Australian/New Zealand Standard™

Occupational diving operations

Part 2: Scientific diving

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee SF-017, Occupational Diving.

This Standard is Part of a series of Standards for the conduct of occupational diving operations. Diving operations which fall into the scope of this sector-specific Standard may be conducted using either this Standard or AS/NZS 2299.1, *Occupational diving operations* Part 1: *Standard operational practice.*

This Standard is based on a draft prepared by the Australian Marine Sciences Association. An earlier version of the draft was released for comment by Standards Australia Committee MS-053, Scientific Diving, in 1991.

The provision of guidance on delay times between diving and altitude exposure was considered at length during preparation of this Standard. Internationally, there are many different recommendations regarding appropriate limits for altitude exposure following diving and extensive public comment was received which made it clear that previous delay to altitude exposure tables have been interpreted as rules which were excessively restrictive for certain situations. Local and international diving medicine experts were consulted and the Committee agreed to encourage diving operators to obtain specialist advice to assist in working out delay protocols to suit their particular situation prior to the diving operation's commencement. It was also agreed to continue to include one set of guidelines that may be used when an individualized protocol had not been arranged but these guidelines have been moved to an informative appendix to reinforce their status as one consensus recommendation only, rather than the definitive publication on this subject. The values in the guidelines provided in this Standard are generally consistent with other published guidelines. The importance of normal health before travel to altitude has been emphasized in view of the frequency with which altitude associated decompression illness seems to be preceded by at least some pre-travel warning symptoms.

The Committee also sought local and overseas expert opinion concerning on-site compression chamber availability requirements. Public comment requested that the Committee consider the difficulty in applying the risk-based table in the Draft for Comment, which was a minor update of that published in the 1999 edition of AS/NZS 2299.1. Particular difficulties were raised with applying this table to repetitive dives and there were requests for the use of the no-decompression limits in the Canadian Defence and Civil Institute of Environmental Medicine (DCIEM) decompression tables as a versatile, consistent and readily implementable alternative means of determining compression chamber needs. The risk-based table was originally introduced to make requirements for compression chamber support more evidence based. The Committee acknowledged that whilst the previous table was based upon decompression illness risk equivalence, the decompression illness (DCI) risk levels chosen to require chamber availability and the travel times selected were derived from expert opinion rather than hard data. Further, while the data set used as the original table's source is the largest, most analysed set available, the dives that provided the data may not necessarily reflect the types of dives conducted during onshore commercial diving and scientific diving, where multi-level dive profiles are often used. The Committee, therefore, agreed to the request to use DCIEM table limits, which were noted to have received extensive field usage in a range of types of diving.

While investigations indicated DCIEM tables could be used for some dive depths, DCIEM suggested to the Committee that more conservative limits should be set for dive depths up to 12 m. The resultant process published in this Standard for determining the level of compression chamber support required for a diving operation is considered suitable for application to the types of diving covered by both this Standard and by AS/NZS 2299.1. It

is intended to revise the corresponding compression chamber availability requirements in AS/NZS 2299.1:1999 in a similar manner. It should be noted that reliance solely upon dive depth and time for determining compression chamber needs was not supported. Requirements for on-site chamber support of dives involving certain types of work or factors that significantly increased risk of arterial gas embolism or high gas load/rapid progression decompression illness have been included.

Also in early deliberations, the Committee planned to use the competencies for scientific divers set out in Appendix A of this Standard as new text for some Parts of the AS 2815 series on training and certification of occupational divers when it was revised. However, it became apparent that the alignment of competencies and training course contents for the scientific sector of the diving industry and for those who used the AS 2815 series was not achievable in the short term. Regulatory interests registered particular concern over the limited range of training exercises required prior to qualification as a scientific diver. The Australian Diver Accreditation Scheme and The National Association of Occupational Diver Training Establishments (Australia) considered the training was reduced too much from that in the AS 2815 series and a mechanism for quality assurance of certification providers should be included. The Committee intends to continue working towards a time when competency and training details align with new qualifications in a revised AS 2815 series that provides competencies for each form of occupational diving.

The illustrations for the hand signals shown in Appendix C are reproduced with the permission of PADI Asia Pacific Pty Ltd.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

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SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies requirements for occupational underwater diving operations performed at a place of work for the purpose of professional scientific research, natural resource management or scientific research as an educational activity. This Standard applies to diving in water to depths not exceeding 39 m in the case of no-decompression diving and 30 m otherwise, where breathing gas is supplied through either self-contained underwater breathing apparatus (SCUBA) or surface-supplied breathing apparatus (SSBA).

NOTE: Without limiting the scope of this Standard, there may be diving tasks or situations which require a scientific diver to operate under other diving standards.

This Standard includes requirements and recommendations for personnel, procedures and the equipment and breathing medium supply utilized, together with appendices containing the following:

(a) Personal records of divers.

(b) Examples of employer's records of dives.

(c) Contents of a diving operations manual.

(d) Hand signals.

(e) Lifeline signals.

(f) Qualification levels for scientific divers.

1.2 OBJECTIVE

The objective of this Standard is to provide the scientific diving industry with a set of minimum requirements to provide uniformity of practice in relation to the health and safety of those people engaged in occupational underwater operations for the purpose of scientific diving.

1.3 APPLICATION

This Standard applies to persons directly involved in scientific diving operations, organizations employing those persons and industries supplying equipment for use in connection with scientific diving operations. This Standard has been developed for diving activities using air or oxygen-nitrogen mixtures where the oxygen concentration is in the range of 20% to 22%. Although this Standard may be used for guidance for diving activities using oxygen-nitrogen mixtures with higher or lower concentrations, additional training and procedures will be necessary. Similarly, this Standard may be used for guidance for diving activities in liquids other than water and for breathing apparatus such as rebreather units with the appropriate additional training and procedures.

This Standard does not apply to—

(a) recreational diving;

(b) diving by undergraduate students in tertiary courses;

(c) diving beyond 39 m depth; and

(d) diving covered by other Standards in the AS/NZS 2299 series.

NOTES:

1 For the types of diving in Items (a), (b) and (c) above, the relevant regulatory authority should be consulted.

2 Specialized gas mixing, filling, analysis and diving procedures are necessary for safe diving using breathing gases other than air. In particular, special equipment selection and cleaning procedures are needed for diving using oxygen enriched gas mixtures. These additional procedures for using breathing gases other than air should be included in the diving operations manual.

1.4 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

1210 Pressure vessels

1885 Measurement of occupational health and safety performance

1885.1 Part 1: Describing and reporting occupational injuries and disease (known as the National Standard for workplace injury and disease recording)

2030 The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases

2030.1 Part 1: Cylinders for compressed gases other than acetylene

2815 Training and certification of occupational divers

2815.1 Part 1: SCUBA diving to 30 m

2815.2 Part 2: Air diving to 30 m

2815.3 Part 3: Air diving to 50 m

2815.4 Part 4: Bell diving

3848 Filling of portable gas cylinders

3848.2 Part 2: Filling of portable cylinders for self-contained underwater breathing apparatus (SCUBA) and non-underwater self-contained breathing apparatus (SCBA)—Safe procedures

4484 Industrial, medical and refrigerant compressed gas cylinder identification

AS/NZS

1337 Eye protectors for industrial applications

2299 Occupational diving operations

2299.1 Part 1: Standard operational practice

ISO

2230 Vulcanized rubber—Guide to storage

Commonwealth of Australia
National Measurement Act 1960

International Maritime Organization
International Regulations for Preventing Collisions at Sea (1972)

National Occupational Health and Safety Commission

NOHSC
1010 National standard for plant

New Zealand Government
Health and Safety in Employment Regulations 1995

UNESCO
UNESCO Technical Papers in Marine Science 53, Code of Practice for Scientific Diving (1990). Eds. N.C. Flemming and M.D. Max

1.5 DEFINITIONS

For the purpose of this Standard, the definitions below apply.

1.5.1 Belt block

A redundant breathing gas supply system that has its controls positioned at the front of the diver's body on a belt.

1.5.2 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.

1.5.3 Breathing hoses

Hoses attached to a regulator that are designed to—

(a) supply breathing gas to the diver;

(b) carry away expired breathing gas; and

(c) operate at near ambient pressure.

1.5.4 Buddy diver

A member of a group of two or three divers.

1.5.5 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.

1.5.6 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, decompression or training purposes.

1.5.7 Decompression illness

A generic term for acute illness resulting when pathological consequences arise from decompression. This term covers the condition known as 'decompression sickness' (also known as 'bends') and arterial gas embolism, but does not include barotrauma of ascent.

1.5.8 Decompression schedule

A specific decompression procedure for a given combination of depth and bottom time as listed in a decompression table; it is normally described in terms of maximum depth (MSW) and bottom time (minutes).

1.5.9 Decompression stop

The specified length of time which 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.

1.5.10 Dive coordinating position

A single, designated location on the surface, adjacent to where a diver enters the water, from which the diver's safety is monitored.

1.5.11 Dive coordinator

A person who supervises and coordinates any dive and is responsible for dive team safety.

1.5.12 Dive leader

A person in charge of a specific part of a diving operation.

1.5.13 Diver

A person who performs diving work underwater and who, for the purposes of this Standard, is trained and experienced in accordance with one of the categories described in Appendix A.

1.5.14 Diving officer

A person who has been nominated in writing by the employer and is ultimately responsible for all diving activities.

1.5.15 Diving program

One or more dives that are related by purpose, place or time to form a series.

1.5.16 Diving team

Divers and support personnel operating together.

1.5.17 Diving work

Work in which diving is conducted using underwater breathing apparatus, including work by the dive team in direct support of the diver.

1.5.18 Effective bottom time (EBT)

For a diver carrying out repetitive diving, the bottom time calculated after taking into consideration the residual nitrogen from previous dives.

1.5.19 Effective depth

For a dive at altitude, the depth of an equivalent dive at sea level.

1.5.20 Exceptional exposure dive

A dive where the maximum recommended dive time for a particular depth (shown by the limiting line in decompression tables) is exceeded by a diver at that depth.

1.5.21 Float line

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.

1.5.22 Free flow system

A breathing method used in SSBA diving operations whereby breathing gas enters the full face mask or incompressible helmet in a continuous flow, and is not controlled by a demand gas supply device.

1.5.23 Habitat worker

Any person who is subject to pressure but who does not physically enter the water. The person is not enveloped by water even though that person may be in a housing, a diving chamber that is, in itself, under or in a water environment.

1.5.24 Lazy shot

A rope running vertically from the surface (dive coordinating position) to an attached weight, hanging free and positioned off the bottom or worksite. The rope is marked with depth graduations to facilitate decompression stops at the correct depth.

1.5.25 Lifeline

A line attached to a diver which is capable of being used to haul the diver to the surface.

1.5.26 Limiting line

A line shown in some decompression tables, which indicates time limits (bottom times) beyond which decompression schedules are less safe.

1.5.27 Multiplace compression chamber

A hyperbaric chamber designed for occupancy by more than one person at a time.

1.5.28 Occupational diving

Diving performed in the course of employment (irrespective of whether or not diving is the principal function of employment or merely an adjunct to it) and comprising all diving carried out—

(a) as part of a business;

(b) as a service;

(c) for research; or

(d) for profit.

1.5.29 Quick release mechanism

A readily operated mechanism that enables the immediate release, e.g. of diver's equipment, from the secured position by a single operation of one hand, but which is designed to minimize the risk of accidental release.

1.5.30 Repetitive dive

Any dive conducted within 18 h of a previous dive or that has a repetitive factor greater than 1.0 when calculated using DCIEM tables.

1.5.31 Repetitive factor

For DCIEM tables, a figure determined by the repetitive dive group and the length of the surface interval after a dive and used for repetitive diving.

1.5.32 Reserve air supply

That quantity of air that will enable a diver to return safely to the surface from the planned depth of the dive, completing any planned decompression stops.

1.5.33 Residual nitrogen

Nitrogen that is still dissolved in a diver's body tissues after the diver has surfaced.

1.5.34 Saturation

That condition where the person's body tissues are totally saturated with the particular inert element of the breathing medium.

1.5.35 Scientific diving

Diving performed for the purpose of professional scientific research, natural resource management or scientific research as an educational activity.

1.5.36 Self-contained underwater breathing apparatus (SCUBA)

Open-circuit diving equipment which supplies the wearer with breathing gas from cylinders carried by the wearer.

1.5.37 Shall

Indicates that a statement is mandatory.

1.5.38 Shot rope

A rope running vertically from the surface (dive coordinating position) and fixed to the worksite or bottom with a weight or attachment. The rope is marked with depth graduations to facilitate decompression stops at the correct depth. See also Clause 1.5.24 'lazy shot'.

1.5.39 Should

Indicates a recommendation.

1.5.40 Submersible work chamber

A chamber designed to withstand both external and internal pressures, which enables divers to descend and ascend from their submerged workplace at atmospheric pressure or pressures up to the pressures at work depth. The chamber may be able to be mated to deck compression chambers.

1.5.41 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 descent.

1.5.42 Surface-supplied breathing apparatus (SSBA)

Diving equipment that supplies breathing gas at the required pressure for the depth, through a diver's hose to a diver from plant at the surface.

1.5.43 Tethered mode (in relation to SCUBA diving)

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.

1.5.44 Therapeutic recompression tables

Tables used for the treatment of decompression injury and other pressure-related injuries.

1.5.45 Transfer-under-pressure (TUP) system

A system for mating a portable compression chamber to another chamber for the purpose of transferring a person under pressure from one chamber to the other.

1.5.46 Visiting scientific diver

A trained, certified visiting diver from another country who performs tasks relevant to scientific diving in his or her own country, who has a current diving medical certification and who is allowed to dive under this Standard during his or her visit (see Section 8).

1.6 RELATIONSHIP WITH LEGISLATION

Attention is drawn to relevant occupational health and safety legislation.

SECTION 2 PERSONNEL FOR DIVING OPERATIONS

2.1 EMPLOYER

The employer shall—

(a) establish an effective administrative system for the management and control of diving;

(b) have and maintain a current diving operations manual complying with Appendix B;

(c) appoint a diving officer in writing (see Clause 2.2); and

(d) delegate to the diving officer authority and control for all aspects of the organization and administration of diving.

2.2 DIVING OFFICER

The diving officer shall—

(a) be an experienced diver with the qualifications set out in Paragraph A6 of Appendix A and with experience appropriate to the type of diving operations undertaken;

(b) be familiar with any legislation and guidelines which may apply to the diving operations, and ensure compliance with this Standard and with the employer's diving operations manual;

(c) have the power to restrict, prohibit or suspend any diving operations, program or practice which he or she considers unsafe;

(d) have the power to require such additional safety practices, procedures or equipment as he or she thinks necessary in any diving operation; and

(e) assess diver's competencies and record the evidence used in the assessment.

NOTE: This Clause outlines the minimum administrative requirement. Employers should establish an administrative system and chain of command commensurate with the number and size of groups or departments engaged in diving within the organization. Examples of systems of organization are given in the UNESCO *Code of Practice for Scientific Diving*.

2.3 DIVE COORDINATOR

2.3.1 Availability

At all times while a diver is in the water or under pressure in a compression chamber, there shall be present a dive coordinator appointed by the diving officer. The dive coordinator shall at all times be responsible for the safe conduct of the diving and shall coordinate and direct the activity of the diving teams.

2.3.2 Qualifications of a dive coordinator

A dive coordinator shall be—

(a) a trained, experienced diver, qualified in accordance with Paragraph A5 of Appendix A who has experience in the diving techniques which may be required to be used and in the use of equipment and procedures used in the diving operation to be performed;

(b) appointed in writing by the diving officer to supervise diving operations; and

(c) trained in the recognition and management of diving emergencies.

2.3.3 Duties of dive coordinators

A dive coordinator shall ensure that all diving operations under supervision are carried out in accordance with this Standard and shall be familiar with any legislative requirements which may be applicable to the diving operations.

2.4 DIVE LEADER

A dive leader is a person in charge of a specific part of a diving operation. A dive leader shall be—

(a) the dive coordinator or a person appointed by the dive coordinator; or

(b) a scientific diver or a visiting scientific diver with adequate knowledge and experience of the diving techniques and equipment to be used.

When a dive leader is the person in charge of a single group of divers who are diving in free-swimming SCUBA mode, that person shall take responsibility for any decisions required as the dive proceeds, in consultation with the dive coordinator, and—

(i) ensure other buddy diver(s) in the group are familiar with the pre-dive plan; and

(ii) conduct the dive in accordance with this Standard and, as far as possible, in accordance with the pre-dive plan.

2.5 DIVER

2.5.1 Qualifications

No person shall employ, instruct or allow any person to act as a diver, and no dive shall be carried out, unless the diver—

(a) is trained, experienced and certified in diving to competency levels appropriate for the diving operation as set out in Appendix A;

(b) is competent to safely carry out the work required in the operation; and

(c) has been certified as medically fit to dive in accordance with the requirements of AS/NZS 2299.1 by a medical practitioner appropriately trained in underwater medicine within 12 months prior to diving (see Clause 2.8.1).

The level of training and experience required by a diver considered a competent person is largely dependent upon the type of equipment or diving apparatus being employed and an assessment of the risks likely to be met, e.g. a diver being employed in a situation calling for the use of SCUBA need not be conversant with the use of SSBA.

2.5.2 Duties

A diver shall—

(a) ensure that he or she is familiar with the pre-dive plan before diving;

(b) dive in accordance with the pre-dive plan; and

(c) act as a buddy diver during the dive to others in his or her designated buddy group, unless diving alone in tethered SCUBA mode or alone on SSBA.

Free-swimming buddy divers shall maintain effective two-way communication with each other at all times while in the water and be able to render assistance in case of need.

2.6 DIVER'S ATTENDANT

2.6.1 Availability and knowledge

Whenever a tethered diver goes underwater or is subjected to pressure, the diver shall be attended by a diver's attendant who shall be competent to administer cardiopulmonary resuscitation (CPR) and oxygen resuscitation and have a working knowledge of the following:

(a) Diving and the requirements of underwater work.

(b) Signals in use, in particular, the systems of hand and rope signals to be used in the diving operations. Commonly used signals are set out in Appendix C and Appendix D.

(c) Decompression procedures.

(d) Diving equipment in use, including ancillary fittings such as pressure gauges, compressors and filters.

The diver's attendant shall not be engaged, other than as specified in Clauses 5.2 or 6.2, in any task other than that of diver's attendant while the diver is in the water or under pressure.

2.6.2 Duties

The diver's attendant, or other person nominated by the dive coordinator, shall—

(a) record the time of descent and surfacing of each diver;

(b) maintain a constant vigil during a dive for divers surfacing at a distance from the boat or other dive control position;

(c) assist in the recovery of divers and all equipment and samples from the water;

(d) 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;

(e) give all necessary attention to tending the diver whilst that diver is in the water; and

(f) if a surface-supply compressor is in use, operate same and ensure that all equipment necessary to provide an adequate supply of air to the diver is in good working order.

2.7 STANDBY DIVER

2.7.1 General

A standby diver shall be present whenever a single diver is underwater in tethered mode, and shall be—

(a) medically fit to dive in accordance with the requirements of AS/NZS 2299.1 (see Clause 2.8.1);

(b) a qualified diver (see Clause 2.5.1); and

(c) located on the surface, dressed and equipped to enable immediate entry into the water for the purpose of providing aid or assistance to a distressed diver.

NOTE: The surface standby diver may perform certain minor duties (e.g. tending the diver's hose or lifeline) provided the safety of the diver in the water is not compromised in any way.

2.7.2 Two divers in the water

Where two divers are in the water at the same time, one may act as standby diver for the other provided that, at all times, both divers have—

(a) no decompression commitment;

(b) visual contact with, and direct access to, each other; and

(c) for SSBA operations, separate air supplies as set out in Clause 4.7.3.2.

2.7.3 Dive profile

The dive profile of the standby diver shall be planned to allow all necessary assistance to be given to a distressed diver without the standby diver incurring a decompression commitment. The only exceptions to this shall be—

(a) in an emergency; or

(b) when the depth of the water is such that the standby diver will automatically incur a decompression commitment.

2.8 SUPERVISION OF HEALTH

2.8.1 Certification by a medical practitioner

No person shall dive or be subjected to pressure unless that person has been examined and certified as fit in accordance with AS/NZS 2299.1. A certificate of fitness to dive shall have been issued by a medical practitioner with training in underwater medicine within the 12 months prior to diving.

NOTE: An increase in the frequency of examinations in individual cases is at the discretion of the medical practitioner.

2.8.2 Fitness to dive

All divers involved in diving shall ensure that they are fit to dive. Fitness should be maintained by exercise and regular diving. Any noticeable variation in normal feeling of health and fitness should be immediately reported to the dive leader, and to a medical practitioner if the variation persists.

Where a diver has not dived for a period of time exceeding six months, the diver shall carry out a check out dive or program of dives with the diving officer or the diving officer's delegate qualified to undertake such an evaluation. The nature of the checkout program is at the discretion of the diving officer and should consider the diver's previous training and experience, the time lapsed since the last scientific dive, the profile of the proposed dive, and the nature of the dive site and work to be undertaken on the proposed dive.

2.8.3 Intoxicants

Diving should not be undertaken while the diver is under the influence of any intoxicants, within 8 h of consuming any intoxicants or if the diver is under the influence of any drugs that may impair his or her mental or physical capacities.

2.9 FIRST AID FOR DIVING TEAMS

At every diving operation there shall be sufficient first aid personnel to administer first aid to any reasonably foreseeable emergency.

All divers and attendants should be trained in first aid so that, as a minimum, they are able to—

(a) control bleeding;

(b) administer 100% oxygen to spontaneously breathing patients and oxygen-enriched resuscitation to non-breathing patients using the oxygen resuscitation equipment at the dive site (as specified in Clause 3.13);

(c) care for an unconscious patient; and

(d) carry out cardiopulmonary resuscitation.

NOTES:

1 The above requirements are usually met by a first aid course leading to certification, incorporating or supplemented by an oxygen administration course.

2 While it is highly desirable for all personnel to have training in first aid, it may in some circumstances be possible to make adequate provision for the delivery of emergency first aid with not all personnel being trained, provided that no less than two persons are trained and available to ensure first aid will be available if required.

2.10 RECORDS

2.10.1 Employer's record of divers

The employer shall maintain records of all divers involved in the organization's diving operations and records of the evidence used in assessing the diver's competencies and fitness to dive.

2.10.2 Diver's record

All divers shall keep and maintain a permanent record of all diving undertaken for the duration of the diver's working life.

This permanent record of diving shall include—

(a) the diver's photograph;

(b) next of kin information;

(c) diver's name, address, date of birth and signature;

(d) a record of medical examinations conducted for the purpose of occupational diving;

(e) a record of diving activity undertaken; and

(f) a record of accidents and incidents including decompression treatment(s).

The diver's record of diving covering at least the previous seven day's diving activity shall be available to the diving officer.

The permanent record of diving shall be presented at each diving medical examination.

The diver's record of dive (including a brief summary of any incidents or accidents) should be entered into this permanent record of diving at the completion of each dive, and signed by the dive coordinator for verification.

The permanent record of diving should have each page consecutively numbered and entries should be made in ink.

NOTES:

1 A typical diver's record of dive is shown in Appendix E.

2 The diver's permanent record of diving usually takes the form of a logbook.

2.10.3 Employer's record of dives

The employer shall ensure that for each diving operation, a record containing the following minimum information is prepared:

(a) Date and time of diving operation.

(b) Location of diving operation.

(c) Name of dive coordinator.

(d) Names of divers and standby divers.

(e) Nature of task(s).

(f) Maximum depth of the dive.

(g) Time left surface, time reached bottom and time left bottom (for each diver).

(h) Duration of dive, dive profile and breathing gases for each diver.

(i) Decompression schedule utilized for each diver (where applicable).

(j) Details of incidents and accidents.

(k) Diving equipment used, including content of cylinders at beginning and end of dives for dives on cylinders.

(l) All other relevant details.

(m) Dive coordinator's signature.

NOTE: A typical employer's record of the diving operation is shown in Appendix F.

2.10.4 Maintenance record

Where tests are carried out, e.g. for breathing gas purity, records of test results, together with identification of the breathing gas supply or air compressor, shall be maintained for a minimum period of 7 years.

SECTION 3 ORGANIZATION AND PLANNING

3.1 GENERAL

Diving needs planning and foresight. Bottom time is at a premium. The diver(s) shall be placed on the job under the optimum conditions of knowledge, equipment, ability, safety, and freedom from distractions. Topside assistance shall be well organized and capable. Time spent in determining conditions under which the diver will work should result in greater efficiency once the work is commenced.

Failure to consider any item of available information during the planning stage may jeopardize the lives of divers or result in failure of the diving operation.

The employer's diving operations manual (see Clause 2.1 and Appendix B) should be consulted during all diving planning.

A written dive proposal shall be produced (see Clause 3.3). When approved, the dive proposal should form the basis of the pre-dive plan and risk assessment (see Clause 3.4).

3.2 DIVE SITE REGISTRATION AND RISK ASSESSMENT

At the beginning of a scientific program, or as new dive sites are used during a program, a site shall be registered with the diving officer. During field operations the dive coordinator may register dive sites. The registration should include the results of a general risk assessment of the site and the type of work proposed, along with emergency numbers, emergency response plans, exposure, isolation, known or anticipated water depths and tidal currents, and other special hazards as appropriate. Travel aspects, such as altitude exposure in travelling to or from a site, should also be included. Risk assessments should be reviewed as divers gain more experience at dive sites.

3.3 DIVE PROPOSAL

Before every diving operation, the dive coordinator shall prepare in writing the dive proposal and shall submit that proposal to the diving officer for approval.

The dive proposal shall—

(a) specify as far as possible the intended location, date, time, depth and duration of every proposed dive;

(b) specify the breathing gas supply appropriate for the dive (see Clause 3.5);

(c) specify the equipment to be used (see Clause 3.5 and Section 4);

(d) give consideration to any need to travel at altitude before or after diving (see Clause 3.14);

(e) provide for emergencies as described in Clauses 3.12, 3.13 and 3.15;

(f) identify appropriate responses to mitigate risk and respond to hazards as identified in the dive site registration and risk assessment (see Clause 3.2); and

(g) identify the make up of the dive team and their duties.

The use of restricted scientific divers shall not compromise the safety of the diving operation. Dive planning shall ensure the operation of the dive team and emergency capabilities are adequately assessed and covered. This may involve the restricted scientific divers being supernumerary to the minimum dive team.

A copy of each approved dive proposal shall be lodged with and retained by the employer as part of the diving records (see Clause 2.10.3).

3.4 ON SITE PRE-DIVE PLAN AND RISK ASSESSMENT

At the dive site before every dive, the dive coordinator, divers, divers' attendants and any non-diving support personnel shall discuss in detail and agree upon the pre-dive plan and update the risk assessment as appropriate.

NOTES:

1 Guidance on carrying out risk assessments for diving operations is provided in Appendix G.

2 Dive planning of an underwater project needs to take into account physiological and practical limitations and scientific objectives. Realistic planning is best carried out by persons with both scientific and diving experience.

The pre-dive plan shall include—

(a) the location of the dive;

(b) consideration of surface and underwater conditions and hazards (see Clauses 3.6 and 3.7);

(c) the maximum depth (see Clause 3.8) and bottom time of the dive;

(d) thermal protection required (see Clause 3.9);

(e) the tasks of all members of the diving team;

(f) residual inert gas status of dive team members;

(g) decompression schedules, if required;

(h) the breathing gas supply appropriate for the dive (see Clause 3.5); and

(i) emergency procedures to be followed in the event of an equipment or system malfunction (see Clause 3.12) or an accident (see Clauses 3.12 and 3.13).

NOTE: Dive planning of an underwater project needs to take into account physiological and practical limitations and scientific objectives; realistic planning is best carried out by persons with both scientific and diving experience.

3.5 SELECTION OF BREATHING APPARATUS

3.5.1 General

The decision as to which type of breathing apparatus is appropriate for a given type of diving operation shall be made after consideration of the competency of the diver, the type of work to be done by the diver(s), the equipment required, the conditions under which the diver(s) will work, and the inherent risks and limitations of each type of breathing apparatus.

3.5.2 Factors to consider when selecting breathing apparatus

The decision as to which type of equipment is appropriate for a given diving operation should be taken after consideration of the following:

(a) Planning a SCUBA diving operation requires assessment of the likely gas consumption for the operation. This can vary greatly, depending on the diver, the task and the environment. As depth increases, it becomes increasingly difficult to make reliable assessments of gas consumption under varying work conditions and, therefore, of the amount of gas left in the cylinders. Specialized equipment to overcome this problem is available.

(b) Surface-supplied systems do not require the same extent of gas consumption assessment as the supply is usually not limited and these systems are therefore more applicable to deep dives or dives requiring hard work.

3.6 SURFACE CONDITIONS

In planning a diving operation, careful consideration shall be given to the surface conditions that will be encountered at the scene of the operation. These conditions include the state of the sea, weather, visibility, tide, currents, water temperature, presence of ships or other craft, and any other surface conditions that could affect the operation.

Diving operations shall not be undertaken in rough seas, unusual tides or currents, or other adverse conditions unless the dive coordinator, dive leader and the diver consider that the diver's safety will not be jeopardized.

3.7 IN-WATER CONDITIONS

Careful consideration shall be given to the in-water conditions likely to be encountered before diving operations commence. Such conditions include visibility, presence of contaminants, obstructions, dangerous marine life, thermoclines, pump intakes, pressure differentials and currents of 0.5 knots or greater.

3.8 DEPTHS

3.8.1 Depth of water

Before diving operations are commenced at any site, the maximum depth of water at the site and the maximum possible depth to which the diver could be exposed shall be ascertained by reliable means.

3.8.2 Depth limit

The maximum depth of diving conducted to this Standard shall be 39 m in the case of no-decompression diving and 30 m for diving that requires decompression.

3.8.3 Precautions for deep diving

No dive shall be carried out at depths greater than 30 m unless—

(a) each diver, including standby divers (see Clause 2.7), has undertaken the appropriate training (see Appendix A);

(b) each diver carries an independent reserve breathing gas supply;

(c) each diver has undertaken a schedule of work-up dives, appropriate to the depth and conditions;

(d) appropriate facilities and equipment including support vessels, shot lines, buoys, ropes, spare SCUBA sets (for SCUBA dives) and reserve breathing gas supplies are in use during the dive; and

(e) arrangements are in place in accordance with Clause 3.15 for emergency recompression of any diver showing signs of decompression illness.

3.9 WATER TEMPERATURES

The temperature of the water at the dive site shall be ascertained and suitable equipment shall be used to maintain the diver at a safe temperature.

3.10 HAZARDOUS CONDITIONS

The following conditions are potentially hazardous and require special training, precautions and equipment:

(a) Diving using dry suits.

(b) Being towed on a 'manta-board'.

(c) Diving in zero or low visibility.

(d) Diving at night (see Clause 3.11).

(e) Deep diving (see Clause 3.8).

(f) Diving in caves, enclosed spaces, or places where there is danger of entanglement.

(g) Blue water diving (diving in open water where the bottom is beyond permitted diving depth).

(h) Decompression diving (requiring the use of decompression schedules, see Clause 3.14).

(i) Diving in surf, strong currents (in excess of 1 knot or 55 cm/s), or heavy seas.

(j) Other conditions that present unusual hazards.

The dive coordinator shall ensure that every diver diving in the conditions set out in Items (a) to (j) has the appropriate training and equipment.

NOTE: Hazardous conditions for diving vary widely throughout Australia and New Zealand and require that additional training, equipment, operational procedures and emergency procedures (Clause 3.13) be specifically developed by employers according to location and environment. This Standard specifies only minimal requirements for commonly encountered hazards.

3.11 DIVING AT NIGHT

During every night diving operation the dive site, including the entry and exit points of a shore dive, shall be adequately and distinctively illuminated. Every diver shall carry at least two lights, one of which may be a chemically-activated light stick.

NOTE: Consideration should be given to the use of other safety measures, according to circumstances. They include tethered mode diving, and the use of emergency lighting such as the chemically-activated light stick attached to the diver and to one or more buoys at the dive site.

3.12 COMMUNICATIONS

A communication system appropriate to the task and situation shall be established between any tethered diver(s) and the surface support position. Voice communications should be considered.

When divers are operating in free-swimming SCUBA mode in circumstances in which there is surface support, there shall be a means to recall the divers to the surface. Through water voice communications should be considered.

The dive coordinator shall ensure that at or close to every dive site there are adequate means of immediate communication in the event of an emergency.

3.13 FIRST AID, MEDICAL AND EMERGENCY SERVICES

3.13.1 General

In all instances, an assessment should be made of the potential hazards of each diving operation. Appropriate first aid equipment, training or other resources should be made available to cope with any reasonably foreseeable emergency. Guidance should be sought from relevant occupational first aid codes of practice, from diving medical advisers or from the relevant regulatory authority where applicable.

Equipment should be chosen taking into account the first aid training and experience of dive team members. Provision should also be made for airway suction and other facilities required by any regulatory authority.

3.13.2 Oxygen resuscitation equipment

Oxygen resuscitation equipment shall be available at the dive site for immediate use if required.

The 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. Sufficient oxygen shall be available to supply the resuscitator taking into account the location of the dive site and access to medical facilities.

3.13.3 Emergency services

The dive coordinator shall identify the location of the nearest emergency medical and hyperbaric facility and shall make appropriate plans for emergency notification of an accident, and transport of an injured person to such facility.

3.14 DECOMPRESSION DIVING

3.14.1 Decompression schedules

All SSBA and SCUBA diving, including repetitive diving, shall be carried out in accordance with widely-recognized and industry-approved decompression tables or a dive computer following the guidelines set by the manufacturer. The decompression schedule followed shall be at least as conservative as the current DCIEM decompression tables.

3.14.2 Decompression diving deeper than 30 m

Decompression diving for dives in excess of 30 m shall be conducted in accordance with AS/NZS 2299.1.

3.14.3 Decompression diving to depths up to and including 30 m

No dive shall be carried out for a period of time that requires a decompression schedule unless—

(a) each diver, including standby divers (see Clause 2.7), has undertaken the appropriate training (see Appendix A);

(b) each diver carries an independent reserve breathing gas supply;

(c) each diver has undertaken a schedule of work-up dives, appropriate to the depth and conditions;

(d) appropriate facilities and equipment including support vessels, shot lines, buoys, ropes, spare SCUBA sets (for SCUBA dives) and reserve breathing gas supplies are in use during the dive; and

(e) arrangements are in place in accordance with Clause 3.15 for emergency recompression of any diver showing signs of decompression illness.

When mandatory decompression stops are required to be carried out in the water the following procedures shall be used:

(i) An accurately marked and adequately weighted shot line shall be used for every decompression stop. The diver shall be on the shot line at all times and shall record the depth and duration of all stops.

(ii) If the diver breaks the surface before completing the time required for each stop, then the procedure outlined in the DCIEM decompression tables shall be followed.

(iii) Voice communications shall be used.

3.14.4 Precautionary decompression stops

Where no-decompression diving is undertaken, divers should carry out a precautionary decompression stop at the end of each dive using the schedule that would be applicable if they had just exceeded the no-decompression limits for the dive. If precautionary decompression stops are to be carried out, they should be included in the dive plan.

3.15 COMPRESSION CHAMBER SUPPORT OF DIVING

3.15.1 Availability of compression (recompression) chamber support

Emergency recompression chamber support shall be organized for all diving operations. This may involve a chamber on site or at a distance and the chamber may or may not be dedicated to support of the diving operation.

3.15.2 Requirement for an on site chamber

An operational recompression chamber shall be located on site when—

(a) decompression diving is undertaken;

(b) free or buoyant ascent training is being conducted;

(c) diving exceeds the depth/time limits given in Column A of Table 3.1; or

(d) the nature of the work or local conditions creates a significant risk of emergency ascent.

NOTES:

1 This Standard does not cover decompression diving to depths greater than 30 m. Any such dives should be carried out in accordance with the requirements of AS/NZS 2299.1.

2 'On site' means at the dive control position or, if this is impossible, close enough to the dive control position to ensure that a diver could be recompressed within the chamber within 5 min of completing the ascent from the dive.

3.15.3 Recompression chamber type, staffing and operation

For on site chambers and chambers dedicated for diving support, the specifications of the recompression chamber, its staffing and operation and the qualifications of operators shall comply with the requirements in AS/NZS 2299.1. Other chambers considered for diving support shall be multiplace, twin lock chambers within medical facilities which have operational capability and availability to provide emergency diver treatment.

NOTE: AS/NZS 2299.1 also provides guidance on recognition and treatment of decompression illness.

3.15.4 Diving without a dive site chamber

The time of availability of recompression shall be estimated realistically in accordance with arrangements made in Clauses 3.4 and 3.13.3. All diving undertaken without 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. Any significant risk-increasing factor (e.g. cold water or hard work) should lead to further shortening of dive times or extra safety time, determined by moving an additional one or two time or depth levels up the DCIEM tables or, for dives to 12 m or less, up Table 3.1. Divers should carry out a precautionary decompression stop at the end of each dive in accordance with Clause 3.14.4.

Depending upon the availability of emergency recompression, diving shall be limited as follows:

(a) *Diving where recompression is available within 2 hours*

Where recompression is available within 2 hours of the dive site, the maximum bottom time for any single dive shall be as listed in Column A of Table 3.1 for the appropriate depth. Where a second or subsequent dive is undertaken, the maximum bottom time shall be determined by reference to Column A of Table 3.2, which will provide a repetitive group limit for the dive. The DCIEM repetitive 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.

(b) *Diving where recompression is available within 6 hours*

Where recompression is available within greater than 2 hours but less than 6 hours of the dive site, the maximum bottom time for any single dive shall be as listed in Column B of Table 3.1 for the appropriate depth. Where a second or subsequent dive is undertaken, the maximum bottom time shall be determined by reference to Column B of Table 3.2, which will provide a repetitive group limit for the dive. The DCIEM repetitive 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.

(c) *Diving where recompression availability exceeds 6 hours*

Where it would take 6 hours or more to effect emergency recompression, the maximum bottom time for any single dive shall be as listed in Column C of Table 3.1 for the appropriate depth. Where a second or subsequent dive is undertaken, the maximum bottom time shall be determined by reference to Column C of Table 3.2, which will provide a repetitive group limit for the dive. The DCIEM repetitive 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.

TABLE 3.1

TIME LIMITS FOR DIVES, DEPENDING ON LEVEL OF RECOMPRESSION CHAMBER SUPPORT

Maximum dive depth m	Maximum bottom time, min		
	Column A (chamber within 2 h)	Column B (chamber within 2 to 6 h)	Column C (chamber over 6 h)
3	No limit	240 (*400*)	190
6	240 (*400*)	240 (*300*)	190
9	180	140	110
12	120	70	55
15	75	60	50
18	50	40	30
21	35	30	20
24	25	20	15
27	20	15	10
30	15	10	10
31 to 39	6	6	5

NOTES:

1 Shallow water dive times listed in brackets and italics represent possible extensions of maximum bottom times where low hazard, 'square profiles', single ascent dives of constant depth are conducted.

2 For depths between 12 m and 30 m, the bottom time limits are based upon the DCIEM tables. Column A lists the 'no-deco' limits. Columns B and C represent one and two repetitive groups less than the 'no-deco' limits. For depths between 3 m and 12 m, the time limits have been selected with the aim of providing approximate equivalence of risk within each column, estimated with reference to data provided by DCIEM.

TABLE 3.2

LIMITS FOR REPETITIVE DIVES, DEPENDING ON LEVEL OF RECOMPRESSION CHAMBER SUPPORT (BASED ON DCIEM TABLES)

Maximum dive depth m	Maximum repetitive group		
	Column A (chamber within 2 h)	Column B (chamber within 2 to 6 h)	Column C (chamber over 6 h)
3	No limit	G(H)	G
6	G(J)	G(H)	G
9	H	G	F
12	H	E	D
12 to 30	DCIEM no deco limits	One repetitive group less than the DCIEM no deco limits	Two repetitive groups less than the DCIEM no deco limits
30 to 39	A	A	A

3.16 DIVING BEFORE OR AFTER TRAVEL

3.16.1 Diving after travel

The diver shall have had adequate rest before diving. Divers should recover from 'jet lag' before diving.

3.16.2 Travel after diving

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

NOTE: For routine diving operations at sea level, the guidelines provided in Appendix H may be used. Where 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 a high bubble load. Travel to altitude should not be undertaken until it is clear that the diver is in completely normal health or until specialist diving medical advice has been obtained.

3.16.3 After decompression illness

Following treatment for decompression illness, divers should obtain specialist diving medical advice regarding the time that should pass before exposure to altitude. Until medical clearance has been obtained for travel to higher altitudes, a diver should remain below 150 m effective altitude.

SECTION 4 DIVING EQUIPMENT

4.1 BREATHING APPARATUS

4.1.1 Design parameters

Breathing apparatus shall be designed and constructed of non-toxic, corrosion-resistant materials, and shall—

(a) provide the wearer with respirable gas at the required pressure and volumetric flow rate at all times during the effective life of the apparatus;

(b) be constructed of materials suitable for the breathing gas used;

(c) prevent ingress of water to the breathing circuit;

(d) prevent leakage from the breathing circuit except through the exhaust valve(s);

(e) ensure that couplings provide a secure and gastight joint and that, when such couplings are detached, any sealing washers are retained in position;

(f) ensure that component parts likely to require maintenance are readily detachable without risk of accidental disconnection;

(g) not unduly impede the wearer when swimming and working underwater;

(h) ensure that the method of fastening the equipment to the wearer is secure in action; and

(i) for SCUBA, permit quick release in cases of emergency.

4.1.2 Requirements for component parts

4.1.2.1 *General*

The component parts of a diver's breathing apparatus shall comply with the requirements of Clauses 4.1.2.2 to 4.1.2.9.

The manufacturer of component parts of a diver's breathing apparatus shall specify proper storage and maintenance conditions.

NOTE: Recommendations for the storage of vulcanized rubber are given in ISO 2230.

4.1.2.2 *Material contacting skin*

Material that is designed to be worn next to the skin or that may come in contact with the skin should—

(a) not restrict the diver's movement in any way;

(b) be comfortable to wear;

(c) be non-irritant; and

(d) be non-staining.

4.1.2.3 *Masks and helmets*

Masks and helmets shall be designed and constructed so as to—

(a) provide a watertight and gastight seal;

(b) enable all the component parts to withstand, without failure or displacement, a pressure of 15 kPa above or below ambient pressure;

(c) cause the least possible interference with vision;

(d) minimize build up of carbon dioxide gas (CO_2);

(e) be purgable of water; and

(f) for full face masks and helmets, incorporate a valve to prevent the ingress of moisture into the breathing circuit.

A full face mask shall cover the eyes, nose and mouth and include a facility for ear-clearing. The mask shall be secured in position by means of a head harness or may form part of a helmet supported on the wearer's head or shoulders by suitable means. The safety faceplate shall be capable of meeting the impact test for eye protectors specified in AS/NZS 1337.

4.1.2.4 *Head harness*

The head harness for a full-face mask (commonly known as a spider) shall comprise a minimum of five straps. The head harness should also be—

(a) replaceable; and

(b) adjustable via positive lock buckles or studs which are fixed to be body of the mask.

4.1.2.5 *Mouthpiece*

A mouthpiece shall be designed to meet the following requirements:

(a) Provide a watertight and gastight seal when fitted correctly and held with normal mouth pressure.

(b) Prevent closure of the aperture of the mouthpiece by normal mouth pressure.

(c) Include a positive means of retention by the diver to prevent accidental dislodgment or slippage from the diver's mouth.

NOTE: Some incompressible helmets, which are designed to free-flow according to the diver's demand, also incorporate a mouthpiece specifically designed to be easily discarded by the diver. In such cases, the mouthpiece need not comply with Item (c) above.

4.1.2.6 *Diver's hoses*

Hoses for use in diving shall be of one continuous length, designed especially for the conditions experienced in such use, and shall be manufactured, maintained and tested in accordance with the following:

(a) A diver's hose shall incorporate a non-return valve located as close as possible to the diver (e.g. at the breathing medium inlet to the incompressible helmet or full-face mask, or at the mouthpiece, or fitted as an integral part of the incompressible helmet or full-face mask).

(b) A hose shall not be used in diving operations for conveyance of the breathing medium at a pressure exceeding one quarter of the burst pressure as specified in Item (c).

(c) The burst pressure of a hose shall be defined as the pressure at which that hose, or another hose similar to it in all respects, has burst when tested at maximum operating temperature.

(d) Hoses used in SSBA systems shall be tested not more than 12 months prior to intended diving operation at a pressure equal to 1.5 times greater than its maximum operating pressure.

(e) A hose assembly shall not be used in diving operations for conveyance of the breathing medium unless—

(i) it is kink resistant;

(ii) it is capable of carrying the breathing medium at the maximum flow rate that may be required in the operations;

(iii) the hose and its couplings are in alignment;

(iv) the couplings are not scored or substantially corroded;

(v) the couplings contain no damaged threads;

(vi) the hose fittings are made of brass, stainless steel, Monel metal or other non-corrosive material;

(vii) the fittings connecting the hose to diving equipment are incapable of accidental disengagement or loosening; and

(viii) it has a diameter and type of connection that minimize the possibility of wrongly connecting hoses and fittings.

4.1.2.7 *Inlet and exhaust valves*

Valves shall be designed and constructed so that—

(a) any leakage will not exceed the limits prescribed below;

(b) adequate protection is provided against mechanical damage;

(c) they are capable of easy maintenance;

(d) they are fitted in, or as close as is practical to, the full face mask or the mouthpiece;

(e) they will not be affected by heat or moisture to which they are likely to be exposed while stored or in use; and

(f) where manually operated, they are easily operated.

The shut-off characteristics of any valve shall be such that the total air leakage shall not exceed 0.03 L/min when tested with air at a constant suction head of 35 mm water. During this test the valve and its seating shall be wet.

The flow characteristics of any valve shall be such that the resistance to a continuous stream of gas through the valve assembly shall not exceed—

(i) 19 mm water when the air flow is 85 L/min; and

(ii) 57 mm water when the air flow is 170 L/min.

The foregoing shut-off and flow requirements apply to the whole valve assembly including all parts through which the gas passes. When a valve is duplicated in the apparatus, the requirements apply to the valves in combination and not to each valve separately.

4.1.2.8 *Demand gas supply device*

The demand gas supply device shall consist of a pressure-reducing system and means of exhausting excess pressure from the breathing circuit. The design shall be such that the device is adequately protected against damage and its efficiency is not impaired by heat variations or moisture likely to be encountered in use.

4.1.2.9 *Cylinders*

4.1.2.9.1 *General*

Gas storage cylinders used in association with diving operations shall comply with the specifications listed in AS 2030.1 or AS 3848.2, as appropriate.

Industrial or medical gases used or stored at the site of diving operations shall be colour-coded in accordance with AS 4484 and systems shall be established to prevent any inadvertent misuse or cross-contamination between these gas cylinders and cylinders containing breathing gas for divers.

4.1.2.9.2 *Diver's breathing air cylinders*

Diver's breathing air cylinders shall be durably marked with the word 'AIR' in letters not less than 50 mm high and in a contrasting colour to the body of the cylinder.

Diver's breathing air cylinders shall not be used for the storage of any gas mixture other than air.

4.1.2.9.3 *Other oxygen-nitrogen mixtures*

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 so as to ensure that there is no possibility of confusion regarding the contents of these cylinders.

The colour-coding specified for oxygen-nitrogen mixtures in AS 4484 shall not be used as it is the same as that for air.

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.

4.2 BREATHING GAS SUPPLIES

4.2.1 Breathing air

Breathing air used in diving operations shall—

(a) have no objectionable or nauseous odour;

(b) contain not less than 20% and not more than 22% by volume of oxygen;

(c) contain not more than 11 mg/m^3 of carbon monoxide at 15°C and 100 kPa (10 p.p.m. by volume);

(d) contain not more than 900 mg/m^3 of carbon dioxide at 15°C and 100 kPa (480 p.p.m. by volume);

(e) for high pressure cylinders, contain not more than 100 mg/m^3 of water at 15°C and 100 kPa (130 p.p.m. by volume);

(f) contain not more than 1 mg/m^3 of oil at 15°C and 100 kPa when sampled from a cylinder filled to a pressure of at least 12 MPa; and

(g) where supplied from a compressor, not be used for diving operations unless the compressor has, within the six month period preceding the operations and every six months during the operation as appropriate, undergone a test to ensure that the compressed air satisfies the requirements specified in Items (a) to (f).

4.2.2 Breathing gas testing equipment

Breathing gas testing equipment shall be installed, operated and maintained in accordance with the manufacturer's instructions. Additional requirements for compressor air supplies are specified in Clause 4.6.

4.2.3 Breathing gases other than air

Breathing gases other than air shall comply with the requirements in Clause 4.2.1 apart from Item (b).

4.3 PRESSURE GAUGES

4.3.1 Gauge calibration

A gauge used in, or in connection with, diving operations shall—

(a) if it is used to measure the depth of the diver or the pressure in a compression chamber, be calibrated either in feet head of sea water or metres head of sea water;

(b) if it is used to measure the depth of the diver on an SSBA control panel or pressure inside a compression chamber be checked by a calibration gauge upon arrival on site, at least once in each period of six months and whenever it appears to be incorrect;

(c) if it is a calibration gauge, be calibrated at least once in each period of 12 months by test;

(d) if it is a deadweight tester, be verified under and in accordance with the *National Measurement Act 1960* or by a deadweight tester or gauges for which an endorsed test certificate is currently in effect;

(e) if it is a personal depth gauge, dive computer (including computer/watches) or low pressure gauge, be measured against a tested gauge or accurately measured depth of water at intervals not exceeding six months; and

(f) if faulty, gauges shall be removed from service and clearly marked as having a malfunction.

4.3.2 Gauge accuracy

A gauge used in diving operations—

(a) for measuring depths less than 30 m, shall have an accuracy within 1% of the maximum scale reading;

(b) with a maximum scale reading not exceeding 200 m for measuring depths exceeding 30 m and less than 200 m, shall have an accuracy within 0.5% of the maximum scale reading; and

(c) in any other case, shall have an accuracy within 2.5% of the actual condition it is measuring.

4.3.3 Contents gauges for SCUBA cylinders

Contents gauges shall be tested at regular intervals to ensure that accurate reporting of cylinder pressure is maintained as the contents drop from working pressure to near empty.

NOTE: Comparison with other contents gauges may be used to check a gauge's operation.

4.4 EMERGENCY GAS SUPPLIES

Emergency gas supplies shall be of sufficient capacity for the diver to return to the surface. In self-contained breathing apparatus, any emergency supply used shall be capable of being brought into operation manually when the warning device operates.

Every SCUBA diver shall carry a sufficient quantity of compressed gas to complete the planned dive and retain a reserve gas supply.

For SSBA divers, in addition to a secondary gas supply on the surface, each diver shall carry an emergency gas supply ('bailout' bottle) with a dedicated demand valve. The emergency gas supply ('bailout' bottle) shall be of sufficient capacity for the diver to return to the surface and complete any decompression requirements.

4.5 GAS SUPPLY SAFETY WARNING SYSTEM

The diver's gas supply system shall incorporate one of the following:

(a) A manually operated reserve valve capable of providing 20% of the working capacity of the cylinder(s), and which cannot be accidentally operated.

(b) A second gas cylinder containing sufficient gas to allow a safe ascent to the surface from the maximum dive depth, and which has a separate valve that can be easily operated by the diver underwater. The cylinder shall have an over-pressure relief valve fitted to the reducing regulator if the gas supply is activated by a valve downstream of the reducing regulator. The relief valve pressure shall be set lower than the maximum pressure of the low pressure hose connected to the cylinder regulator.

(c) A cylinder contents gauge complying with Clause 4.3.3, that is visible to the diver underwater and which features a warning mark for low pressure.

In conditions of poor visibility, the second gas cylinder described in Item (b) is preferred to the valve in Item (a); the gauge in Item (c) is not recommended.

4.6 AIR COMPRESSOR SYSTEMS

4.6.1 General

Where breathing air in SSBA diving operations is supplied from a power-driven compressor, the following shall apply:

(a) The compressed air shall be delivered via a receiver and a cooling/drying/filtration system to ensure the purity requirements of Clause 4.2 are met.

(b) A non-return valve shall be fitted between the compressor and the receiver, and located adjacent to the receiver wherever possible.

(c) The intake of the compressor shall be located or fitted with an extension pipe or hose so as to prevent contamination of the supplied breathing air by dust, engine gases or fumes from any other source (particularly from welding, painting or cleaning operations) or from any other internal combustion machinery running in the vicinity of the compressor.

(d) The intake hose shall be routed, positioned and secured to ensure that there is no possibility of contact with hot or moving components.

(e) Any sections of the intake pipe or hose which could possibly be crushed, melted or otherwise damaged whilst in use shall be constructed of suitable metal pipe or tube.

(f) The exhaust and any other hot components shall be shielded to prevent contact by diving equipment, including hoses.

NOTES:

1 A typical system is shown in Figure 4.1.

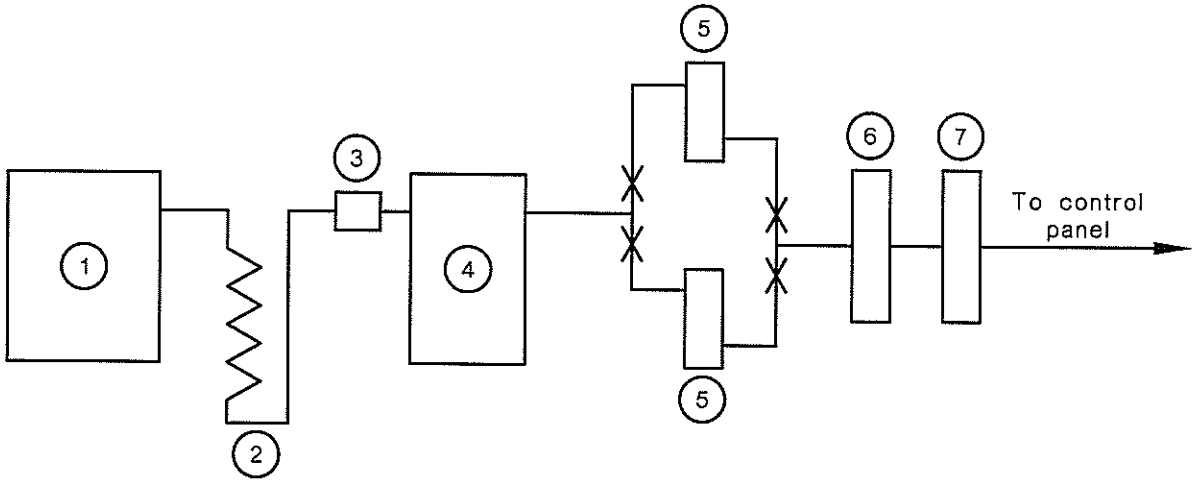
2 See also Clause 4.6.2.

Where either the intake hose or the engine exhaust require extending or modifying in any way to prevent breathing air contamination or hose damage from hot or moving parts, the compressor manufacturer should be consulted before any such extensions or modifications are carried out, to confirm that the nature of any modification and the length and cross-sectional area of any extension do not reduce the efficiency of the compressor.

Similar care in the prevention of contamination of the breathing air shall also be exercised in determining the location of the compressor itself.

Compressor systems should not be capable of being moved inadvertently during operation. Where wheels are fitted, these should be of the fold-up or removable type rather than merely lockable castors which can inadvertently become unlocked.

Where the compressor is used on any potentially mobile platform, including any vessel or floating platform, the compressor shall be securely fastened when in use.



LEGEND:

1 = Compressor
2 = Cooling coil
3 = Pressure maintenance check valve
4 = Receiver
5 = Drying filter
6 = Activated carbon filter
7 = Particulate filter (may be combined or reversed with Item 6).

FIGURE 4.1 TYPICAL SYSTEM FOR SUPPLY OF AIR TO DIVERS FROM COMPRESSOR PLANT

4.6.2 Air receivers

Air receivers and their fittings shall comply with AS 1210.

4.6.3 Pressure relief devices

A receiver shall be fitted with relief valves of sufficient capacity to prevent the rated pressure of the receiver from being exceeded. In addition, compressors may be fitted with 'off loading' mechanisms.

4.6.4 Filtration, drying and odour absorption

Materials used for filtering, drying or odour absorption shall not introduce contaminants into the air supply.

Drain cocks shall be provided to draw off any water and oil that may accumulate in filters. The drain cocks shall be arranged so that they can be operated while the filter is in use.

4.6.5 Supply lines

The supply line between the compressor and the receivers shall be either permanent pipe or high quality air grade hose with external grade protection suitable for the delivery of breathing gas and shall be free of contaminants.

All supply lines shall be located or guarded so that they are protected against mechanical damage, fatigue and vibration.

4.6.6 Operation and maintenance

Compressors and their power sources (prime movers) shall be operated and maintained in accordance with the manufacturer's instructions to maintain the required air quality. Manufacturer's recommendations for types of lubricating oils suitable for air compressor systems for diving purposes should be strictly adhered to. The air filters on the intake and delivery sides of the compressor should have their elements renewed as recommended by the manufacturer, or more frequently if contaminated air is noted.

The drain valve on the air reservoir should be operated momentarily at intervals, when the compressor is running, to prevent the accumulation of moisture.

NOTE: For guidance on plant, see NOHSC:1010.

4.7 SSBA BREATHING GAS SUPPLIES AND CONTROL SYSTEMS

4.7.1 Sources

The compressed gas used for breathing in SSBA diving operations shall be of a purity complying with Clause 4.2 and shall be supplied to the dive control panel or chamber control panel from a primary and secondary supply. For air, each source shall be either a power-driven compressor complying with Clause 4.6 or compressed air cylinders complying with Clause 4.7.5. For other breathing gas systems, compressed gas cylinders complying with Clause 4.7.5 shall be used. A control system shall be provided (see Clause 4.7.4).

Where breathing gas is supplied from the primary or secondary supply at a pressure exceeding 2100 kPa, the pressure shall be reduced by an adjustable reducer able to match the diver's varying gas requirements under all conditions. Where automatic reducers are used, they shall be capable of providing sufficient breathing gas to match—

(a) the breathing apparatus to be used;

(b) extended diver's hose lengths at shallow depths; and

(c) increased gas consumption due to physical exertion.

4.7.2 Working pressure

The pressure required to be delivered to the diver's breathing apparatus will depend on the type of breathing apparatus being used by the diver, and on the type and depth of the dive.

Where a free-flowing system is used, the pressure of the breathing gas shall be not less than 350 kPa or the diver's working depth in metres multiplied by 15 kPa, whichever is the greater.

Where a demand gas supply device is used, the minimum gauge pressure shall be 700 kPa plus 10 kPa for every metre of the diver's working depth.

NOTE: The value of 10 kPa does not make allowance for the effects of increased pressure on gas density or the frictional losses of the hose.

4.7.3 Breathing gas supplies

4.7.3.1 *Primary and secondary gas supplies*

Each diver shall breathe from a primary gas supply that is backed up by a secondary breathing gas supply of the same composition. In the event of failure of the primary supply, the secondary supply shall enable the diver to be brought back to the surface, taking into account any decompression schedule that may be required.

When two divers are in the water at the same time, both the primary and secondary gas supplies (shown as Supply 1 and Supply 2 in Figure 4.2) shall be individually capable of supporting both divers at the maximum depth of the dive. Should one of the gas supplies become unabailable, the dive shall be terminated immediately and the divers brought to the surface.

Suitable forms of secondary supplies are as follows:

(a) High pressure reservoirs fitted with appropriate reduction stages.

(b) Additional primary units.

Such secondary supplies shall be kept fully operational at all times and shall be connected to the dive control panel or chamber control panel.

4.7.3.2 *Gas supply system design*

The breathing gas supply system shall be designed to minimize the risk of more than one diver becoming affected if any one gas supply becomes contaminated. This can be achieved if the primary gas supply of one diver is used as the secondary supply of the second diver or standby diver and vice versa (as per Figure 4.2).

Alternatively, each diver may be supplied from separate individual primary and secondary systems. In general, more than one diver should not be supplied from any one low pressure compressor at the same time.

If multiple divers are to be supplied from one compressor, special procedures and design features shall be incorporated to prevent simultaneous casualties in the event of breathing gas contamination. This may include in-line carbon monoxide catalyst/filter units or on-line gas monitoring and alarm units.

4.7.3.3 *Emergency gas supply*

The emergency gas supply (see Clause 4.4) shall be the same composition as the diver's primary and secondary breathing gas supplies, of sufficient capacity to enable the diver to return to the surface or a place of safety, and shall not be used as a secondary gas supply.

When the emergency gas supply is activated by a valve downstream of the reducing regulator of the 'bail-out' cylinder, an over-pressure relief valve shall be fitted to the reducing regulator. This is necessary to avoid rupture of the emergency gas supply hose should the high pressure seat of the reducing regulator leak or fail. The relief valve pressure shall be set lower than the maximum pressure of the low pressure hose connected to the cylinder regulator.

NOTE: Valve handles and the means by which the valve is secured to the cylinder should, by virtue of their design or positioning, or both, be distinguishable by touch from other fittings to eliminate the possibility of them being confused in an emergency.

4.7.4 Control systems

4.7.4.1 *Gas control system*

The breathing gas control system shall provide suitable means for measuring the pressures of the primary and secondary gas supplies and the diver's gas supply. It shall include control valves and appropriate check and non-return valves. These shall be firmly mounted and arranged so that they can be easily and rapidly observed and operated (see Clause 4.7.4.3).

Flexible connections (such as those fitted to divers' hoses) and connections to the secondary gas supply shall be secured to the control system in a way which prevents any strain coming onto the fittings or any possibility of the flexible connections blowing off.

4.7.4.2 *Diver depth monitoring system*

A system shall be used where the diver's depth can be ascertained and monitored, or where the diver can be maintained at a known depth.

4.7.4.3 *Control panel*

The control panel used in an SSBA diving operation shall be of such a design that—

(a) it meets the requirements in Clause 4.7.3.2.

(b) in the event of contamination or total failure of one gas supply, both divers have the option of a second supply; and

(c) in the event of a hose rupture between the supply and the panel, there will always be sufficient gas from the other supply to safely return to the surface.

The panel design shown in Figure 4.2 is an example of a design that satisfies the above requirements.

4.7.5 Cylinder gas systems

An alternative method of supplying breathing gas to divers is from a bank of compressed gas cylinders, and the following requirements apply:

(a) Cylinders for compressed breathing gas shall comply with AS 2030.1.

(b) The cylinder pressure shall be reduced by a suitable device capable of adjusting line pressure appropriately, ensuring that adequate gas is supplied to the diver under all conditions of gas demand and depth, e.g. in circumstances involving hard work, and extended hose lengths at shallow depths.

(c) Each bank of cylinders shall be connected through the control system in such a manner that each can be isolated from the other while allowing the secondary bank to deliver gas to the diver(s).

(d) Cylinders shall be appropriately marked to identify their contents (see Clause 4.1.2.9).

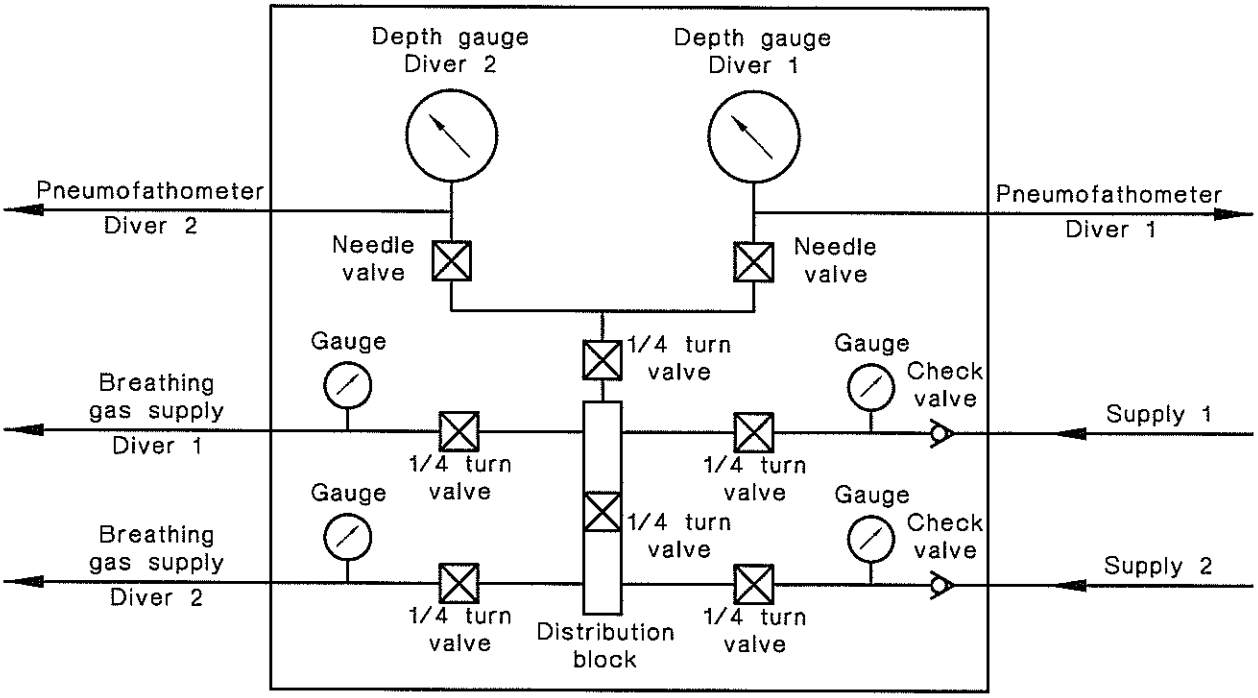


FIGURE 4.2 TYPICAL CONTROL PANEL FOR TWO DIVERS

4.8 PNEUMATIC TOOLS

Gas for hand-held pneumatic tools shall be taken from a source entirely separate from the diver(s) breathing gas supply.

NOTE: Divers qualified as scientific divers or visiting scientific divers are qualified to use hand-held pneumatic tools only. Restricted scientific divers are not permitted to use pneumatic tools of any form (see Paragraph A4 of Appendix A).

4.9 LIFELINE

A lifeline shall be—

(a) a cordage line with a diameter not less than 8 mm;

(b) a combined communications line and cordage line of diameter not less than 8 mm;

(c) the diver's hose (see Clause 4.1.2.6) and its attachments; or

(d) a diver's umbilical consisting of more than one component.

The minimum breaking strain of any potentially load-bearing sections (including connections) shall be at least 6 kN.

4.10 DIVING SUIT

Diving suits shall be a suitable fit and designed to maintain the diver at a comfortable temperature during diving operations.

4.11 WEIGHTS

4.11.1 Weight belt or weights

Where weights are worn by a diver, some or all such weights shall be fitted with a reliable quick-release mechanism which cannot be accidentally released, but which can be readily operated by the diver underwater. Sufficient weight shall be readily releasable to ensure positive buoyancy regardless of the diving depth or degree of air filling of any dry suit, buoyancy compensator or 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. In addition, the weights shall be attached in such a manner as not to slide and foul the quick-release mechanism.

4.11.2 Weighted boots

Weighted boots worn by divers shall be of a type specifically designed for use in diving work and fitted with reliable release fastenings which can be readily operated by the diver underwater.

4.12 DIVER'S KNIFE

Every diver shall carry a knife at all times when engaged in a diving operation or underwater. The knife shall be worn in such a position that it will not foul any discarded equipment, e.g. released weights.

4.13 SURFACE SIGNALLING DEVICE

A highly-visible surface signalling device such as a 'safety sausage' should be carried by each diver.

SECTION 5 PROCEDURES FOR SCUBA DIVING

5.1 GENERAL

5.1.1 Requirements

When SCUBA has been selected as the appropriate type of equipment for a diving operation (see Clause 3.5), then that diving operation shall comply with the requirements in this Section in addition to the general and medical requirements contained in other sections of this Standard.

5.1.2 Decompression diving

No dive shall be planned or undertaken for a period of time that requires a decompression schedule, except in accordance with Clause 3.14.

5.1.3 Breathing gas supply

Every SCUBA diver shall carry a sufficient quantity of breathing gas to complete the planned dive plus a reserve supply providing a minimum safety margin of 25% for dives to depths of up to 21 m and 30% for dives to depths greater than 21 m.

5.2 PERSONNEL REQUIRED

5.2.1 General

At every SCUBA diving operation there shall be sufficient personnel to ensure that diving is performed safely. The minimum number and designations of personnel required for various types of SCUBA diving operations are set out in Clauses 5.2.2 to 5.2.4. The provision of extra personnel should always be considered as a means to reduce risk, particularly during dives involving particular hazards or those involving unusual underwater tasks. Sufficient first aid personnel with first aid and oxygen administration training as set out in Clause 2.9 shall be present.

5.2.2 Free-swimming mode SCUBA diving operations in open water

The following personnel shall be present:

(a) One dive coordinator.

(b) Two buddy divers.

(c) One divers' attendant.

The dive coordinator may act either as the divers' attendant, dive leader or as a diver. Thus, the minimum dive team for free-swimming mode SCUBA diving operations is THREE, one of whom shall remain at the surface dive coordinating position.

If the dive coordinator enters the water, then the duties which the dive coordinator has at the surface at the dive site shall be transferred to another person who shall remain at the surface and is competent to recognize and manage diving emergencies.

When a free-swimming mode SCUBA diving operation involves more than two divers, the divers shall dive in pre-arranged groups of either two or three buddy divers, but no more. Before the divers enter the water, one member of each group of divers shall be designated the underwater dive leader for that group.

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

5.2.3 SCUBA diving operations in aquarium tanks and swimming pools or in sheltered open water

The following personnel shall be present:

(a) One dive coordinator.

(b) One diver.

(c) One diver's attendant.

Thus, the minimum dive team for dives in aquarium tanks and swimming pools or in sheltered open water is THREE, one of whom shall remain at the surface dive coordinating position.

In exceptional circumstances, where minimal risk is present, the diving officer may authorize a minimum team of TWO. If the operation is conducted in free-swimming SCUBA mode, then two divers may be underwater operating as a buddy pair. Where one diver is in the water, the dive coordinator shall maintain constant visual contact with the diver and be capable of removing the diver from the water in an emergency or if the diver requests assistance. In sheltered open water, the single diver shall be tethered.

Authorization of a dive team of two shall not be considered if any of the following apply:

(i) Poor visibility.

(ii) Danger to the diver from natural currents or currents associated with weirs, sluices, locks, outlets or inlets in the vicinity of the workplace.

(iii) Risk of entrapment of the diver or entanglement in his equipment.

(iv) A situation in which third party assistance is not readily available in an emergency.

(v) If the dive is from a boat, and the boat cannot be securely anchored or moored.

5.2.4 Tethered mode SCUBA diving operations for dive depths of up to 21 m

The following personnel shall be present:

(a) One dive coordinator.

(b) One diver.

(c) One diver's attendant.

(d) One standby diver.

The dive coordinator may act as either the divers' attendant or the standby diver.

Thus, the minimum dive team for tethered mode SCUBA diving operations is THREE, one of whom shall remain at the surface dive coordinating position.

The diver shall be either—

(A) secured by a lifeline which is tended by the diver's attendant; or

(B) secured by a float line whose surface float is observed by the diver's attendant at all times.

A SCUBA diver tethered by a lifeline shall maintain the ability to communicate with the diver's attendant at all times.

When a SCUBA diver is tethered to a float line, the diver's attendant shall have and maintain the ability to recall the diver by means of an agreed signal at all times.

5.2.5 Tethered mode SCUBA diving operations exceeding 21 m

The diver shall be secured by a lifeline and tended by a diver's attendant and the following personnel shall be present:

(a) One dive coordinator.

(b) One diver.

(c) One diver's attendant.

(d) One standby diver.

(e) 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 attendant for both the diver and the standby diver.

Thus, the minimum dive team for tethered mode SCUBA diving operations consists of FOUR persons, two of whom shall remain at the surface dive coordinating position.

A SCUBA diver tethered by a lifeline shall maintain the ability to communicate with the diver's attendant at all times. If there is only one diver in the water voice communications between the diver and the dive coordinating position are recommended.

5.3 DIVING EQUIPMENT AND BREATHING GAS SUPPLIES

5.3.1 General

Diving equipment and breathing gas supplies shall comply with the relevant requirements in Section 4.

5.3.2 Equipment for SCUBA divers

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

(a) Open-circuit SCUBA with two demand regulators.

(b) Face mask.

(c) Swimming fins.

(d) Snorkel for surface swimming.

(e) Diver's knife.

(f) Weight belt with a quick-release closure.

(g) Submersible pressure gauge for measuring breathing gas pressure in cylinder(s).

(h) Wetsuit or protective clothing appropriate for the conditions of work and the temperature of the water.

(i) Buoyancy compensator of an approved design that is inflatable orally and from a compressed air cylinder.

(j) Diver's watch or elapsed-time indicator.

(k) Diver's depth gauge which should incorporate a maximum depth indicator.

NOTE: A dive computer may be used to fulfil the timing device and depth indicator requirements in Items (j) and (k).

5.4 LOW VISIBILITY

In conditions of low underwater visibility divers shall take additional precautions to ensure that they maintain contact with each other. Appropriate additional precautions include—

(a) diving with a buddy line; or

(b) diving in the tethered mode.

NOTE: A horizontal visibility of 2 m is usually considered to be the limit below which additional precautions should be taken.

5.5 BOATS—EQUIPMENT AND OPERATION

Every boat from which diving operations are conducted shall—

(a) be safe and suitable for the purpose;

(b) have suitable means, appropriate to the type of boat, by which a diver can enter and leave the water; and

(c) display a diving flag and other signals required by the International Regulations for Preventing Collisions at Sea (1972).

NOTE: Attention is drawn to the surveying and certification of craft required by various regulatory authorities.

5.6 DIVING FROM SHORE

5.6.1 Shore party

A shore party should be present and at a position where they can effectively monitor the divers or their floats and render assistance as required.

5.6.2 Entry and exit

The divers should have experience in entry and exit procedures appropriate to the conditions that may occur at the dive site.

5.6.3 Dive site

Every dive site in navigable waters shall be marked in either, or both, of the following ways:

(a) The dive site shall be identified by a secured floating device to which is attached a dive flag.

(b) At least one of the diving team shall be secured to a float line with dive flag attached.

5.7 TERMINATION OF DIVE

5.7.1 Termination

A dive shall be terminated in accordance with the pre-dive plan, or when—

(a) the dive coordinator or person remaining at the surface requests termination;

(b) a diver requests termination;

(c) a diver loses contact with, or fails to respond correctly to communications from a buddy diver;

(d) a diver fails to respond correctly to communications from the diver's attendant;

(e) a diver begins to use his or her reserve gas supply;

(f) a diver is aware of any sign of malfunction of equipment or of any sign or symptom of distress; or

(g) a diver becomes aware of any unusual or unplanned situation which threatens the health or safety of any dive team member.

5.7.2 Resumption

Diving activity may be resumed, after a decision has been made to terminate the dive under Clause 5.7.1 Items (c) or (d), if contact between buddy divers or the diver and the diver's attendant is restored.

NOTE: Where the original dive plan has been compromised, diving should not resume until a revised dive plan has been put in place.

SECTION 6 PROCEDURES FOR SSBA DIVING OPERATIONS

6.1 GENERAL

When SSBA has been selected as the appropriate type of equipment for a diving operation (see Clause 3.5), then that diving operation shall comply with the requirements in this Section in addition to the general and medical requirements contained in other sections of this Standard.

6.2 PERSONNEL REQUIRED

6.2.1 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 various types of SSBA diving operations are set out in Clauses 6.2.2 to 6.2.5. The provision of extra personnel should always be considered as a means to reduce risk, particularly during dives involving particular hazards or those involving unusual underwater tasks. Sufficient first aid personnel, with both first aid and oxygen administration training as set out in Clause 2.9, shall be present.

6.2.2 Dives in aquarium tanks and swimming pools or in sheltered open water up to 1.5 m deep (see Note)

The following personnel shall be present:

(a) One dive coordinator.

(b) One diver.

(c) One diver's attendant.

The dive coordinator may act as the diver's attendant provided that the diving operation does not involve—

(i) poor visibility;

(ii) danger to the diver from natural currents or currents associated with weirs, sluices, locks, outlets or inlets in the vicinity of the workplace;

(iii) risk of entrapment of the diver or entanglement in his equipment;

(iv) use of equipment or tools; or

(v) a situation in which third party assistance is not readily available in an emergency.

Thus, the minimum dive team for dives in up to 1.5 m of water or in aquarium tanks and swimming pools is TWO. If a dive team of two is used, the dive coordinator shall maintain constant visual contact with the diver and be capable of removing the diver from the water in an emergency or if the diver requests assistance.

NOTE: The limitation of this type of diving in sheltered open water to sites less than 1.5 m deep is intended to restrict its application to situations where the head of a diver standing on the bottom would be above the surface.

6.2.3 Dives to depths up to and including 21 m

The following personnel shall be present:

(a) One dive coordinator.

(b) One diver.

(c) One standby diver.

(d) 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.

6.2.4 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.

6.2.5 Dives to depths deeper than 21 m

The following personnel shall be present:

(a) One dive coordinator.

(b) One diver.

(c) One diver's attendant.

(d) One standby diver.

(e) 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 attendant for both the diver and the standby diver.

Thus, the minimum dive team for dives to depths deeper than 21 m consists of FOUR persons.

6.3 LIFELINE

No SSBA diving operation shall be carried out unless the diver is secured by a lifeline complying with Clause 4.9 and both the diver and the diver's attendant are thoroughly conversant with the agreed system of lifeline signals (see Appendix D).

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

6.4 DIVING EQUIPMENT AND BREATHING GAS SUPPLIES

6.4.1 General

Diving equipment and breathing gas supplies shall comply with the relevant requirements in Section 4.

6.4.2 Equipment for SSBA divers

For surface-supplied diving operations, the underwater equipment shall include the following:

(a) A surface-supply breathing gas hose for each diver, including a non-return valve located as close as possible to the diver, e.g. at the breathing gas inlet to the mask or mouthpiece or as an integral part of the components specified in Item (b).

(b) Either—

  (i) an incompressible helmet, band mask or full face mask; or

  (ii) a half-face mask and separate demand valve.

(c) Inlet and exhaust valves.

(d) Either one of or a combination of—

(i) a demand gas supply device with or without breathing hoses (see Clause 1.5.3); or

(ii) a free-flow gas device.

(e) For demand breathing, breathing hoses or pressure pipe or pressure hose.

(f) An emergency gas supply (see Clause 4.4).

(g) A harness to secure the gas supply hose and the equipment to the diver.

(h) Lifeline.

(i) A buoyancy compensating device.

(j) Diving suit.

(k) Weight belt or other weights.

(l) Diver's knife.

SECTION 7 DIVING ACCIDENTS

7.1 ACCIDENT REPORT

The employer shall ensure that all accident and incident reports are recorded and retained in accordance with the relevant regulatory requirements.

The employer should refer to the relevant regulatory authority for the requirements for recording and reporting accidents and incidents.

NOTE: Attention is drawn to AS 1885.1. Employers may be required by legislation to report all lost-time injuries, or serious incidents where no injury has occurred, to the relevant regulatory authority.

7.2 INVESTIGATION OF ACCIDENTS AND INCIDENTS

In addition to existing legal requirements to record and report incidents, accidents and injuries, the employer should investigate and document all diving-related incidents, accidents and injuries. Appropriate action to prevent further occurrences should then be taken. This should be done in consultation with employees and their representatives. The investigation report should contain the following:

(a) A summary of all aspects of the event occasioning the injury or death, specifying—

  (i) the name and address of the injured diver;

  (ii) the date, location and time of the incident;

  (iii) details of the diving experience of the injured diver, if injured whilst diving;

  (iv) full details of the incident and cause (if known) or possible contributing factors;

  (v) the nature of the injury sustained by the diver; and

  (vi) the supervisor's recommendations to prevent a recurrence.

(b) Full narrative statements from all persons (including the supervisor, diver and diver's attendant) engaged in the relevant diving operation and who can detail any information pertinent to the occurrence of the incident.

(c) Such medical reports, in relation to the diver, as are available, being reports compiled both before and after the occurrence of the incident.

(d) 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—

  (i) whether cylinder valves were opened or closed and to what extent;

  (ii) remaining pressures in cylinder;

  (iii) the position of the emergency supply valve; and

  (iv) 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.

NOTE: Notwithstanding the above, 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.

SECTION 8 RECIPROCITY

8.1 INTENT

It is the intent of this Standard that there shall be full reciprocity between scientific divers authorized to dive pursuant to this Standard and persons of other scientific diving organizations outside Australia and New Zealand. The basis for reciprocity is that a person certified to dive under the auspices of a foreign organization is recognized and allowed to dive within Australia and New Zealand provided he or she presents satisfactory documentary evidence of qualifications to the diving officer of the employer. Such documentary evidence shall include but shall not be limited to a letter or certificate from the diving officer of such organization, diver's logbooks and a current medical certificate of fitness to dive.

Diving officers are strongly recommended to arrange appropriate dives at the start of a visiting diver's stay in Australia or New Zealand so that person's overall competence to participate in the diving planned can be directly assessed.

8.2 CERTIFICATION

8.2.1 Issue of certification

When the diving officer is satisfied that an applicant for visiting scientific diver status under Clause 8.1 is trained and competent to undertake their proposed tasks and has produced satisfactory evidence of fitness to dive, then the diving officer may issue a 'visiting scientific diver' certification or a 'visiting restricted scientific diver' certification as appropriate subject to such special conditions as the diving officer may deem appropriate.

8.2.2 Medical certificate

The diving officer shall be satisfied that the visiting scientific diver holds certification that he or she is currently fit to dive.

APPENDIX A

MINIMUM COMPETENCIES, TRAINING AND CERTIFICATION FOR SCIENTIFIC DIVERS

(Normative)

A1 GENERAL

When approving dive proposals, the employer's diving officer shall ensure that the divers are trained and competent for the specific diving operation proposed, and have received any extra training they may require prior to particular dives. See also Clauses 2.2(e) and 2.10.1. The diving officer may authorize a diver to dive on certain diving operations only, depending on the qualifications of the diver and relevant legislative requirements. For example, for low risk diving such as in sheltered water without night diving or the use of lifting bags, the diving officer may allow divers without night diving or lifting bag competencies to participate.

A2 CLASSIFICATION AND COMPETENCY OF DIVERS

Every diver shall be classified as a restricted scientific diver, a scientific diver, a visiting restricted scientific diver or a visiting scientific diver. Every diver, except a visiting scientific diver shall have the competencies set out in Paragraph A9 of this Appendix and shall hold appropriate certificates or documentation of prior learning to this effect.

NOTES:

1 New Zealand requires each scientific diver to hold an appropriate Certificate of Competency issued in accordance with the *Health and Safety in Employment Regulations 1995*.

2 A visiting scientific diver is a diver who holds a current certification under Clause 8.2.

Restricted scientific divers shall be made aware of their occupational health and safety responsibilities and the organization's relevant procedures.

A3 SCIENTIFIC DIVER

A3.1 Scientific SCUBA diver

In order to carry out scientific diving using SCUBA, a scientific diver shall have all the competencies set out for training as a scientific SCUBA diver in Paragraph A9.1 of this Appendix.

A3.2 Scientific SSBA diver

In order to carry out scientific diving using SSBA, a scientific diver shall have all the competencies called up in Paragraph A3.1 together with those in the additional module for a scientific SSBA diver in Paragraph A9.2 of this Appendix.

A4 RESTRICTED SCIENTIFIC DIVER

A4.1 General

This category is specifically for persons who are involved in research requiring diving but who have limited diving experience and are deemed by the diving officer of their host institution not to have experience equivalent to a scientific diver.

A4.2 Criteria

As a minimum, the diver should—

(a) be 18 years of age;

(b) hold an open water diver certificate from a recognized SCUBA training and certifying organization; and

(c) have at least 15 h of underwater diving experience after certification.

A4.3 RESTRICTIONS

A restricted scientific diver shall—

(a) not dive using SSBA equipment unless trained in SSBA diving;

(b) only dive when conditions are suitable for untethered SCUBA mode;

(c) not dive deeper than 18 m depth;

(d) not act as a standby diver or a dive leader;

(e) not dive as a restricted diver other than for a single initial period of up to 12 months; and

(f) not use powered tools or lift bags.

A5 DIVE COORDINATOR

In order to fulfil the role of dive coordinator, a person shall—

(a) be a scientific SCUBA diver as prescribed in Paragraph A3.1;

(b) be a scientific SSBA diver, as prescribed in Paragraph A3.2, if also coordinating SSBA diving operations;

(c) be able to recognize and manage diving emergencies;

(d) have at least 15 h of experience as a scientific diver;

(e) satisfy any other reasonable requirements specified by the organization's diving officer.

A6 DIVING OFFICER

In order to fulfil the role of diving officer, a person shall—

(a) be trained to a level equal to or exceeding that specified in AS 2815.1 and have a certificate to that effect issued by—

  (i) an occupational diver training establishment;

  (ii) the Australian Diver Accreditation Scheme (ADAS); or

  (iii) the relevant regulatory authority.

(b) if also controlling SSBA diving operations, be trained to a level equal to or exceeding that for a restricted diver as specified in AS 2815.2 and have a certificate to that effect issued as in Item (a);

(c) have at least 100 h of underwater diving experience; and

(d) satisfy any other reasonable requirements specified by the organization.

The diving officer should also keep up to date with current developments in diving technology and practice.

A7 DIVING FROM A BOAT

Whenever diving operations are to be carried out from a boat, the dive coordinator shall ensure that the person responsible for boat operations is competent to undertake the tasks safely and, where necessary, has the required certification for boat operation.

NOTE: Regulatory authorities may require specific certification such as a speed boat licence or a coxswain's certificate for operating small boats in a diving workplace.

A8 DIVING WHERE A SURFACE RECOMPRESSION CHAMBER IS ON SITE

If diving operations are such that a compression chamber is required on site, then all diving personnel shall—

(a) be able to explain the preparation of a typical twin-lock compression chamber for therapeutic recompression treatment;

(b) be able to explain the provision and necessity for maintaining the chamber atmosphere within acceptable limits;

(c) understand the principles of air and oxygen therapeutic tables and their application; and

(d) have some (limited) practical familiarity with recompression chambers, their fittings, their operation, and their hazards.

NOTES:

1 These requirements are insufficient to qualify the scientific diver as a chamber operator or attendant. Compression chamber operators are normally required to have at least the appropriate training and certification set out in either AS 2815.3 or AS 2815.4.

2 Operation of a compression chamber is beyond the scope of this Standard.

A9 COMPETENCIES

A9.1 Scientific SCUBA diver

A9.1.1 *Units of competency and training course content*

Table A1 sets out the units of competency and minimum performance criteria to be achieved during a training course for a scientific SCUBA diver.

In addition to certification as an open water diver through a certified recreational instructor, or equivalent training through any other certification scheme, the diver shall demonstrate competency and satisfactory performance in diving theory and diving practical units as specified in Paragraphs A9.1.2 and A9.1.3 respectively. Each represents a different aspect of the training required.

NOTE: Attention is drawn to relevant safety information and occupational health and safety legislation.

A9.1.2 *SCUBA diving theory*

The units of competency in Table A1 are aimed at ensuring the trainee understands the theory of safely performing scientific tasks underwater. The trainee shall demonstrate an understanding of the concepts listed as elements of competency in the left-hand column of Table A1 and their application to scientific diving by achieving the performance criteria corresponding to each element.

TABLE A1
SCUBA DIVING THEORY

	Element of competency	Performance criteria
A1.1	The role and function of the scientific diver	Correctly list the role and function of scientific divers
A1.2	Knowledge of diving physics, including:	
	Relationship between pressure and volume (Boyle's Law)	Volume changes with changing depths and pressures are calculated corrected
	Relationship between pressure and temperature (Charles' Law)	Pressure changes with changes in temperature are calculated correctly
	Partial pressure of gases (Dalton's Law)	Partial pressure of gases at different depths are calculated correctly.
	Solubility of gases (Henry's Law)	Solubility effect of gases at different depths are calculated correctly
	Buoyancy (Archimedes' Principle)	(a) Buoyancies of various objects at different depths are calculated correctly. (b) The different effects of salt water and fresh water on buoyancy are explained
	Light and sound	Behaviour of light and sound under water are explained
	Heat loss	An understanding of heat loss and the factors which affect it is demonstrated
A1.3	Knowledge of diving equipment	(a) Demonstrate knowledge of the function and operation of SCUBA and associated diving equipment, including dry suits (b) Demonstrate knowledge of the preparation of diving equipment for use and the pre-dive testing procedures to check equipment for defects (c) Demonstrate knowledge of safety procedures for handling equipment (d) Demonstrate knowledge of post-dive procedures, including care and maintenance of equipment
A1.4	Dive planning including risk assessment, hazard identification and control	Prepare dive plans for scientific dives to a depth of 15 m to 20 m and 25 m to 30 m and undertake a risk assessment of each dive, identifying hazards, such as trapping hazards, and measures to be taken in response to them. Each dive is to include a safety stop of at least five minutes at five metres
A1.5	Accident management	Demonstrate the knowledge required to manage accident scenarios and react to diving emergencies
A1.6	Be able to assist in treatment of diving-related ill-health conditions	(a) Demonstrate knowledge of human respiratory and circulatory physiology with particular regard to the diving-related ill-health conditions listed in Item (b) (b) Demonstrate knowledge of signs and symptoms of the following diving-related ill-health conditions for their occurrence in others and self: decompression illness mask and suit squeeze ear and sinus problems near drowning

(*continued*)

TABLE A1 *(continued)*

Element of competency		Performance criteria
		vomiting under water
		gas embolism and pulmonary barotrauma
		carbon monoxide poisoning
		carbon dioxide poisoning
		oxygen toxicity
		anoxia and hypoxia
		nitrogen narcosis
		bites and stings from dangerous marine creatures
		hypothermia and hyperthermia
		(c) Outline the appropriate treatment for the above ill-health conditions
A1.7	Use dive tables and computers to plan and carry out safe diving practices	Demonstrate an understanding and application of decompression tables and computers at a level suitable for scientific diving
A1.8	Use of communications systems	(a) Demonstrate hand and line signals as outlined in Appendices C and D respectively
		(b) Demonstrate an understanding of through water voice communications systems
A1.9	Lifting techniques	Demonstrate the theoretical techniques of lifting items with a lift bag and the problems inherent in this operation
A1.10	Navigation and search techniques	(a) Prepare an underwater search plan and demonstrate the ability to design a plan to navigate underwater to a given point
		(b) Explain the following search methods: circular search jackstay grid search snag line search
A1.11	Zero visibility diving	List the precautions necessary to undertake zero visibility diving
A1.12	Night diving	List the precautions necessary to undertake night diving
A1.13	Deep diving	List the precautions necessary to undertake diving to depths greater than 30 m and prepare a dive plan and risk assessment for a 39 m dive
A1.14	Underwater use of pneumatic tools	Identify hazards and describe correct procedures and safety precautions when using pneumatic tools
A1.15	Compression chamber theory	(a) Explain the uses and limitations of compression chambers
		(b) Describe correct procedures and safety precautions when using compression chambers
		(c) Describe the layout and explain the functions of compression chambers
		(d) Describe the pre-dive procedures for a twin-lock (two-compartment) compression chamber

(continued)

TABLE A1 *(continued)*

Element of competency	Performance criteria
A1.16 Understand the main duties of the employer and employee under occupational health and safety legislation.	Requirements for the employer to provide and maintain the following are understood: Safe systems of work Safe equipment Arrangements ensuring safe use of hazardous substances Instruction, information and training for safety and safe working Safe access and egress to workplace Clean and healthy environment Safe place of work (b) Employee obligations are understood as— (i) to take care of their own health and safety and that of other persons working with the, or in the vicinity of the work site; and (ii) to cooperate with the employer in ensuring health and safety
A1.17 Understand the relevance and requirements of other codes, awards and guidance	Awareness of the existence of other guidance that could be useful in specialized operations is indicated and relevant sources, such as AS/NZS 2299.1 and Petroleum (Submerged Lands) Acts Part VIII, are listed

A9.1.3 *SCUBA diving practical*

The units of competency in Table A2 are aimed at ensuring the trainee can perform surface activities associated with the use of SCUBA equipment as part of a diving team and, as a diver, go under water and return to the surface. They also cover the ability of the trainee to perform useful work underwater and their ability to render first aid and recognize the symptoms of diving related illnesses.

TABLE A2
SCUBA DIVING PRACTICAL

Element of competency	Performance criteria
A2.1 Air management	Demonstrate ability to prevent exhaustion of air supply by monitoring air consumption and air supply and ascending when a predetermined level of air remains
A2.2 Out of air procedures and emergency procedures for panicking diver, tired diver, and unconscious diver at depth	Demonstrate correct out of air procedure and the ability to control a panicking diver, tow a tired diver and rescue a diver from depth to a point clear of the water
A2.3 Hand and line signals	Correctly demonstrate hand signals as outlined in Appendix C and line signals as set out in Appendix D as both sender and receiver
A2.4 Buoyancy control	Correctly demonstrate variation of buoyancy and achievement of neutral buoyancy by using oral and power adjustment of BCD inflation to achieve a motionless hover at three marked points each separated by at least 3 m on a buoyed shot line from the bottom to the surface over a depth at least 12 m
A2.5 Navigation and search skills	(a) Navigate with a compass on prescribed true bearings, perform an underwater swim of at least three legs (each of no less than 30 m in length), successfully locating the marked end points of each leg and returning to within 5 m of the start point (b) Perform a search underwater over an area of not less than 400 m^2 in which at least three out of five objects are recovered using one of the search methods listed in Item A1.10 (circular search, jackstay grid search, snag line search). The search is to be carried out in a low visibility situation in a depth of between 9 m and 15 m
A2.6 Night dive	As a member of a buddy pair, undertake a night dive (at least 30 min after sunset or before sunrise) to a depth of at least 10 m successfully demonstrating the following competencies: (a) Dive planning for a night dive including appropriate organization of the dive site (especially marking of entry and exit points) and emergency procedures (b) Demonstrate effective teamwork while undertaking a manual task requiring the involvement and cooperation of both members of the buddy pair (c) Demonstrate effective use of hand signals with a torch

(*continued*)

TABLE A2 (*continued*)

Element of competency	Performance criteria
A2.7 Zero visibility dive	(a) As a diver, undertake a zero visibility dive in a depth of between 2 m and 9 m with a minimum of 20 min bottom time, sending and responding correctly to appropriate line signal directions from the surface. A dive site where an ungloved hand is not visible at the glass/water interface of the face mask is preferred. Where there is no alternative, a simulated zero visibility situation such as a blacked out mask may be used (b) As a surface attendant, control a diver undertaking a zero visibility dive of similar duration and depth
A2.8 Lifting skills	(a) Using appropriate mathematics, calculate the displacement of an object of known density and volume (to be of a weight of no less than 40 kg) and select an appropriate sized open lift bag (b) Observing all appropriate safety procedures, correctly secure and lift the object under control from a depth of between 15 m and 21 m using an open lift bag and recover the object from the water onto a boat or beach
A2.9 Fitness	Perform a 200 m swim without aids or equipment; tread water for 10 min without aids or equipment; perform a 200 m surface swim wearing full SCUBA equipment
A2.10 Training dives	Undertaken, as a minimum, the dives planned for Item A1.4 of Table A1, i.e. one dive to between 15 m and 20 m and one dive to between 25 m and 30 m. Each dive is to— (a) be conducted as a no-decompression dive; and (b) include a realistic work task, one of which should require the use of light hand tools or scientific equipment (e.g. transect line, sediment corer, camera, other recording or collecting equipment). The dives shall include at least one dive made from a boat and the activities set out in Item A2.11 NOTE: Simulated decompression stops should be made during ascents from two of the dives Performance evidence, as observed by a qualified instructor, shall be available of the candidate utilising correct breathing techniques, demonstrating proper buoyancy in relation to depth, demonstrating operational techniques required to descend and ascend in comfort and to deal with a variety of underwater conditions. Ability to enter and leave the water in different situations (from a beach, a jetty and from a small diving boat) shall be demonstrated

(*continued*)

TABLE A2 *(continued)*

	Element of competency	Performance criteria
A2.11	Use of equipment underwater	During the dives in A2.10, the trainee shall conduct the following equipment exercises: (a) Use a half face mask, mouth held demand valve, life line or float line and line signals (b) Use a range of reserve systems (two out of these options: belt block, integrated pony bottle, manually activated integrated reserve and twin decant, hanging tanks on shot line) NOTE: Inclusion of additional exercises where the trainee uses a full face mask and voice communications is strongly recommended
A2.12	Rescue operations	(a) Act as a stand-by diver, both as a surface standby and as an in-water standby, in simulated emergency situations, by promptly when instructed by the dive coordinator— (i) locating the divers; (ii) correctly assessing for danger; (iii) undertaking assessment of, and responding appropriately to, the diver's condition and recovering the diver direct to the surface; (iv) assisting appropriately in the recovery of the diver from the water; and (v) at all times maintaining effective communication with the dive coordinator throughout the rescue (b) As a diver's attendant, follow commands from the dive coordinator, promptly and strictly to help effect diver recovery and maintain communication where appropriate (c) As a diver's attendant, assist in the recovery of unconscious or injury diver from surface onto dry land/deck of dive platform, ensuring no further injury is sustained by the diver (d) As a diver's attendant, administer appropriate assistance as directed by the dive coordinator
A2.13	First aid and emergency skills	(a) Demonstrate the initial emergency management of an unconscious patient (b) Perform expired air resuscitation (EAR) and cardiopulmonary resuscitation (CPR) using a suitable manikin (c) Using a manikin, demonstrate the ability to set up and use equipment to provide supplementary oxygen during artificial ventilation by mouth to mask technique or resuscitator devices (d) Demonstrate administration of oxygen therapy to a conscious, breathing patient, such that the inspired oxygen concentration achieved is as near as practicable to 100% (e) Demonstrate appropriate methods to control bleeding

A9.2 Scientific SSBA diver

A9.2.1 *Competencies*

A scientific SSBA diver shall have the competencies set out in Tables A3 and A4.

A9.2.2 *Diving using incompressible helmets and band masks*

For SSBA diving using incompressible helmets and band masks, the competencies in Tables A3 and A4 shall be obtained through the training set out in AS 2815.2 and AS 2815.3 for training and certification of occupational divers diving on air to 30 m and 50 m respectively.

A9.2.3 *Diving using half-face masks and separate demand valve, and 'soft' full face masks*

NOTE: Reference to SSBA equipment in this Paragraph refers only to equipment used when a diver is using half-face masks and separate demand valve or 'soft' full face masks with built-in demand valves. Air sources may either be from 'hookah'-type compressors or a bank of high pressure cylinders, which may be SCUBA cylinders.

The diver shall have completed the scientific SCUBA diver competency units in Paragraph A9.1 and shall demonstrate an understanding of the elements of competency in Paragraphs A9.2.4 and A9.2.5 and their application to scientific diving.

A9.2.4 *SSBA diving theory*

For qualification as a scientific SSBA diver, the trainee shall comply with the performance criteria in Table A3.

TABLE A3
SSBA DIVING THEORY

Element of competency	Performance criteria
A3.1 Knowledge of SSBA equipment	(a) Show a good working knowledge of the function and operation of the following common types of SSBA and associated equipment: hookah full or half-face masks air cylinder banks connected through a panel compressors air receivers filtration systems communication systems harnesses bail out of emergency supplies (b) Outline the advantages and disadvantages of each type
A3.2 Potential problems with SSBA equipment	Describe common problems with SSBA equipment and appropriate preventative maintenance/repair methods, including thorough awareness of potential dangers (and preventative measures) from engine exhaust fumes and oil 'flashing' using SSBA equipment
A3.3 SSBA air source control panels	(a) Describe the design, and outline the operation, of a typical surface supply control panel (see Clause 4.7.4.3) (b) Describe the duties of the panel operator
A3.4 Pre- and post-dive checks	Describe all necessary pre- and post-dive checks on SSBA
A3.5 Duties of diver's attendant	Outline the duties of a surface attendant specific to the use of SSBA equipment in which diver(s) are using half-face masks with separate demand valve
A3.6 Duties of a standby diver	Outline the duties of both a surface standby and an in-water standby, covering preparations prior to any emergency and actions to be taken once called to assist a diver
A3.7 Duties of a dive leader	Outline the duties of the dive leader with respect to communication of the pre-dive plan to others in the dive team, control of the dive as it proceeds and any decisions required as the dive proceeds
A3.8 Duties of a dive coordinator for an SSBA operation	Outline the duties of the dive coordinator for an SSBA operation with respect to both normal operations and emergency procedures
A3.9 Out of air procedures	Describe options for use of an alternative air source
A3.10 Emergency procedures	Describe the procedure for recovery of a diver using SSBA from depth

A9.2.5 *SSBA diving practical*

For qualification as a scientific SSBA diver, the trainee shall show the practical skills set out in Table A4.

TABLE A4

SSBA DIVING PRACTICAL UNITS OF COMPETENCY

Element of competency	Performance criteria
A4.1 SSBA equipment	(a) Set up SSBA equipment, and perform pre- and post-dive checks on that equipment using 'hookah' and banks of high pressure cylinders as air sources
	(b) Demonstrate particular awareness of all potential dangers particularly from engine exhaust fumes, oil 'flashing', and other contaminated air problems. Show awareness of appropriate preventative measures
	(c) Effectively monitor SSBA equipment from the surface during a dive, including operation of drain valves on frame reservoir and filters where appropriate
	(d) Don SSBA equipment and successfully perform dives with that equipment, demonstrating an ability to both enter and leave the water from a boat and from the shore or fixed platform
	(e) Demonstrate an ability to reach and operate a bailout bottle during a dive
	(f) Demonstrate ability to use communications system, including line signals
A4.2 Air source control panel	Operate the control panel during a dive (see Clause 4.7.4.3)
A4.3 Diver's attendant	(a) Act as a diver's surface attendant during a dive, including assisting the diver to don equipment correctly, performing pre-dive checks, recording descent and surfacing times for the diver, and keeping the diver's air hose reasonably taut as much as possible without restricting the diver
	(b) Demonstrate correct operation of a surface backup air source during a dive
A4.4 Standby diver	(a) For a surface standby, maintain state of readiness according to equipment and type of conditions to ensure prompt action in the event of an emergency and maintain awareness of all aspects of the dive operation in order to be aware of the exact status of the diver(s)
	(b) For an in-water standby diver, maintain visual contact with, and direct access to, the other diver and maintain effective communication with surface during all rescue procedures

(*continued*)

TABLE A4 *(continued)*

Element of competency	Performance criteria
A4.5 Emergency procedures/ out of air	(a) As a diver in a simulated out-of-air situation, respond using appropriate out of air procedures according to the equipment used
	(b) Use correct emergency drills, procedure and methods in exercise conditions
A4.6 Rescue operations	(a) As a standby diver on the surface in a simulated emergency situation, promptly when instructed by the dive coordinator—
	(i) enter the water;
	(ii) follow the life/air hose to the diver;
	(iii) correctly assess for danger;
	(iv) undertake assessment of and respond appropriately to the diver's condition and recover the diver direct to the surface, assist appropriately in the recovery of the diver from the water; and
	(v) at all times maintain effective communication with the dive coordinator throughout the rescue
	(b) Act as an in-water standby, in simulated emergency situations, by promptly when instructed by the dive coordinator—
	(i) locating the diver;
	(ii) correctly assessing for danger;
	(iii) undertaking assessment of, and responding appropriately to, the diver's condition and recovering the diver direct to the surface;
	(iv) assisting appropriately in the recovery of the diver from the water; and
	(v) at all times maintain effective communication with the dive coordinator throughout the rescue
	(c) As a diver's attendant, follow commands from the dive coordinator, promptly and strictly to help effect diver recovery and maintain communication where appropriate
	(d) As a diver's attendant, assist in the recovery of unconscious or injured diver from surface onto dry land/deck of dive platform, ensuring no further injury sustained to the diver
	(e) As a diver's attendant, administer appropriate assistance as directed by the dive coordinator.

APPENDIX B

DIVING OPERATIONS MANUAL

(Normative)

B1 CONTENT OF MANUAL

The diving operations manual of the employer shall prescribe—

(a) the organization of diving operations under the auspices of an employer;

(b) the procedures to be followed to ensure observance of this Standard; and

(c) such other matters as are appropriate for local conditions or for this requirements of the employer.

The content of the manual shall be reviewed both periodically and as required so that the maximum period between reviews is two years. The review shall be conducted by the diving officer in consultation with other employees.

B2 PROCEDURES

In particular, the manual shall include—

(a) procedures for the approval of persons to dive under the auspices of the employer;

(b) training qualifications, if any, in addition to those specified in this Standard, of the diving officer or any person involved in a diving operation;

(c) procedures to ensure compliance by all divers with the medical requirements of this Standard;

(d) emergency information and first-aid procedures;

(e) procedures for inspection and maintenance of all diving and related equipment used in conjunction with diving;

(f) procedures for the approval of dive proposals (see Clause 3.3);

(g) procedures for specialized kinds of diving, in particular diving using breathing gases other than air, or diving in hazardous conditions in addition to those prescribed by this Standard; and

(h) matters incidental to the administration and execution of diving.

NOTE: The relevant regulatory authorities may require employers to submit their diving operations manuals for approval.

B3 ITEMS FOR INCLUSION IN MANUALS

B3.1 General

Paragraphs B3.2 to B3.8 provide grouped lists of items which should be considered for inclusion in a diving operations manual.

B3.2 Administration

Administration items include—

(a) corporate structure and philosophy;

(b) corporate responsibility;

(c) chain of authority;

(d) delegation of authority;

(e) delegation of authority in emergencies;

(f) delegation of duties;

(g) consultation with person having control over or information related to, safety of any diving operation to be carried out (including the control of lifting operations and shipping/boating movements);

(h) diving with other groups and organizations;

(i) qualifications of the persons required for the tasks and activities to be undertaken;

(j) contractors, volunteer and non-employee divers;

(k) limitation to and type of travel after diving;

(l) other administrative procedures relevant to the undertaking of safe diving practice; and

(m) revision details for the manual, including the review dates and records of reviews undertaken.

B3.3 Plant for diving

Details for this topic should include—

(a) provision of protective clothing;

(b) use and selection of breathing gas and plant;

(c) repair and maintenance of plant;

(d) operation and use of plant; and

(e) loss, damage, repair, replacement procedures.

B3.4 Diving procedures

Procedures covered should include all diving activities undertaken such as general diving, diving using breathing gases other than air, night diving, under ice diving, deep diving, breath hold diving and remote locality diving. The procedures should reflect the results of risk assessment and control activities and include the following:

(a) Operation preparation comprising—

  (i) assessment of foreseeable meteorological and oceanographic conditions;

  (ii) depth and type of operation;

  (iii) suitability of plant;

  (iv) allocation of employees and other persons;

  (v) fitness of divers for underwater operations; and

  (vi) underwater hazards.

  NOTE: These activities can be adequately recorded by the submission of a dive plan and logistics form that incorporates all the required information.

(b) Pre-dive preparation comprising—

  (i) responsibility of each person in the dive team;

  (ii) use of types of diving equipment;

  (iii) supply of gases and gas mixtures, including maximum and minimum partial pressure of gases;

(iv) limits on depth and time underwater, repetitive dive tables reference and use;

(v) orientation, entry, descent, directional and navigational techniques, underwater activity, task completion, ascent and egress review;

(vi) alteration to dive plan;

(vii) reporting and recording of incidents and accidents; and

(viii) record keeping.

NOTE: Many of these factors can be adequately covered by development and use of an appropriate organization checklist.

B3.5 Diving emergencies

Details should address—

(a) emergency assistance underwater and on surface;

(b) emergency communications;

(c) advanced liaison with emergency services and calling for assistance;

(d) first aid;

(e) medical assistance;

(f) decompression and recompression;

(g) contingency planning in the event of evacuation of a platform or vessel;

(h) roles and responsibilities of staff during emergencies including staff qualifications; and

(i) arrangements for the refresher training of staff in the management of emergencies.

NOTE: Contingency planning in the event of evacuation of a platform or vessel includes—

(a) a comprehensive evacuation plan for any divers undergoing hyperbaric recompression from initial alert stage to completion of decompression; and

(b) limitations on vessels and aircraft.

B3.6 Associated activity factors

The effects of associated activity factors should be addressed, including—

(a) manual handling;

(b) boat handling;

(c) dive platforms;

(d) crane operation; and

(e) rigging.

B3.7 Other hazards

Procedures relating to the presence of other hazards such as the following:

(a) Dangerous marine animals.

(b) Shipping movements.

(c) Water inlets.

(d) Hazards peculiar to the dive locations.

(e) Use or presence of hazardous substances, biological pollutants or explosives.

B3.8 Appendices

Samples of the various types of documentation which relate to diving operations should be included, for example—

(a) recommended permanent record of diving format;

(b) record of the dive plan;

(c) dive plan sample;

(d) medical standards;

(e) logistics plan;

(f) risk assessment sheet; and

(g) incident/accident recording and reporting sheet.

APPENDIX C

HAND SIGNALS

(Normative)

Figure C1 illustrates the hand signals most commonly used in SCUBA diving operations.

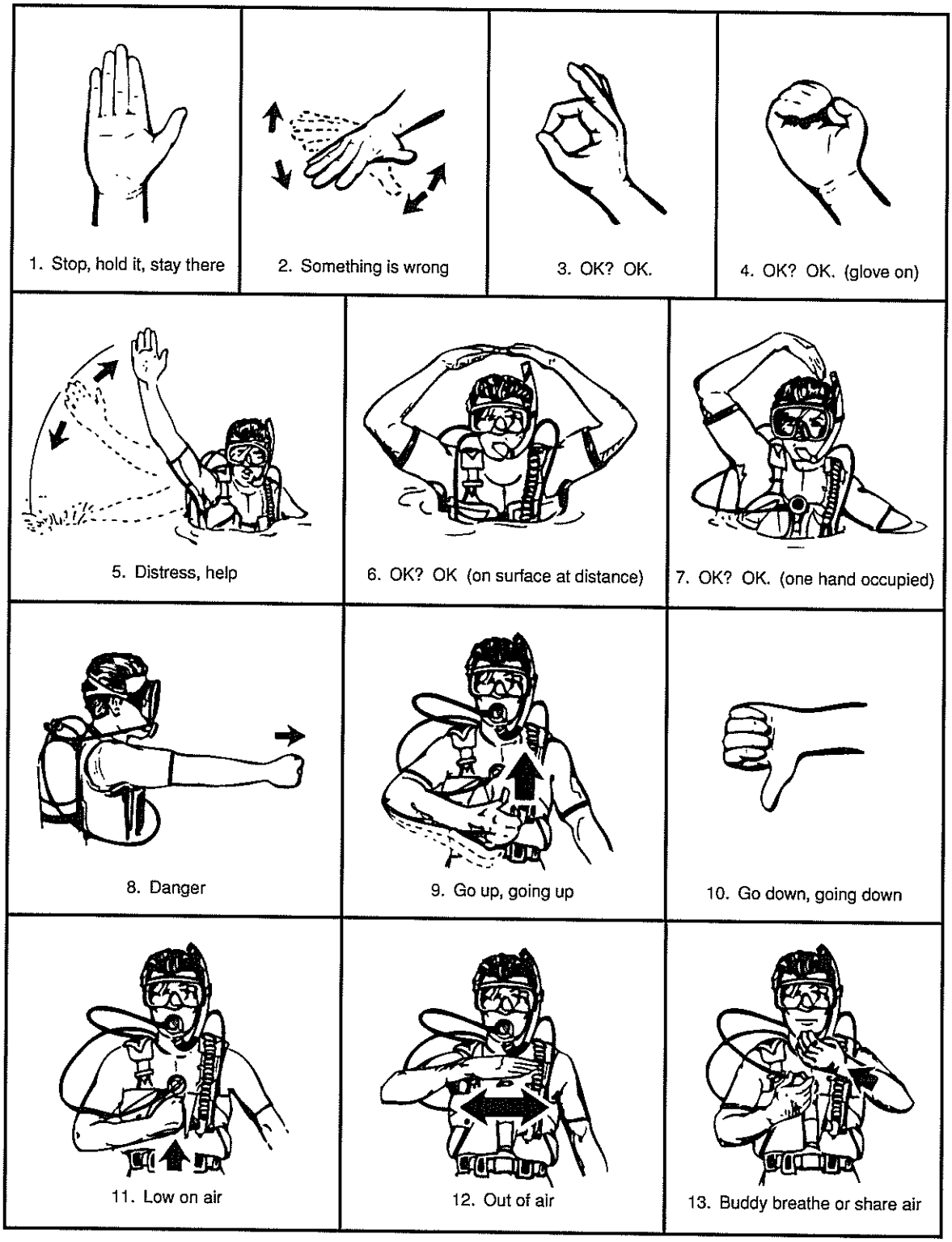


FIGURE C1 (in part) HAND SIGNALS

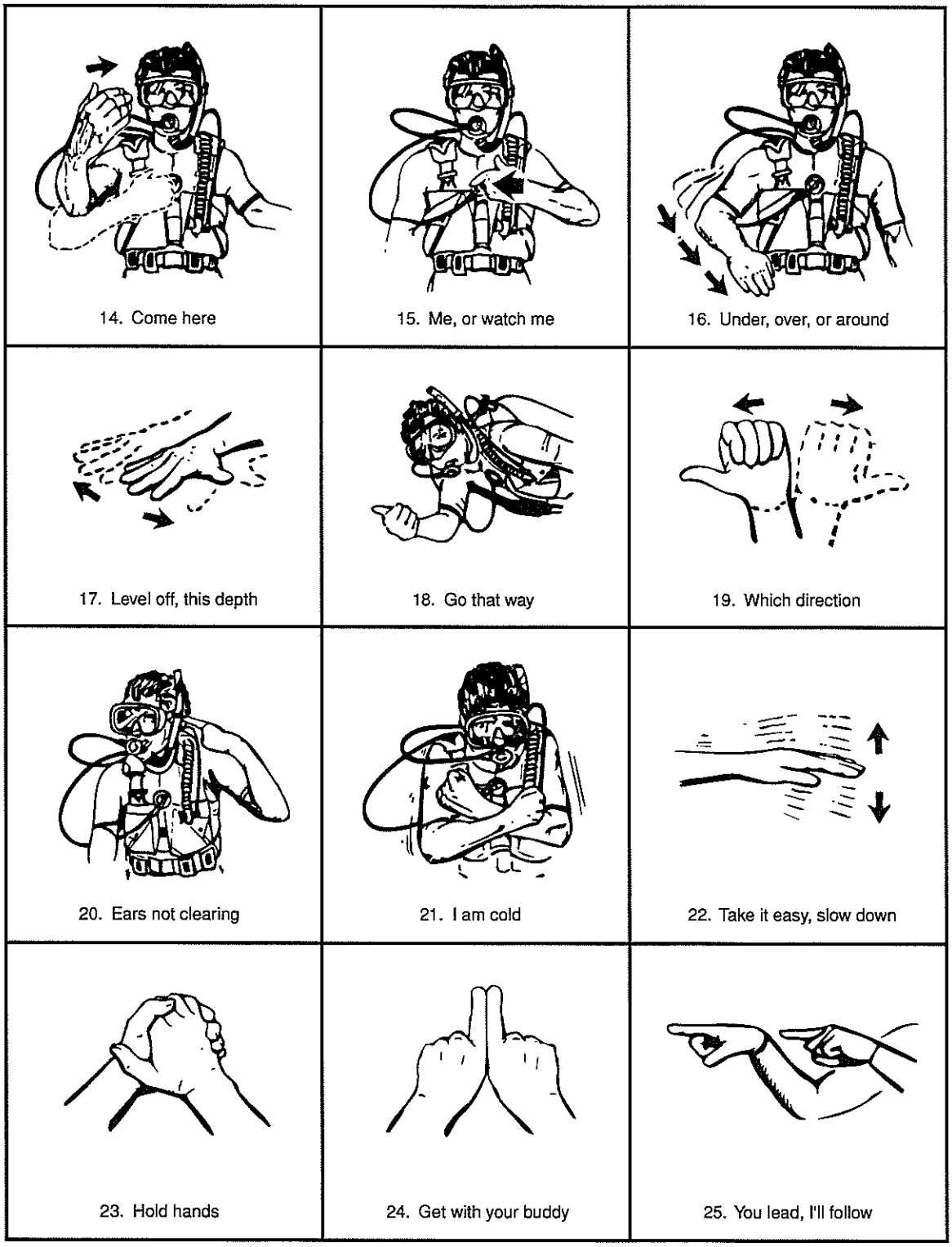


FIGURE C1 (in part) HAND SIGNALS

APPENDIX D

LIFELINE SIGNALS

(Normative)

All personnel involved in diving operations shall know the following lifeline signals:

(a) Four pulls: ***Come up*** (attendant to diver)

May I come up? (diver to attendant)

(b) Succession of pulls (has to be more than four):

EMERGENCY—Pull me up immediately (diver to attendant)

APPENDIX E

EXAMPLE OF DIVER'S LOGBOOK*

(Informative)

DIVE LOG

Employer/Organization: _____

Date ____/____/____ Site & location: _____

Current: _____ Visibility: _____ Water Temperature: _____

Type of dive SCUBA ❐ SSBA ❐ Snorkel ❐

Shore ❐ Jetty ❐ Boat ❐

Breathing medium Air ❐ Gas mix ❐ (detail) _____

Work/training description _____

_____

_____

_____

Comments (incl. any unusual aspects of dive, medical incidents etc) _____

_____

_____

Left surf: _____ Left bott: _____ Arr. surf: _____ Left water: _____

Bottom time: _____ Total dive time: _____ Total in water time: _____

Cumulative DIVE time: _____ **Cumulative IN WATER time:** _____

Decompression (incl. safety stops): _____

Dive depth _____

Validated

Diver Coordinator _____

Signature

Diving Officer signature/stamp _____

* This example was provided by the University of Tasmania.

APPENDIX F

EXAMPLE OF EMPLOYER'S RECORD SHEET*

(Informative)

Dive Coordinator's 'Record of Dive' Form

This form must be submitted to the Diving Officer within 48 hours of return from any field trip involving diving activities. If diving is to occur on one day only, then one page may be used for a number of divers. Otherwise, where diving takes place over more than one day each diver must have separate forms.

NB 1: Any dive after a surface interval of greater than 15 minutes must be deemed a new dive.
NB 2: DCIEM Tables must be followed. **NB 3: This form is for recording AIR dives only.**

Date: _____ Site/s: _____

Dive coordinator/s: _____

Standby diver/s: _____ O_2 Cylinder Pressure at start of day: _____

Diver: _____ **Dive #:** _____ **Surface Attendant:** _____

Start Dive: RF: ___ SCUBA Tank Pressure: _____ **End Dive:** RF: ___SCUBA Tank Pressure: ____

SI since last dive	Time In	Time Out	Max. Depth	Tot. time (min)	Deco (time/depth)

Dive Profile:

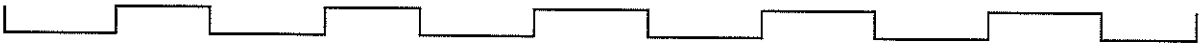
Repetitive Group and repetitive factor at end of dive – **RG:** _____ **RF:** _____

Diver: _____ **Dive #:** _____ **Surface Attendant:** _____

Start dive: RF: ___ SCUBA Tank Pressure: ____ **End Dive:** RF: ___ SCUBA Tank Pressure ____

SI since last dive	Time In	Time Out	Max. Depth	Tot. time (min)	Deco (time/depth)

Dive Profile:



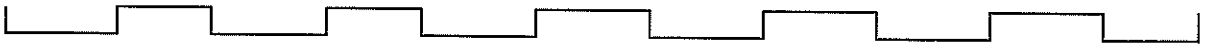
RG? EBT = (RF) _____ x (BT) _____ = _____ **RG:** _____ **RF:** _____

Diver: _____ **Dive #:** _____ **Surface Attendant:** _____

Start dive: RF: ___ SCUBA Tank Pressure: ____ **End Dive:** RF: ___ SCUBA Tank Pressure ____

SI since last dive	Time In	Time Out	Max. Depth	Tot. time (min)	Deco (time/depth)

Dive Profile:



RG? EBT = (RF) _____ x (BT) _____ = _____ **RG:** _____ **RF:** _____

* This example was provided by the University of Tasmania

Diver: ______________ **Dive #:** ______ **Surface Attendant:** ____________________

Start dive: RF: ___ SCUBA Tank Pressure: ____ **End Dive:** RF: ___ SCUBA Tank Pressure ____

SI since last dive	Time In	Time Out	Max. Depth	Tot. time (min)	Deco (time/depth)

Dive Profile:

RG? EBT = (RF) _____ x (BT) _____ = _____ **RG:** _____ **RF:** _____

Diver: ______________ **Dive #:** ______ **Surface Attendant:** ____________________

Start dive: RF: ___ SCUBA Tank Pressure: ____ **End Dive:** RF: ___ SCUBA Tank Pressure ____

SI since last dive	Time In	Time Out	Max. Depth	Tot. time (min)	Deco (time/depth)

Dive Profile:

RG? EBT = (RF) _____ x (BT) _____ = _____ **RG:** _____ **RF:** _____

Diver: ______________ **Dive #:** ______ **Surface Attendant:** ____________________

Start dive: RF: ___ SCUBA Tank Pressure: ____ **End Dive:** RF: ___ SCUBA Tank Pressure ____

SI since last dive	Time In	Time Out	Max. Depth	Tot. time (min)	Deco (time/depth)

Dive Profile:

RG? EBT = (RF) _____ x (BT) _____ = _____ **RG:** _____ **RF:** _____

Diver's/Dive Coordinator's Comments: ____

____

Diver 1 Signature: ____________________ **Diver 2 Signature:** ____________________

Diver 3 Signature: ____________________ **Dive Coordinator's Signature:** ______________

Diving Officer's Comments: ____

____

____

UDO Signature: ______________________________ **Date:** ______________

APPENDIX G

HAZARD IDENTIFICATION, RISK ASSESSMENT AND CONTROL

(Informative)

G1 HAZARD IDENTIFICATION

Hazards should be identified at the time of registration of the dive site, during the preparation of the dive plan and at the dive site prior to the commencement of the dive. Any hazards which arise during the dive should immediately be brought to the attention of the dive coordinator and the dive plan varied as necessary to ensure the health and safety of the diver or the dive aborted.

G2 RISK ASSESSMENT

G2.1 General

An assessment by a competent person is the critical appraisal of a diving operation with particular emphasis on the potential risk to divers. The assessment process focuses on the overall risk to a diver from a number of elements rather than from the risk from one of these elements in isolation. Thorough assessment assists in the identification and prioritization of the control measures to be applied.

G2.2 Process

The assessment process should be undertaken in consultation with divers in the following three parts:

(a) *Dive site registration*—in assessing the risks posed by working at a particular site at the beginning of a scientific program.

(b) *Before the diving operation*—in the selection of appropriate control measures for inclusion in the dive plan.

(c) *At the dive site and during the diving operation*—to ensure that the limitations of the control measures selected are not exceeded, including during the dive and post-dive activities.

Operational planning may take place well in advance of the intended diving operation based on assessment of likely conditions at the dive site. Prior to the commencement of any diving operation, the dive coordinator should ensure that a suitable dive plan, including objective assessment of all observed, known or charted site conditions is conveyed to, and understood by, all members of the diving team.

G2.3 Basis for an assessment

An assessment should be based on at least—

(a) the identification of hazards in the workplace;

(b) the nature of the risks created by those hazards;

(c) the degree of exposure to those risks;

(d) the potential of those risks to cause injuries and illness; and

(e) the measures required to control the exposure to those risks.

G2.4 Factors for consideration

As a minimum, the factors in the following list should be considered when conducting an assessment of risk:

(a) *Environmental conditions* Certain parameters should be examined for their effects on the dive from the perspective of operations both on the surface and below, including, but not limited to—

(i) strength and direction of wind and the degree of influence that it may have on the diving operation and emergency response capability;

(ii) current and tide;

(iii) visibility;

(iv) entrapment hazards;

(v) depth at worksite;

(vi) water temperature;

(vii) time of day;

(viii) underwater terrain;

(ix) atmospheric temperature and humidity;

(x) contaminants; and

(xi) isolation of the dive site.

(b) *Task related factors* The complexity of the diving task or the presence of a component which is non-routine in nature may increase the level of risk associated with a diving operation.

(c) *Hyperbaric/physiological factors* Hyperbaric and physiological factors include—

(i) frequency of diving, including multiple ascents, repetitive diving and multi-day diving;

(ii) depth of dive;

(iii) duration of dive;

(iv) breathing gas;

(v) exertion required to reach dive site or conduct task;

(vi) excessive noise;

(vii) immediate pre-dive fitness (prior dives, prior physical exertion, fatigue, recent illness); and

(viii) altitude exposure.

(d) *Associated activity factors* The effects of associated activity factors should be assessed. These associated activities include—

(i) manual handling;

(ii) boat handling; and

(iii) dive platforms.

(e) *Other hazards* Presence of other hazards such as the following should be taken into account:

(i) Dangerous marine animals.

(ii) Shipping movements.

(iii) Water inlets.

(iv) Use or presence of hazardous substances, biological pollutants or explosives.

(v) Other hazards peculiar to the dive location(s).

(f) *Emergency response factors* There should be an assessment of what would be required in case of an emergency. The assessment should include consideration of—

(i) the location and availability of appropriate emergency systems; and

(ii) emergency response procedures.

G2.5 Record of assessment

The risk assessment process should be detailed in the diving operations manual. Such details should clearly demonstrate that the following processes have been addressed:

(a) *Hazard identification* Risk factors identified.

(b) *Risk assessment* Consideration of all relevant risk factors and their magnitude.

(c) *Risk control* Control measures proposed and basis for their selection.

(d) *Monitoring* Conduct of the operation assessed for effectiveness of Items (a) to (c).

G3 RISK CONTROL

G3.1 General

Control of risk is achieved by selecting from the hierarchy of control measures, one or more measures which individually or in combination achieve the required risk reduction.

G3.2 Control measures

Appropriate control measures should be applied to risks, using the hierarchy of controls in the following order:

(a) *Elimination* Where the level of risk cannot be controlled to an acceptable level, no diving should take place.

(b) *Substitution* Where the risk can be controlled by performing the task using alternative methods of diving, consideration should be given to using these alternative methods.

(c) *Design* Plant and procedures should be designed to minimize risk.

(d) *Isolation* Persons should be isolated from the identified hazards.

(e) *Administrative* Every dive plan should seek to minimize the degree and duration of the diver's exposure to risk.

NOTE: Almost every aspect of dive planning falls into this administrative category.

Administrative controls include—

(i) training, supervision, experience and selection of dive team members, including staffing levels;

(ii) provision of an appropriate diving operations manual;

(iii) organization and planning before, during and after the dive;

(iv) selection of appropriate plant; and

(v) selection of the appropriate form and level of communication.

(f) *Personal protective equipment* Appropriately designed and sized personal protective equipment should be provided, used and maintained. The limitations of all equipment used should be identified as part of the risk assessment process. Information from manufacturers and from records of prior experience should be used to identify limitations.

APPENDIX H

GUIDELINES REGARDING EXPOSURE TO ALTITUDE FOLLOWING DIVING

(Informative)

H1 SCOPE

This Appendix provides recommendations regarding the period which should elapse after diving and before a diver ascends to altitude or is otherwise exposed to reduced atmospheric pressure. These recommendations are intended to provide guidance for operations where no specific alternative protocol has been established.

H2 RECOMMENDATIONS

The minimum delays should be as set out in Table H1. These recommendations are for divers who find themselves in normal health following diving. If any signs or symptoms of illness or injury are present, individualized advice should be sought regarding the need for either emergency medical evacuation or a prolonged stay at sea level altitude.

TABLE H1

RECOMMENDED DELAY BEFORE EXPOSURE TO ALTITUDE

Altitude m	Minimum delay before travel to altitude h		
	Category of dive (see Legend)		
	1	2	3
0 – 150	Nil	Nil	2
150 – 600	Nil	2	12
600 – 2400	12	24	48
Greater than 2400	24	48	72

LEGEND:

Category 1 = A single dive to ≤50% of the DCIEM no-decompression limit or two short dives within 18 h with a total, combined bottom time of ≤50% of the no-decompression limit for the depth of the deeper dive. No decompression diving or repetitive dives in previous few days.

Category 2 = Dives exceeding Category 1 but not included in Category 3, e.g. one or more dives to ≥50% of the no decompression limits or a single decompression dive a day.

Category 3 = Repetitive deep diving over multiple days, multiple decompression dives on one day, extreme exposures; omitted decompression; or other adverse events.

NOTES:

1 The altitude referred to is the effective altitude. In pressurized aircraft the relevant environment is the effective altitude of the aircraft cabin and not the flying altitude. Commercial aircraft are usually pressurized to achieve an effective cabin altitude of 2400 m or less.

2 The recommendations given in Table H1 are drawn from expert opinion regarding what should be safe for routine diving operations. The risk of decompression illness varies substantially with differing dive profiles, and data regarding risks associated with altitude exposure after diving is limited. Specialist advice is recommended whenever altitude exposure following diving is planned.

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