constant flow rate of 15 L/min will last approximately 55 minutes for one patient.

### 7.3.2 *Dive flag*

A dive flag **must** be displayed prominently whenever diving is conducted and wherever practical when snorkelling is conducted (it may not be practical for example during river drift snorkelling). When diving or snorkelling from shore and in navigable waters, the dive site should be identified by either a secured floating device to which is attached a dive flag or lights, or at least one of the dive or snorkel team should be secured to a float line with dive flag or lights attached.

The dive flag should be visible from 200 m distance, be in good condition (i.e., not damaged, faded etc), be at least 600 x 600 mm in size (for vessels under 6 m) and be spread out and displayed so that it is clear of obstructions and visible to all approaching vessels.

### 7.3.3 *Compression chamber*

A compression chamber is not required to be on site during diving operations; however, the location of the nearest operational compression chamber and contact details should be identified in the Dive Proposal and Safety Plan.

All diving undertaken without an on-site compression chamber support should be low risk diving with controlled ascents and routine safety stops performed. Where multiple dives are undertaken on one day, residual nitrogen times from previous dives shall be taken into account in calculating the time allowable for a subsequent dive. Divers should carry out precautionary safety stops at the end of each dive. Precautionary safety stops should be included in the Dive Proposal.

### 7.3.4 Compressors

All compressors used to pump or transfer gas for breathing purposes must fulfil the following criteria:

- Air intake is to be provided with a filter and be located in a position to ensure a supply of clean air, free from contamination by fumes, engine exhaust etc (e.g., placed upwind of the compressor exhaust);
- Compressed air or gas must pass through high purity filters before being stored in pressure cylinders in order to remove dust, oil droplets, water, carbon monoxide and other contaminants. Filters must be changed in accordance with the compressor's service manual;
- Oil lubricated compressors must be well-ventilated and otherwise cooled during operation to ensure against high temperatures at which carbon monoxide may be formed;
- When positioning a compressor for use it is also recommended the effects of compressor noise on the surrounding environment/neighbourhood is considered;
- High-pressure air or gas compressors must be equipped with "automatic stop" safety devices set for the desired pressure, and relief valves set to prevent over-pressurisation of the system;
- Compressors are not be used for diving operations unless the compressor has, in the last three month period preceding the operations, and every three months during the operation as appropriate, undergone a test as part of the clean air programme to ensure that the compressed air satisfies the requirements listed in Section 7.4 and is operated by a certified operator;
- Evidence of air quality standards and the certifications of persons operating compressors must be maintained on site during compressor use.

### 7.3.5 Equipment used with Oxygen

Equipment used with oxygen or mixtures containing over 40% oxygen by volume must be designed and maintained for oxygen service. All components exposed to oxygen or mixtures containing over 40% oxygen by volume must be clean of flammable materials. Oxygen systems over 8.6 BAR must have slow-opening shut-off valves. Oxygen cylinders must comply with the relevant standards.

## 7.4 Air quality standards

Breathing air for scuba shall meet the following specifications as set forth in AS/NZS2299.1.2015.

Component	Concentration at 15°C and 100 kPa
Oxygen	21% (+/- 1)
Carbon Monoxide	≤ 2 ppm
Carbon Dioxide	≤ 600 ppm
Condensed hydrocarbons	< 0.1 ppm
Objectionable Odours	None

Residual water content when air is tested should not exceed 50 mg/m<sup>3</sup> for cylinders filled to 22,500 kPa and 30 mg/m<sup>3</sup> for cylinders filled to 33,000 kPa.

# 8. Record keeping requirements

## 8.1 Record of diver and snorkeller certifications

The DSO or designee shall maintain permanent records for each of the Department's Scientific Divers and Snorkellers in DOClearn. The file shall include evidence of certification level, results of current physical examination, reports of disciplinary actions, and other pertinent information deemed necessary. All divers and snorkellers must assist the DSO or designee in this by ensuring that their diving and snorkelling competencies (see Section 4) are logged and kept up to date in DOClearn.

## 8.2 Employee's record of diving activity

Each scientific diver shall log every dive made under the auspices of the Department's diving programme, and is encouraged to log all other dives. The diving log shall be in the form of a hardcopy personal logbook (which is a requirement by WorkSafe New Zealand for CoC recertification) and signed by the dive coordinator. A permanent written record of all occupational dives is to be kept for the duration of the divers working life, and shall include at least the following:

- Name of diver;
- Date, time, and location;
- Time left and returned to the surface;
- Maximum depth, bottom time, resulting pressure groups, and surface interval time;
- Diving modes used;
- Breathing medium;
- Cumulative dive time;
- Dive leader and other participants;
- General nature of diving activities;
- Detailed report of any near or actual incidents.

A diver's current logbook containing at least the previous seven days diving activity shall be available to the DSO at all times.

Divers are also required to complete an annual online survey of their diving activity in DOClearn at the end of each financial year, which will be administered by the DSO. The specific information to be logged is included in [DOC-2515200](#).

Failure of Departmental divers to fulfil their reporting requirements may result in a suspension from diving.

## 8.3 DOC's record of diving activity

DOC must ensure that a permanent written record is kept for at least 7 years of all diving work undertaken. Details must be kept of:

- Date and time of the diving operation;

- Location of the diving operation;
- Name of the Diving Coordinator;
- Names of the divers and standby divers;
- Nature of the task(s);
- Maximum depth of the dive;
- Time left the surface, bottom time and time out;
- Decompression schedules for each diver (if required);
- Details of incidents and accidents;
- Contents of cylinders at beginning and end of dives;
- Any other relevant details;
- The Dive Coordinators signature.

To meet this requirement, all diving activities must be logged on the Daily Dive Log (DOC-2313398), signed by each diver, and countersigned by the Dive Coordinator at the end of each diving day.

Additionally, the DSO is required to produce an annual report on scientific diver activity within the Department. The information collected from divers during individual activity reporting will be used to produce a summary of annual diving activity for DOC.

## 8.4 Maintenance of equipment record

A log is to be kept of any maintenance or repairs made to any dive equipment (e.g., breathing gas purity, annual service of regulators, scuba cylinder visual and hydro testing) using the maintenance schedule in [DOC-2604305](#), whether or not it is the diver's personal equipment or the Department's.

## 8.5 Required incident reporting

All diving and snorkelling incidents including near misses, incidents requiring recompression treatment, or resulting in moderate or serious injury, or death shall be reported by the Dive Coordinator to the DSO and entered into Risk Manager ([www.riskmanager.co.nz](http://www.riskmanager.co.nz)) within 5 working days (2 days if the incident caused serious harm or death). DOC's regular procedures for incident reporting shall be followed and the resulting report will specify the circumstances of the incident and the extent of any injuries or illnesses (see [DOC-25389](#)).

If the incident results in serious harm or death contact WorkSafe NZ immediately (0800 030040). When entered into Risk Manager, and serious harm is selected, the system will produce a serious harm form in PDF format that is to be printed, signed and sent to WorkSafe NZ within 7 days of the incident, with a copy kept on file.

If notifying WorkSafe NZ, refer to [DOC-102533](#). This includes what to do if an accident occurs where an enforcement agency such as WorkSafe NZ are showing interest, how to deal with a WorkSafe NZ inspector, and rights and responsibilities.

No incident can be entered into Risk Manager without prior approval of the line manager. Incidents should not be entered by the injured person.

**Maritime incidents** must be **notified** to Maritime New Zealand who will likely investigate. See <http://www.maritimenz.govt.nz/Commercial/Accidents-and-investigations/Accidents-and-investigations.asp>.

With diving incidents, it is important to note the full details of the type of diving apparatus used by the diver, in particular noting the condition of such equipment immediately after the incident including, in the appropriate case:

- Whether cylinder valves were opened or closed and to what extent;
- Remaining pressure in cylinder;
- The type of breathing gas used.

In any case where component malfunction was likely or was suspected to have been a likely cause of a serious accident, then this equipment should be immediately sealed. In any case where a fatality has occurred, all equipment should be left in the condition that it was in at the time of the accident until it has been investigated by the relevant authorities. Notwithstanding this, the breathing gas supply should be isolated to retain the remaining gas. During such isolation, the number of turns, any undue force or other actions required to isolate the gas supply should be noted and recorded.

## 9. Diving activities requiring special considerations

### 9.1 Night diving

All Departmental divers undertaking night dives are subject to the following requirements:

- The preparation for the dive, including gear checks and site orientation, should be completed during the day;
- Divers are to carry two independent light sources (one of which may be a chemical light);
- If diving from shore, the entry and exit points shall be adequately illuminated.

Consideration should be given to the use of other safety measures, according to circumstances. They may include the use of emergency lighting such as chemically activated light sticks attached to divers, buoys at the surface and the deployment of shot lines.

### 9.2 Diving at altitude

Because of the reduced atmospheric pressure at altitude, no-decompression limits must be adjusted for dives above 300 m elevation. To determine the sea level equivalent depth, a cross correction using the cross-correction provided by the US Navy Tables must be applied (see Section 11.5).

Departmental divers must always dive conservatively when at altitude.

When diving is conducted at altitude and even further altitude exposure is required, specialist advice should be sought.

## 9.3 Diving in remote locations

All diving undertaken in remote locations shall be low risk diving with controlled ascents and routine safety stops at the end of each dive. Any significant risk-increasing factor (e.g., cold water or hard work) should lead to shortening of dive times determined by moving an additional one or two 'time' or 'depth' levels up the US Navy dive tables and extra safety-stops determined by using the schedule that would be applicable if they had just exceeded the no decompression limit for the dive. Depending upon the availability of emergency recompression, diving in remote locations (i.e., there is no recompression chamber on site) shall be limited as follows:

- When diving where recompression is available within 2 hours of the dive site, the maximum bottom time for any single dive shall be determined by the US Navy dive tables no-decompression limit for the appropriate depth. Where a second or subsequent dive is undertaken, the maximum bottom time shall be determined by reference to one repetitive group designation inside the US Navy no decompression limit for the appropriate depth. The US Navy dive tables shall be used to ensure that the bottom time for second and subsequent dives does not result in the diver exceeding this repetitive group limit;
- When diving where recompression facilities are more than 2 hours from the dive site, the maximum bottom time shall be determined by reference to one repetitive group designation inside the US Navy no decompression limit for the appropriate depth. Where a second or subsequent dive is undertaken, the maximum bottom time shall be determined by reference to two repetitive group designations inside the US Navy no decompression limit for the appropriate depth. The US Navy dive tables shall be used to ensure that the bottom time for second and subsequent dives does not result in the diver exceeding this repetitive group limit.

Sufficient emergency oxygen equipment must be available on site to provide recommended levels of medical oxygen to a breathing or non-breathing patient for the time it takes from initial response to a diving emergency to reaching medical facilities. For example, an E-cylinder of medical oxygen with 200 psi set to a constant flow rate of 15 L/min will last approximately 55 mins. Consideration will need to be given to the potential for multiple patients.

## 9.4 Nitrox diving

For the purposes of Departmental diving, nitrox is defined as breathing mixtures of nitrogen and oxygen with more than 21% but less than or equal to 32% oxygen content, which may contain trace gases at levels no higher than breathable air.

### 9.4.1 Competencies

To be competent to undertake nitrox diving activities under the auspices of DOC, the person must retain currency for the following competencies:

- All competencies in Section 4.1, plus;
- Nitrox certification from a recognised training provider (e.g., PADI, SDI, TDI).

However, nitrox certification alone does not automatically result in authorisation to use nitrox and this must be given by the DSO. The applicant must convince the DSO that they are sufficiently skilled and proficient and that there is a clear need to utilise nitrox during the proposed diving operation.



Authorisation to use nitrox may be denied to any diver who does not demonstrate to the satisfaction of the DSO the appropriate judgment or proficiency to ensure the safety of the diver and dive buddy.

#### **9.4.2 Lead diver requirements**

On any dive during which nitrox will be used by any team member, the Lead Diver should be authorised to use nitrox, and hold appropriate authorisations required for the dive.

In addition to responsibilities listed in Section 5.1.2, the Lead Diver should:

- As part of the dive planning process, verify that all divers using nitrox on a dive are properly qualified and authorised;
- As part of the pre-dive procedures, confirm with each diver the nitrox mixture the diver is using, and establish dive team maximum depth and time limits, according to the shortest time limit or shallowest depth limit among the team members.
- The Lead Diver should also reduce the maximum allowable inspired oxygen partial pressure ( $pO_2$ ) exposure limit for the dive team if on-site conditions so indicate (see Section 9.4.3).

#### **9.4.3 Oxygen exposure limits**

The inspired oxygen partial pressure ( $pO_2$ ) experienced at depth should not exceed 1.4 ATA. The recommended bottom time limits for various  $pO_2$  exposures as detailed in TDI Nitrox Tables must be adhered to.

The maximum allowable exposure limit should be reduced in cases where cold or strenuous dive conditions, or extended exposure times are expected. The DCB should consider this in the review of any dive plan application, which proposes to use nitrox. The Lead Diver should also review on-site conditions and reduce the allowable  $pO_2$  exposure limits if conditions indicate.

If using the equivalent air depth (EAD) method, the maximum depth of a dive should be based on the oxygen partial pressure for the specific nitrox breathing mix to be used.

#### **9.4.4 Bottom time limits and repetitive dives**

Maximum bottom time should be based on the depth of the dive and the nitrox mixture being used.

Bottom time for a single dive should not exceed the maximum allowable “Single Exposure Limit” for a given oxygen partial pressure.

Repetitive dives using nitrox mixtures should be performed in compliance with procedures required of the specific dive tables used.

Residual nitrogen time should be based on the EAD for the specific nitrox mixture to be used on the repetitive dive, and not that of the previous dive.

The total cumulative exposure (bottom time) to a partial pressure of oxygen in a given 24 hour period should not exceed the current *NOAA Diving Manual* 24- hour Oxygen Partial Pressure Limits for “Normal” Exposures.

When repetitive dives expose divers to different oxygen partial pressures from dive to dive, divers should account for accumulated oxygen exposure from previous dives when determining acceptable exposures for repetitive dives. Both acute (CNS) and chronic (pulmonary) oxygen toxicity concerns should be addressed.

### 9.4.5 Dive tables and gases

A set of DCB approved nitrox dive tables should be available at the dive site.

When using the equivalent air depth (EAD) method, dives should be conducted using air dive tables approved by the DCB.

If nitrox is used to increase the safety margin of air-based dive tables, the maximum operating depth and oxygen exposure and time limits for the nitrox mixture being dived should not be exceeded.

### 9.4.6 Nitrox dive computers

Dive computers may be used to compute decompression status during nitrox dives. Manufacturers' guidelines and operations instructions should be followed.

Nitrox dive computer users should demonstrate a clear understanding of the display, operations, and manipulation of the unit being used for nitrox diving prior to using the computer, to the satisfaction of the DCB or designee.

If nitrox is used to increase the safety margin of an air-based dive computer, the maximum operating depth and oxygen exposure and time limits for the nitrox mixture being dived shall not be exceeded.

Dive computers capable of pO<sub>2</sub> limit and fraction of oxygen (fO<sub>2</sub>) adjustment should be checked by the diver prior to the start of each dive to assure compatibility with the mix being used.

### 9.4.7 Oxygen parameters

**Authorised Mixtures** – Only mixtures up to 32% oxygen may be used for Departmental nitrox diving operations.

**Purity** - Oxygen used for mixing nitrox-breathing gas should meet the purity levels for “Medical Grade” (U.S.P.) or “Aviator Grade” standards.

In addition to the Air Quality Standards (Section 7.4), the following standard should be met for breathing air that is either:

- Placed in contact with oxygen concentrations greater than 40%.
- Used in nitrox production by the partial pressure mixing method with gas mixtures containing greater than 40% oxygen as the enriching agent.

Air Purity:	CGA Grade E (Section 3.60)
Condensed Hydrocarbons	5mg/m <sup>3</sup>
Hydrocarbon Contaminants	No greater than 0.1 mg/m <sup>3</sup>

### 9.4.8 Gas mixing and analysis

Nitrox for use in Departmental diving activities must be mixed by a reputable provider in accordance with preparation procedures outlined in AS/NZS2299.1.2015. Currently, mixing of Nitrox is not to be undertaken by Departmental staff.

The percentage concentration of oxygen in a nitrox mix is critical to the safety of the diver, in particular, to enable the calculation of the maximum safe depth allowable to avoid exceeding a partial pressure of 1.4 ATA oxygen. It is the responsibility of each diver to analyse immediately prior to the

dive the oxygen content of their scuba cylinder and acknowledge in writing the following information for each cylinder: fO<sub>2</sub>, maximum operating depth, cylinder pressure, date and time of analysis, and user's name. Individual dive log reporting forms should report fO<sub>2</sub> of nitrox used, if different than 21%. Oxygen analysers shall be suitable for the purpose, and maintained according to the manufacturer's guidelines.

#### **9.4.9 Nitrox diving equipment**

All of the equipment requirements outlined in Section 7 apply to nitrox scuba operations. Additional minimal equipment necessary for nitrox diving operations includes:

- Labelled SCUBA Cylinders
- Oxygen Analysers

##### **9.4.9.1 Oxygen cleaning and maintenance requirements**

All equipment, which during the dive or cylinder filling process is exposed to concentrations greater than 40% oxygen at pressures above 150 psi, should be cleaned and maintained for oxygen service.

Equipment used with oxygen or mixtures containing over 40% by volume oxygen shall be designed and maintained for oxygen service. Oxygen systems over 125 psig shall have slow-opening shut-off valves. This should include the following equipment: scuba cylinders, cylinder valves, scuba and other regulators, cylinder pressure gauges, hoses, diver support equipment, compressors, and fill station components and plumbing.

##### **9.4.9.2 Scuba cylinder identification marking**

Scuba cylinders to be used with nitrox mixtures shall be a dedicated cylinder and must have the following identification documentation affixed to the cylinder.

- Cylinders should be marked "NITROX", or "EANx", or "Enriched Air".
- Nitrox identification colour-coding should include a 10 cm wide green band around the cylinder, starting immediately below the shoulder curvature. If the cylinder is not yellow, the green band should be bordered above and below by a 2 cm yellow band.
- The alternate marking of a yellow cylinder by painting the cylinder crown green and printing the word "NITROX" parallel to the length of the cylinder in green print is acceptable.
- A label indicating that the cylinder and valve have been cleaned and inspected for use with Nitrox mixtures up to 40% oxygen by volume.
- A contents label should be affixed, to include the current fO<sub>2</sub>, date of analysis, MOD and name of person who analysed the gas in the cylinder.

Cylinders which have previously contained air shall not be relabelled and used for oxygen-rich gases unless appropriate inspection, cleaning and filling procedures have been followed.

##### **9.4.9.3 Regulators**

Regulators to be used with nitrox mixtures containing greater than 40% oxygen should be cleaned and maintained for oxygen service, and marked in an identifying manner.

##### **9.4.9.4 Other support equipment**

An oxygen analyser is required which is capable of determining the oxygen content in the scuba cylinder. Two analysers are recommended to reduce the likelihood of errors due to a faulty analyser. The analyzer should be capable of reading a scale of 0 to 100% oxygen, within 1% accuracy.

All diver and support equipment should be suitable for the fO<sub>2</sub> being used.

## 9.5 Tethered diving

### **9.5.1 Eligibility**

All competencies in Section 4.1, plus all divers wishing to use tethered diving mode, must have completed training (typically done in accordance with AS/NZS 2815.6 Training and Certification of Occupational Divers during the CoC application process). Training alone does not automatically result in authorisation to use tethered diving mode and this must be given by the DCB. Authorization to use tethered diving mode may be denied to any diver who does not demonstrate to the satisfaction of the DSO the appropriate judgment or proficiency to ensure safety during tethered diving operations.

### **9.5.2 Tethered mode SCUBA diving operations for dive depths of up to 21 m**

The following personnel shall be present:

- One Dive Coordinator
- One Diver
- One Diver's Attendant
- One Standby Diver

The Dive Coordinator may act as either the Divers' Attendant or the Standby Diver. So, the minimum team size for tethered mode SCUBA diving operations is THREE, one of which must remain on the surface at all times.

A SCUBA diver tethered by a lifeline must be able to communicate with the divers attendant at all times. If there is only one diver in the water, voice communications between the diver and dive coordinator are recommended.

### **9.5.3 Tethered mode SCUBA diving operations exceeding 21m**

The requirements for tethered mode SCUBA diving operations exceeding 21 m are the same as those outlined in Section 9.5.2 with the following additional requirements:

- One Standby Diver's Attendant

The dive coordinator can act as the Diver's Attendant or the standby diver's attendant or carry out other surface duties, but must not be attendant for both the diver and the standby diver.

So, the minimum team size for tethered mode SCUBA diving operations exceeding 21 m consists of FOUR persons, two of whom must remain at the surface.

## 9.6 Surface supplied breathing apparatus (SSBA)

### **9.6.1 Eligibility**

All competencies in Section 4.1 plus all divers wishing to use SSBA must have completed training in accordance with AS/NZ 2815.2.2013; however, training alone does not automatically result in authorisation to use SSBA and this must be given by the DCB. Authorisation to use SSBA may be

denied to any diver who does not demonstrate to the satisfaction of the DCB the appropriate judgment or proficiency to ensure safety during SSBA operations.

### **9.6.2 General**

At every SSBA diving operation, there shall be sufficient personnel to ensure that diving is performed safely. The minimum number and designations of personnel required for SSBA diving operations are set out below. The provision of extra personnel should always be considered as a means to reduce risk, particularly during dives involving hazards or those involving unusual underwater tasks.

### **9.6.3 Dives to depths up to and including 21 m**

The following personnel shall be present:

- One Dive Coordinator
- One Diver
- One Standby Diver
- One Diver's Attendant

The Dive Coordinator may act as the diver's attendant or carry out other surface duties but shall not be nominated as the diver or standby diver. Thus, the minimum dive team for dives to 21 m depth consists of THREE persons.

### **9.6.4 Dives deeper than 21 m**

The requirements for SSBA diving operations exceeding 21 m are the same as those outlined in Section 9.6.3 with the following additional requirements:

- One standby diver's attendant

The Dive Coordinator may act as the diver's attendant or the standby diver's attendant or carry out other surface duties but shall not be nominated as the diver or standby diver or be attendant for both the diver and standby diver. Thus, the minimum dive team for dives to 21 m depth consists of FOUR persons.

### **9.6.5 Dives with two or more divers in the water**

Where two or more divers are, or may be required in the water at the same time, the Dive Coordinator shall ensure that prior to the commencement of diving operations, sufficient qualified personnel are available to carry out such diving operations in a safe manner.

### **9.6.6 Lifeline**

No SSBA diving operation shall be carried out unless the diver is secured by a lifeline with a minimum braking strain at any load bearing sections (including connections) of at least 6 kN and both the diver and diver's attendant are thoroughly conversant with the agreed system of lifeline signals.

The lifeline shall be independently attached in such a manner that the weights and other equipment can be readily discarded by the diver underwater without fouling the line.

### **9.6.7 Equipment for SSBA divers**

Diving equipment and breathing gas supplied shall comply with the relevant requirements in Section 7.

For SSBA diving operations, the underwater equipment shall include the following:

- A surface supplied breathing gas hose for each diver, including a non-return valve located as close as possible to the diver;
- Either:
  - An incompressible helmet, band mask or full face mask; or
  - A half-face mask and separate demand valve;
- Inlet and exhaust valves;
- Either one or a combination of:
  - A demand gas supply device with or without breathing hoses; or
  - A free-flow gas device;
- For demand breathing, breathing hoses or pressure pipe or pressure hose;
- An emergency gas supply of sufficient supply to allow the diver to return to the surface and complete any decompression requirements;
- A harness to secure the gas supply hose and equipment to the diver;
- Lifeline;
- A buoyancy compensator device;
- Diving suit;
- Weight belt or other weights;
- Diver's knife.

## **10. Activities not permitted by DOC divers**

### **10.1 Solo diving**

Solo diving is not permitted - all diving activities shall assure adherence to the buddy system for scuba diving. This buddy system is based upon mutual assistance, especially in the case of an emergency. Usually this will consist of 2-3 comparably equipped divers in the water in constant communication with each other, although in some circumstances, a tethered mode with one diver on the surface may be preferred (see Section 9.5).

## 10.2 Cave, cavern and wreck diving

Cave, cavern, and wreck diving are not permitted as part of Departmental diving operations. A dive team shall be considered to be in a cave, cavern, or wreck if at any time during the dive they find themselves in a position where they cannot complete a direct, unobstructed ascent to the surface because of rock formations or structures.

## 10.3 Staged decompression diving

Staged decompression diving (i.e., the ascent is interrupted by decompression stops at calculated depth intervals, with the entire ascent critical to harmless elimination of inert gas) is not permitted as part of Departmental diving operations.

## 10.4 Mixed gas diving

Mixed gas diving is defined as dives done while breathing gas mixes containing proportions greater than 1% by volume of an inert gas other than nitrogen. Mixed gas diving is not permitted as part of Departmental diving operations.

## 10.5 Rebreathers

Currently the use of rebreather technology is not permitted as part of Departmental diving operations.

## 10.6 Other diving technology

Certain types of diving require equipment or procedures that require additional training. Any modes of diving not specifically identified in this technical document require the approval of the DCB and SOP owner before diving operations can begin.

# 11. Related documents

## 11.1 Standards

- WorkSafe NZ, Guidelines for Occupational Diving, 2004 (<http://www.business.govt.nz/worksafe/information-guidance/all-guidance-items/guidelines-for-occupational-diving>);
- AS/NZS 2299.1:2015 Occupational Diving Operations Part 1: Standard Operational Practice;
- AS/NZS 2299.2:2002 Occupational Diving Operations Part 2: Scientific Diving;
- AS/NZS 2299.3:2003 Occupational Diving Operations Part 2: Recreational Industry Diving and Snorkelling Operations;
- AS/NZ 2815.3 Training and certification of occupational divers - Part 2: Surface supplied diving to 30 m;

- AS/NZS 2815.6 Training and Certification of Occupational Divers – Part 6 Restricted Occupational SCUBA Diver;
- New Zealand Underwater Association (2001), New Zealand Underwater Code of Practice for Vessels used for Recreational and Occupational Scuba Diving Activities;
- Australian Institute of Marine Science (1999), Diving Procedures;
- American Academy of Underwater Sciences Standards for Scientific Diving 2013;
- AS 3848 Filling of Portable Gas Cylinders;
- Health and Safety in Employment Regulations 1995;
- NOAA (2011) Scientific Diving Standards and Safety Manual;
- US Navy Diving Manual Revision 6 2008 (SS521-AG-PRO-010).

## 11.2 Diving practice

- PADI (1996) The Encyclopaedia of Recreational Diving. International PADI Inc.

## 11.3 Dive medicine

- Lippmann, J. (2001) Oxygen First Aid: A Guide to the Provision of Oxygen in Scuba Diving and other Emergencies. J.L. Publications;
- Lippmann, J. Bugg, S. (1990) The DES Emergency Handbook: A Guide to the Identification of and First Aid for SCUBA (Air) Diving Injuries. J.L. Publications. (Note: this is printed on waterproof paper and is useful for keeping in the first aid kit and/or in the boat).

## 11.4 Forms and templates

### **11.4.1 CoC application form**

All applications for a Certificate of Competency for Occupational Diving – Scientific must be filled out on the form found here:

<http://www.business.govt.nz/worksafe/notifications-forms/diving/application-diving-certificate-competency-form.pdf>

### **11.4.2 Medical examination forms**

The full diving medical examination must be carried out by a Designated Diving Doctor (DDD) every 5 years using this form:

<http://www.business.govt.nz/worksafe/notifications-forms/diving/diver-medical-assessment-questionnaire-pdf>

During the interim four-year period, an Occupational Diver Medical Assessment Questionnaire must be completed annually by the diver, which can be found here: [www.divemedical.co.nz](http://www.divemedical.co.nz)



### **11.4.3 Annual emergency drill test form**

All divers and snorkellers must be judged to have successfully completed an annual emergency drill test as determined by an assessor approved by the DCB. The assessment must be recorded on the Annual emergency drill test form (DOC-2547088) and kept for 7 years.

### **11.4.4 Dive proposal form**

All diving and snorkelling activities must be planned by the Dive Coordinator using the Dive Proposal form ([DOC-2546826](#)), which must be accompanied by a Safety Plan for the operation (see Section 5.2.2). A copy of each approved Dive Proposal must be retained for 7 years as part of the Department's diving and snorkelling records.

### **11.4.5 Example emergency plan**

All Safety Plans must include an emergency plan section that outlines the procedures to be followed when responding to an emergency that may arise during diving operations. An example of the details to be included in the emergency plan section of the Safety Plan can be found in [DOC-2547110](#).

### **11.4.6 Risk Manager diving hazards**

Hazard Management must be incorporated into the Safety Plan, and may draw upon pre-loaded diving hazards within Risk Manager, which can be found in [DOC-2547102](#).

### **11.4.7 Daily dive log**

To meet the legal requirement that a record of all dives is kept for 7 years, all diving and snorkelling activities must be logged on the Daily Dive/Snorkel Log ([DOC-2313398](#)), signed by each diver and/or snorkeller, and countersigned by the Dive Coordinator at the end of each diving day.

### **11.4.8 DOC annual statistics collection criteria**

The DSO is required to produce an annual report on scientific diver activity within the Department. The information collected from divers during individual activity reporting will be used to produce a summary of annual diving activity for DOC at the organisation level. The specific information to be logged by individual divers is presented in [DOC-2515200](#).

## 11.5 US Navy Tables

The US Navy no-decompression air tables were developed by the US Navy as an internationally recognized standard for allowable exposure while breathing compressed air at varying depths. The current version presents the culmination of research and validation of air diving tables, and is presented in Revision 6 of the US Navy Diving Manual. Use of earlier US Navy tables is not approved for Departmental diving. The US Navy no-decompression air tables include the following information: No-decompression limits and repetitive group designations; minimum surface intervals; residual nitrogen for repetitive dives; decompression schedules for the breach of no-decompression limits; cross-corrections for diving at altitude; and are shown on the following pages. All dives at DOC must be planned in accordance with the 2008 US Navy no-decompression air tables and a copy of these tables must be present at all dive sites.

### ***11.5.1 No-Decompression Limits and Repetitive Group Designation Table for No-Decompression Air Dives***

The No-Decompression Table (Table A, located at the end of section 11.5.4) gives the maximum time that can be spent at a given depth without the need for decompression stops during the subsequent ascent to the surface. At depths of 6 m and shallower, there is no limit on the amount of time that can be spent at depth. Deeper than 6 m, the time that can be spent is limited. For example, at 18 meters sea water (msw), any dive longer than 60 minutes will require decompression stops.

Table A also provides the repetitive group designators for dives that fall within the no-decompression limits. Even though no decompression stops are required during ascent, the diver still surfaces with some residual nitrogen in their tissues. This residual nitrogen needs to be accounted for if a repetitive dive is planned.

If a diver exceeds the limits given in the No-Decompression Table, then the decompression stop requirement must be calculated using Table C and the diver must complete the decompression stop before returning to the surface. If No-Decompression limits are exceeded, divers they must remain on the surface for at least 18 hours before making another dive.

For each depth listed in the No-Decompression Table (Table A), the corresponding no-decompression limit is indicated in the second column. This limit is the maximum bottom time that a diver may spend at that depth and still return to the surface without taking decompression stops. To find the no-decompression limit, enter the table at the depth equal to or next greater than the maximum depth of the dive. Follow that row to the second column to obtain the no-decompression limit.

The columns to the right of the no-decompression limit column contain the repetitive group designators for dives with bottom times equal to or shorter than the no-decompression limit. A repetitive group designator must be assigned to a diver subsequent to every dive, even a no-decompression dive.

To find the repetitive group designator following a no-decompression dive:

- Enter the table at the depth equal to or next greater than the maximum depth of the dive.
- Follow that row to the right to the bottom time equal to or next greater than the actual bottom time of the dive.
- Follow the column up to obtain the repetitive group designator.

**Example:** Divers conduct a brief inspection of a worksite located at a depth of 22 msw. Bottom time is 10 min. What is the no-decompression limit for a dive to 22 msw? What is the repetitive group designator following this 10-minute dive?

Enter the No-Decompression Table at the next greater depth, 24 msw. Follow the row horizontally to the second column. The no-decompression limit at 24 msw is 39 min. The divers could spend up to 39 min at this depth and still ascend to the surface without decompression stops. Continue reading horizontally to the right to the bottom time that is next greater than the actual bottom time. This is 12 min. Read vertically up the column to obtain the repetitive group designator for this 10-min dive. The repetitive group designator is C. If the divers had spent the full 39 min allowed at 24 msw, the repetitive group designator would have been J.

### **11.5.2 Residual Nitrogen Timetable for Repetitive Air Dives**

The time elapsed between surfacing from a dive and beginning the descent on the following dive is called a Surface Interval. Surface intervals are expressed in hours and/or minutes.

During the surface interval after an air dive, the quantity of residual nitrogen in the diver's body will gradually be reduced to its normal value. If the diver makes a second dive before the residual nitrogen has been dissipated (a repetitive dive), they must consider this residual nitrogen level when planning for the second dive.

Upon completing the first dive, the diver is assigned a repetitive group designator from the No-Decompression Table (Table A). This designator tells the diver how much residual nitrogen they have upon surfacing from the first dive. A diver in Group A has the lowest amount of residual nitrogen; a diver in Group Z has the highest. As nitrogen passes out of the diver's body during the surface interval, the repetitive group designation changes to a lower letter group to reflect the lower quantity of residual nitrogen. The top half of Table B allows the repetitive group designator to be determined at any time during the surface interval. The lower half of Table B gives the Residual Nitrogen Time (RNT) corresponding to the repetitive group designator at the end of the surface interval and the depth of the repetitive dive. The residual nitrogen time is the time a diver would have had to spend at the depth of the repetitive dive to absorb the amount of nitrogen he has left over from the previous dive. The residual nitrogen time is added to the bottom time of the repetitive dive to obtain the Equivalent Single Dive Time (ESDT). The decompression schedule for the repetitive dive is obtained by entering the No-Decompression Table at the depth of the repetitive dive and the Equivalent Single Dive Time.

To use the repetitive dive procedure described below, the interval on the surface between dives must be at least 10 minutes. If the surface interval between dives is less than 10 minutes, add the bottom time of the two dives and enter the decompression table at the deeper of the two depths.

To determine the decompression schedule for a repetitive dive when the surface interval is greater than 10 minutes:

- Obtain the repetitive group designator from Table A upon surfacing from the first dive.
- Using the repetitive group designator, enter the top half of Table B on the diagonal. Table B is the Residual Nitrogen Timetable for Repetitive Air Dives.
- Read horizontally across the row to locate the time interval that includes the diver's surface interval. The times are expressed in hours and minutes (e.g., 2:21 = 2 hours 21 minutes). Each time interval has a minimum time (top limit) and a maximum time (bottom limit). The time spent on the surface must be between or equal to the limits of the selected interval. If the

surface interval exceeds the longest time shown in the row, the dive is not a repetitive dive. No correction for residual nitrogen is required.

- Read vertically down the column to obtain the repetitive group designator at the end of the surface interval.
- Continue down the same column to the depth row that is exactly equal or next deeper than the depth of the planned repetitive dive. The time given at the intersection of the column and row is the residual nitrogen time in minutes.
- Add the residual nitrogen time to the planned bottom time of the repetitive dive to get the Equivalent Single Dive Time (ESDT).
- Enter Table A at the depth that is exactly equal to or next deeper than the actual depth of the repetitive dive. Select the schedule that is exactly equal to or next longer than the Equivalent Single Dive Time. Follow the prescribed decompression to the surface.
- At depths of 3 and 6 msw, some of the higher repetitive groups do not have a defined residual nitrogen time. These groups are marked with a double asterisk in the lower half of Table B. The RNT is undefined because the tissue nitrogen loading associated with those repetitive groups is higher than the nitrogen loading that could be achieved even if the diver were to remain at those depths for an infinite period. A diver entering the dive in one of those higher groups marked by a double asterisk can still perform a repetitive dive at 3 or 6 msw because the no-decompression time at those depths is unlimited. An RNT time is not required to make the dive. If a subsequent repetitive dive to a deeper depth is planned, however, the diver will need a repetitive group at the end of the shallow dive in order to continue using the RNT table. If a double asterisk is encountered in Table B, assume that the repetitive group remains unchanged during the course of the dive at 3 or 6 msw.

**Example:** A diver surfaces from a dive in repetitive Group N. Thirty minutes later, they make a dive to 6 msw. The diver begins the 6 msw dive in Group N. The RNT time for Group N at 6 msw is undefined. This is not a problem because the no-decompression time at 6 msw is unlimited. Regardless of their starting repetitive group, the diver can spend any amount of time at 6 msw without incurring a decompression obligation. If a subsequent dive deeper than 6 msw is planned, the diver should assume that they surfaced from the 6 msw dive in Group N regardless of the duration of the 6 msw dive.

- If a diver exceeds the nDL limits shown in Table A, they must perform in-water decompression as shown in Table C and remain on the surface for at least 18 hours before making another dive.

**Example:** A repetitive dive is planned to 18 msw for an estimated bottom time of 20 minutes. The previous dive was to a depth of 26 msw and had a bottom time of 28 minutes. The diver's surface interval is 2 hours 26 minutes (2:26). What is the proper decompression schedule for the repetitive dive?

- Enter the Air Decompression Table at a depth of 27 msw and a bottom time of 28 minutes. Read across the row to obtain the repetitive group designator upon surfacing from the first dive. The repetitive group designator is H.
- Move to the Residual Nitrogen Timetable for Repetitive Air Dives, Table B.
- Enter the top half of the table on the diagonal line at H.

- Read horizontally across the line until reaching the time interval that includes the diver's surface interval of 2 hours 26 minutes. The diver's surface interval falls within the limits of the 1:45/2:37 column.
- Read vertically down the 1:45/2:37 column. The repetitive group designator at the end of the surface interval is F.
- Continue to read down the column until reaching the depth that is exactly equal or next deeper than the depth of the repetitive dive. This is 18 msw. The residual nitrogen time is 35 minutes.
- Add the 35 minutes of residual nitrogen time to the estimated bottom time of 20 minutes to obtain the single equivalent dive time of 55 minutes.
- This is within the nDL of 60 min from Table A for a depth of 18 msw.

### **11.5.2.1 RNT Exception Rule**

In some cases, the residual nitrogen time given in Table B may be longer than needed to provide adequate decompression on the repetitive dive. This situation is most likely to occur when the surface interval between the dives is short. After determining the decompression requirement for the repetitive dive, the diver should recalculate the requirement by summing the bottom times of the two dives and taking the deepest depth. If the resultant table and schedule produces a longer no-decompression time than calculating each dive separately, the table and schedule with the lesser decompression obligation may be used. This alternative method of determining the table and schedule is referred to as the RNT Exception Rule.

**Example:** A diver makes an air dive to 18 msw for 40 minutes and plans to make a repetitive air dive to 17 msw for 20 minutes after a 30-minute surface interval. Determine the table and schedule for the repetitive dive.

The diver surfaces from the first dive in repetitive group H. After 30 minutes on the surface, they remain in repetitive group H. The depth of the repetitive dive is rounded up to the next deeper depth in Table A, 18 msw. The residual nitrogen time for a group H diver at 18 msw is 46 minutes. The equivalent single dive time of the repetitive dive is  $20 + 46 = 66$  minutes. The 18 msw/70 min schedule in Table C calls for a 7 min stop on air at 6 msw. The alternative table and schedule for the repetitive dive is 18 msw (deepest of the two depths) and 60 minutes (sum of the 40 and 20-minute bottom times). The 18 msw/60 min schedule does not require decompression stops. The diver uses the 18 msw/60 min schedule for the repetitive dive under the RNT exception rule.

### **11.5.3 Diving at altitude**

Because of the reduced atmospheric pressure, dives conducted at altitude require more decompression than identical dives conducted at sea level. The air decompression tables (tables A, B and C) therefore, cannot be used as written. Some organizations calculate specific decompression tables for use at each altitude. An alternative approach is to correct the altitude dive to obtain the equivalent sea level dive, then determine the decompression requirement using standard tables. This procedure is commonly known as the "Cross Correction" technique and always yields a sea level dive that is deeper than the actual dive at altitude. A deeper sea level equivalent dive provides the extra decompression needed to offset effects of diving at altitude.

To apply the "Cross Correction" technique, two corrections must be made for altitude diving. First, the actual dive depth must be corrected to determine the sea level equivalent depth. Second, the decompression stops in the sea level equivalent depth table must be corrected for use at altitude. To

simplify calculations, Table D gives corrected sea level equivalent depths and equivalent stop depths for dives from 3-42 msw and for altitudes from 300-3000 m in 300 m increments. No correction is required for dives between sea level and 300 m, as the additional risk associated with these dives is minimal.

#### **11.5.4 Ascent to altitude after diving**

Leaving the dive site may require temporary ascent to a higher altitude. For example, divers may drive over a mountain pass at higher altitude or leave the dive site by air. Ascent to altitude after diving increases the risk of decompression sickness because of the additional reduction in atmospheric pressure. The higher the altitude, the greater the risk.

Table E gives the surface interval (hours:minutes) required before making a further ascent to altitude. The surface interval depends on the planned increase in altitude and the highest repetitive group designator obtained in the previous 24 hour period. Enter the table with the highest repetitive group designator obtained in the previous 24 hour period. Read the required surface interval from the column for the planned change in altitude. Note that Section 5.5 of this document requires a minimum surface interval of 18 hours following multiple dives per day or multiple days of diving; therefore use the longest hour surface interval calculated in Table E or 18 hours, whichever is greater.

**Example:** A diver surfaces from a 18 msw for 60 minutes no-decompression dive at sea level in Repetitive Group K. After a surface interval of 6 hours 10 minutes, the diver makes a second dive to 9 metres for 20 minutes placing them in Repetitive Group F. They plan to ascend to 2400 metres in order to cross a mountain pass. What is the required interval before ascending to altitude?

The planned increase in altitude is 2400 m. Because the diver has made two dives in the previous 24-hour period, you must use the highest repetitive group designator of the two dives. Enter Table E at 2400 m and read down to Repetitive Group K. The diver must wait 15 hours 35 minutes after completion of the second dive before ascending to altitude. However, in accordance with this technical document, an 18 hour surface interval is required.

**Table A. US Navy no-decompression limits and repetitive group designators for no-decompression air dives**

Depth (msw)	Depth (fsw)	nDL (mins)	Repetitive group designation															
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Z
3	10	unlimited	57	101	158	245	426	*										
6	20	unlimited	26	43	61	82	106	133	165	205	256	330	461	*				
9	30	371	17	27	38	50	62	76	91	107	125	145	167	193	223	260	307	371
12	40	163	12	20	27	36	44	53	63	73	84	95	108	121	135	151	163	
15	50	92	9	15	21	28	34	41	48	56	63	71	80	89	92			
18	60	60	7	12	17	22	28	33	39	45	51	57	60					
21	70	48	6	10	14	19	23	28	32	37	42	47	48					
24	80	39	5	9	12	16	20	24	28	32	36	39						
27	90	30	4	7	11	14	17	21	24	28	30							
30	100	25	4	6	9	12	15	18	21	25								
33	110	20	3	6	8	11	14	16	19	20								
36	120	15	3	5	7	10	12	15										
39	130	10	2	4	6	9	10											
42	140	10	2	4	6	8	10											

\*Highest repetitive group that can be given at this depth regardless of bottom time

**Bottom times are given in minutes** and include the time it takes to descend and the actual time spent at depth before the final ascent

**Ascent rate** is 9m (30') plus or minus 3m (10') per minute

**No-decompression limits (nDL)** are given for first dives

See Table B for **Minimum Surface Intervals and repetitive nitrogen times for repetitive dives**

See Table C for **Decompression tables when nDLs are exceeded**

See Table D for **Depth Corrections** required at Altitudes above 300m (1000')

**Table B. US Navy residual nitrogen timetable for repetitive dives.** Locate the diver's repetitive group designation from their previous dive along the diagonal line above the table. Read horizontally to the interval in which the diver's surface interval lies. Next, read vertically downward to the new repetitive group designation. Continue downward in this same column to the row that represents the depth of the repetitive dive. The time given at the intersection is residual nitrogen time, in minutes, to be applied to the repetitive dive. \* Dives following surface intervals longer than this are not repetitive dives. Use actual bottom times in Table A to compute decompression for such dives.

		Repetitive group at beginning of surface interval													A															
															:10	2:20 *														
															B															
															:10	1:17														
															1:16	3:36 *														
															C															
															:10	:56	2:12													
															:55	2:11	4:31 *													
															D															
															:10	:53	1:48	3:04												
															:52	1:47	3:03	5:23 *												
															E															
															:10	:53	1:45	2:40	3:56											
															:52	1:44	2:39	3:55	6:15 *											
															F															
															:10	:53	1:45	2:38	3:32	4:49										
															:52	1:44	2:37	3:31	4:48	7:08 *										
															G															
															:10	:53	1:45	2:38	3:30	4:24	5:41									
															:52	1:44	2:37	3:29	4:23	5:40	8:00 *									
															H															
															:10	:53	1:45	2:38	3:30	4:22	5:17	6:33								
															:52	1:44	2:37	3:29	4:21	5:16	6:32	8:52 *								
															I															
															:10	:53	1:45	2:38	3:30	4:22	5:14	6:09	7:25							
															:52	1:44	2:37	3:29	4:21	5:13	6:08	7:24	9:44 *							
															J															
															:10	:53	1:45	2:38	3:30	4:22	5:14	6:07	7:01	8:17						
															:52	1:44	2:37	3:29	4:21	5:13	6:06	7:00	8:16	10:36 *						
															K															
															:10	:53	1:45	2:38	3:30	4:22	5:14	6:07	6:59	7:53	9:10					
															:52	1:44	2:37	3:29	4:21	5:13	6:06	6:58	7:52	9:09	11:29 *					
															L															
															:10	:53	1:45	2:38	3:30	4:22	5:14	6:07	6:59	7:51	8:45	10:02				
															:52	1:44	2:37	3:29	4:21	5:13	6:06	6:58	7:50	8:44	10:01	12:21 *				
															M															
															:10	:53	1:45	2:38	3:30	4:22	5:14	6:07	6:59	7:51	8:43	9:38	10:54			
															:52	1:44	2:37	3:29	4:21	5:13	6:06	6:58	7:50	8:42	9:37	10:53	13:13 *			
															N															
															:10	:53	1:45	2:38	3:30	4:22	5:14	6:07	6:59	7:51	8:43	9:35	10:30	11:46		
															:52	1:44	2:37	3:29	4:21	5:13	6:06	6:58	7:50	8:42	9:34	10:29	11:45	14:05 *		
															O															
															:10	:53	1:45	2:38	3:30	4:22	5:14	6:07	6:59	7:51	8:43	9:35	10:28	11:22	12:38	
															:52	1:44	2:37	3:29	4:21	5:13	6:06	6:58	7:50	8:42	9:34	10:27	11:21	12:37	14:58 *	
															Z															
															:10	:53	1:45	2:38	3:30	4:22	5:14	6:07	6:59	7:51	8:43	9:35	10:28	11:20	12:14	13:31
															:52	1:44	2:37	3:29	4:21	5:13	6:06	6:58	7:50	8:42	9:34	10:27	11:19	12:13	13:30	15:50 *
		Repetitive group at end of surface interval																												
Depth (msw)	Depth (fsw)	Z	O	N	M	L	K	J	I	H	G	F	E	D	C	B	A													
3	10	**	**	**	**	**	**	**	**	**	**	**	**	427	246	159	101	58												
6	20	**	**	**	**	**	462	331	257	206	166	134	106	83	62	44	27													
9	30	372 <sup>‡</sup>	308	261	224	194	168	146	126	108	92	77	63	51	39	28	18													
12	40	188 <sup>‡</sup>	169 <sup>‡</sup>	152	136	122	109	97	85	74	64	55	45	37	29	21	13													
15	50	131 <sup>‡</sup>	120 <sup>‡</sup>	109 <sup>‡</sup>	99 <sup>‡</sup>	90	81	73	65	57	49	42	35	29	23	17	11													
18	60	101 <sup>‡</sup>	93 <sup>‡</sup>	86 <sup>‡</sup>	79 <sup>‡</sup>	72 <sup>‡</sup>	65 <sup>‡</sup>	58	52	46	40	35	29	24	19	14	9													
21	70	83 <sup>‡</sup>	77 <sup>‡</sup>	71 <sup>‡</sup>	65 <sup>‡</sup>	59 <sup>‡</sup>	54 <sup>‡</sup>	49 <sup>‡</sup>	44	39	34	29	25	20	16	12	8													
24	80	70 <sup>‡</sup>	65 <sup>‡</sup>	60 <sup>‡</sup>	55 <sup>‡</sup>	51 <sup>‡</sup>	46 <sup>‡</sup>	42 <sup>‡</sup>	38	33	29	25	22	18	14	10	7													
27	90	61 <sup>‡</sup>	57 <sup>‡</sup>	52 <sup>‡</sup>	48 <sup>‡</sup>	44 <sup>‡</sup>	41 <sup>‡</sup>	37 <sup>‡</sup>	33 <sup>‡</sup>	29	26	22	19	16	12	9	6													
30	100	54 <sup>‡</sup>	50 <sup>‡</sup>	47 <sup>‡</sup>	43 <sup>‡</sup>	40 <sup>‡</sup>	36 <sup>‡</sup>	33 <sup>‡</sup>	30 <sup>‡</sup>	26 <sup>‡</sup>	23	20	17	14	11	8	5													
33	110	48 <sup>‡</sup>	45 <sup>‡</sup>	42 <sup>‡</sup>	39 <sup>‡</sup>	36 <sup>‡</sup>	33 <sup>‡</sup>	30 <sup>‡</sup>	27 <sup>‡</sup>	24 <sup>‡</sup>	21 <sup>‡</sup>	18	16	13	10	8	5													
36	120	44 <sup>‡</sup>	41 <sup>‡</sup>	38 <sup>‡</sup>	35 <sup>‡</sup>	32 <sup>‡</sup>	30 <sup>‡</sup>	27 <sup>‡</sup>	24 <sup>‡</sup>	22 <sup>‡</sup>	19 <sup>‡</sup>	17 <sup>‡</sup>	14	12	9	7	5													
39	130	40 <sup>‡</sup>	37 <sup>‡</sup>	35 <sup>‡</sup>	32 <sup>‡</sup>	30 <sup>‡</sup>	27 <sup>‡</sup>	25 <sup>‡</sup>	22 <sup>‡</sup>	20 <sup>‡</sup>	18 <sup>‡</sup>	15 <sup>‡</sup>	13 <sup>‡</sup>	11 <sup>‡</sup>	9	6	4													
42	140	37 <sup>‡</sup>	34 <sup>‡</sup>	32 <sup>‡</sup>	30 <sup>‡</sup>	27 <sup>‡</sup>	25 <sup>‡</sup>	23 <sup>‡</sup>	21 <sup>‡</sup>	19 <sup>‡</sup>	16 <sup>‡</sup>	14 <sup>‡</sup>	12 <sup>‡</sup>	10 <sup>‡</sup>	8	6	4													
Residual nitrogen time (minutes)																														

\*\* Residual Nitrogen Time is undefined because tissue nitrogen loading associated with these repetitive groups is higher than the nitrogen loading that can be achieved if a diver was to remain at 3 or 6 meters for an infinite period of time. A diver entering a dive with a residual nitrogen time marked by an asterisk can still perform a repetitive dive at 3 or 6 meters because the no-decompression limit at those depths is unlimited. If a subsequent dive is planned, assume that the repetitive group remains unchanged during the course of the dive at 3 or 6 meters.

‡ Residual Nitrogen Time exceeds nDL; therefore, a longer surface interval is required before undertaking a repetitive dive.



**Table C. US Navy air decompression table.** Note, decompression diving is not permitted as part of Departmental diving procedures; however, if nDL limits are exceeded, divers should undertake in-water decompression as detailed in this table. For bottom times exceeding the nDL limit, required decompression stops at 6 m are indicated in ( ).

Depth (msw)	Depth (fsw)	nDL (mins)	Bottom time and required decompression stop (min) at 6 m							
3	10	unlimited	-	-	-	-	-	-	-	-
6	20	unlimited	-	-	-	-	-	-	-	-
9	30	371	380 (5)	420 (22)	480 (42)	540 (71)	600 (92)	680 (120)	720 (158)	
12	40	163	170 (6)	180 (14)	190 (21)	200 (27)	210 (39)	220 (51)	230 (64)	240 (75)
15	50	92	95 (2)	100 (4)	110 (8)	120 (21)	130 (34)	140 (45)	150 (56)	160 (78)
18	60	60	65 (2)	70 (7)	80 (14)	90 (23)	100 (42)	110 (57)	120 (75)	
21	70	48	50 (2)	55 (9)	60 (14)	70 (24)	80 (44)	90 (64)	100 (88)	
24	80	39	40 (1)	45 (10)	50 (17)	55 (24)	60 (30)	70 (54)	80 (77)	
27	90	30	35 (4)	40 (14)	45 (23)	50 (31)	55 (39)	60 (56)	70 (83)	
30	100	25	30 (3)	35 (15)	40 (26)	45 (36)	50 (47)	55 (65)	60 (81)	
33	110	20	25 (3)	30 (14)	35 (27)	40 (39)	45 (50)	50 (71)		
36	120	15	20 (2)	25 (8)	30 (24)	35 (38)	40 (51)	45(72)		
39	130	10	15 (1)	20 (4)	25 (17)	30 (34)	35 (49)			
42	140	10	15 (2)	29 (7)	25 (26)	30 (44)				

**Table D. US Navy Sea Level Equivalent Depth in meters (ft).**

Depth (msw)	Depth (fsw)	Altitude (m)									
		300	600	900	1200	1500	1800	2100	2400	2700	3000
3	10	3 (10)	5 (15)	5 (15)	5 (15)	5 (15)	5 (15)	5 (15)	5 (15)	5 (15)	5 (15)
6	20	6 (15)	8 (25)	8 (25)	8 (25)	8 (25)	8 (25)	8 (25)	9 (30)	9 (30)	9 (30)
9	30	9 (30)	11 (35)	11 (35)	11 (35)	12 (40)	12 (40)	12 (40)	14 (45)	14 (45)	14 (45)
12	40	12 (40)	14 (45)	14 (45)	15 (50)	15 (50)	15 (50)	17 (55)	17 (55)	18 (60)	18 (60)
15	50	15 (50)	17 (55)	18 (60)	18 (60)	21 (70)	21 (70)	21 (70)	21 (70)	21 (70)	24 (80)
18	60	18 (60)	21 (70)	21 (70)	21 (70)	24 (80)	24 (80)	24 (80)	27 (90)	27 (90)	27 (90)
21	70	21 (70)	24 (80)	24 (80)	27 (90)	27 (90)	27 (90)	30 (100)	30 (100)	30 (100)	33 (110)
24	80	24 (80)	27 (90)	27 (90)	30 (100)	30 (100)	30 (100)	33 (110)	33 (110)	36 (120)	36 (120)
27	90	27 (90)	30 (100)	33 (110)	33 (110)	33 (110)	36 (120)	36 (120)	39 (130)	39 (130)	42 (140)
30	100	30 (100)	33 (110)	36 (120)	36 (120)	39 (130)	39 (130)	39 (130)	42 (140)	42 (140)	-
33	110	33 (110)	36 (120)	39 (130)	39 (130)	42 (140)	42 (140)	-	-	-	-
36	120	36 (120)	39 (130)	42 (140)	42 (140)	-	-	-	-	-	-
39	130	39 (130)	42 (140)	-	-	-	-	-	-	-	-
Depth (msw)	Depth (fsw)	Equivalent stop depths (m)									
6	20	6 (19)	6 (19)	5.5 (18)	5.5 (17)	5.5 (17)	5 (16)	4.5 (15)	4.5 (15)	4.5 (14)	4.5 (14)
9	30	9 (29)	8.5 (28)	8 (27)	8 (26)	7.5 (25)	7.5 (24)	7 (23)	6.5 (22)	6.5 (21)	6.5 (21)
12	40	12 (39)	11.5 (37)	11 (36)	10.5 (35)	10 (33)	10 (32)	9.5 (31)	9 (30)	9 (29)	8.5 (28)

**Table E. Required surface interval before ascent to altitude after diving.**

Repetitive group	Increase in altitude (m)										
	300	600	900	1200	1500	1800	2100	2400	2700	3000	
A	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
B	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	1:42
C	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	1:48	6:23
D	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00	1:45	5:24	9:59
E	0:00	0:00	0:00	0:00	0:00	0:00	0:00	1:37	4:39	8:18	12:54
F	0:00	0:00	0:00	0:00	0:00	1:32	4:04	7:06	10:45	15:20	
G	0:00	0:00	0:00	0:00	1:19	3:38	6:10	9:13	12:52	17:27	
H	0:00	0:00	0:00	1:06	3:10	5:29	8:02	11:04	14:43	19:18	
I	0:00	0:00	0:56	2:45	4:50	7:09	9:41	12:44	16:22	20:58	
J	0:00	0:41	2:25	4:15	6:19	8:39	11:11	14:13	17:52	22:27	
K	0:30	2:03	3:47	5:37	7:41	10:00	12:33	15:35	19:14	23:49	
L	1:45	3:18	5:02	6:52	8:56	11:15	13:48	16:50	20:29	25:04	
M	2:54	4:28	6:12	8:01	10:06	12:25	14:57	18:00	21:38	26:14	
N	3:59	5:32	7:16	9:06	11:10	13:29	16:02	19:04	22:43	27:18	
O	4:59	6:33	8:17	10:06	12:11	14:30	17:02	20:05	23:43	28:19	
Z	5:56	7:29	9:13	11:03	13:07	15:26	17:59	21:01	24:40	29:15	

**NOTE 1** Use of this table does not remove the requirement to meet the minimum surface intervals before travelling to altitude that are presented in Section 5.5 of this document.

**NOTE 2** When using Table E, use the highest repetitive group designator obtained in the previous 24-hour period.

**NOTE 3** Table E may only be used when the maximum altitude achieved is 3,000 m or less.

**NOTE 4** The cabin pressure in commercial aircraft is maintained at a constant value regardless of the actual altitude of the flight. Though cabin pressure varies somewhat with aircraft type, the nominal value is 2,400 m. For commercial flights, use a final altitude of 2,400 feet to compute the required surface interval before flying.

**NOTE 5** No surface interval is required before taking a commercial flight if the dive site is at 2,400 feet or higher. In this case, flying results in an increase in atmospheric pressure rather than a decrease.

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**Amendments**

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