

DRAFT AUSTRALIAN STANDARD FOR
TRAINING AND CERTIFICATION OF DIVERS

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The Standards Association of Australia's Committee SF/17 (Work in Compressed Air) has produced a Draft Standard for public review. The Standards Association of Australia has kindly given permission for the SPUMS Journal to reprint parts of the draft standard (in italics wherever the quotations appear). The draft is "a proposed series of standards relevant to the training and certification of divers where the requirements of regulatory authorities and industry demand a prescribed degree of training and competence to ensure an adequate degree of safety, performance and economy." It applies to employed divers, not to sports divers, but most of the terminal objectives and training topics of Part 1 "Scuba Divers" (Tables 1 to 10) are applicable to sports divers. Unfortunately many sports divers could not give the right answers or take the right actions in response to a number of these objectives. This paper is based on the drafts that are to be circulated for comment. These drafts will almost certainly be modified in content and presentation, when in their final form, to take account of such comment. The object of this paper is to bring to the attention of SPUMS members the proposed standards so that they can contribute their ideas to the final product.

Part 1 - Scuba Diving

Part of the preface and Sections 1 and 2 are reproduced here.

PREFACE

This draft is related to those persons not normally working underwater but who are required to dive in connection with archaeology, non-commercial research, scientific work, and observation tasks.

Other proposed standards cover the training of divers required to undertake a range of work tasks underwater. These parts are as follows:

- Part 2 - Restricted Commercial Air Diving*
- Part 3 - Professional Air Diving with Surface Compression Facilities*
- Part 4 - Bell Diving.*

This draft is largely based on requirements originally developed by the (UK) Manpower Services Commission (MSC) and the European Diving Technology of the EEC, which were developed to meet the UK Health and Safety at Work Regulations.

As with the training described in the other parts of this standard related to professional diving, the SAA drafting committee has strongly supported the objective of developing requirements compatible with the UK standards. Such compatibility should lead to reciprocal acceptance of diver qualification/certification sufficient to enable persons to undertake diving, to the appropriate classification, throughout Australia and overseas.

SECTION 1. SCOPE AND GENERAL

1.1 SCOPE. *This standard specifies the training activities and terminal objectives required for training and accreditation of persons who wish to dive safely and competently -*

- (a) *to perform a limited range of underwater tasks deemed to represent underwater construction or repair activities;*
- (b) *using self-contained breathing apparatus (SCUBA) to depths of 20m; and*
- (c) *on sites with no surface compression chamber required in accordance with AS 2299.*

NOTES:

- 1. *It is thought that such training would be of interest (the minimum) to those who dive in connection with archaeology, non-commercial research, scientific work, and observation tasks.*
- 2. *Currently AS 2299 restricts the depth and duration of diving with SCUBA and diving without access to surface compression chambers.*

1.2 PURPOSE AND TERMINAL OBJECTIVES

1.2.1 Purpose. *The purpose of this standard is to describe the organizational and syllabus requirements for the following:*

- (a) *To train air divers to operate safely and competently to 20m using self-contained diving equipment where no surface compression chamber is required on site in accordance with AS 2299.*
- (b) *To provide a knowledge and practical application of techniques for divers who only have to undertake a limited range of air diving tasks.*

NOTE: *The basic training provided by this standard is limited to dives that do not include underwater construction or repair activities, or dives that routinely extend to depths in excess of 20m. Attention is drawn to the additional training specified in other parts of this standard and in AS 2299 for such diving.*

The following important aspects need to be stressed:

- (i) Competence. *The range of diving tasks covered by this standard is limited. Accordingly, divers who wish to dive to depths greater than 20m or undertake work while underwater should be trained and accredited in accordance with AS XXXX, Part 2 or AS XXXX, Part 3.*

NOTES:

- 1. *The requirements of AS 2299 state - "No person shall employ, instruct or allow any*

person to be employed as a diver and no dive shall be carried out unless the diver -

“(a) has passed all medical requirements (set out in Appendix A of AS 2299); and

“(b) has practical experience, has a knowledge of diving, practice and the requirements of this standard and has a full understanding of the diving apparatus in use.”

2. Some statutory authorities require that persons carrying out diving work must be in possession of an appropriate certificate of competency issued by that authority.

(ii) Safety and health. The safety and health of the diver and the development of safe working practices MUST be integrated into all aspects of the training program.

(iii) Team training. The training, particularly in practical diving and underwater working, needs to be directed not only towards developing individual competence, but also to develop the trainee to think and act as a member of a team.

1.2.2 Terminal Objectives. The terminal objectives describe what the trainee must be able to do on completion of training and can be classified broadly into two groups as follows:

- (a) Objectives whose purpose is to develop a degree of competence in the trainee.
- (b) Objectives which are limited to developing in the trainee and appreciation, or acquaintance with, a piece of equipment or a procedure.

The terminal objectives have been grouped under ten headings (Tables) in this standard as follows:

Table 2.1 -	Diving theory
Table 2.2 -	Use of self-contained diving equipment
Table 2.3 -	Seamanship
Table 2.4 -	Diver communication systems
Table 2.5 -	Underwater tasks
Table 2.6 -	Underwater hazards
Table 2.7 -	Air compressors
Table 2.8 -	Surface compression chambers and therapeutic decompression
Table 2.9 -	The physiology of diving and first aid
Table 2.10 -	Relevant legislation and guidance.

The wording of the terminal objectives and their interpretation is very important as they are used to produce the topics to be included in the training program. It is realized that there are difficulties in expressing clearly and precisely the level of competence to be developed in the trainee.

1.3 APPLICATION. The standard recognizes that training may take place in a diving school or in-company.

Regulatory authorities may utilize the standard to -

(a) approve establishments to run courses to this standard;

(b) monitor courses to ensure standards are being maintained; and

(c) issue or accept certificates of competence to persons who have completed the training tasks specified herein and are adjudged competent to achieve the terminal objectives described herein.

NOTE: Persons completing training to this standard may undertake additional training (see AS XXXX, Part 2 or AS XXXX, Part 3) if they wish to increase their level of competence and be considered for additional diving operations not covered by this Part.

1.4 REFERENCED DOCUMENTS. The following standards are referred to in this standard:

AS 2030	SAA Gas Cylinders Code
AS 2299	Underwater Air Breathing Operations
AS XXXX	Training and Certification of Divers
	Part 2 - Restricted Commercial Air Diving*
	Part 3 - Professional Air Diving with Surface Compression Facilities*

1.5 SELECTION CRITERIA. The trainee MUST be in possession of a valid certificate of medical fitness to dive (see AS 2299) issued, after examination, by a doctor experienced in underwater medicine and approved by the relevant Regulatory Authority.

DRAFTING NOTE: Discussions with overseas authorities are under way regarding accreditation of medical doctors to perform medical examination of divers.

The trainee should, as a minimum -

(a) be at least 18 years of age;

(b) be a competent swimmer, at least to the standard laid down by the Royal Life Saving Society Survival Certificate;

(c) be able to -

(i) add, subtract, multiply and divide whole numbers, decimals and simple fractions;

(ii) calculate percentages; and

(iii) transpose and solve simple formulas, eg. gas laws; and be able to understand written and verbal communications and communicate easily with instructors and other trainees/members of the diving team.

(d) be able to understand written and verbal communications and communicate easily with instructors and other trainees/members of the diving team.

* In course of preparation

SECTION 2. TABLES OF TERMINAL OBJECTIVES AND TRAINING TOPICS

<i>Terminal objectives</i>	<i>Training Objectives</i>
<i>The overall standard to be achieved by the end of the training (to be able to) -</i>	<i>Specific topics to be achieved during the training to meet the requirements of the terminal objectives</i>

TABLE 2.1
DIVING THEORY

<i>Outline the following properties of liquids and gases:</i>	
<i>2.1.1 Relationship between pressure and volume (Boyle's Law).</i>	<i>- Calculate the volume changes with changing depths.</i>
<i>2.1.2 Relationship between pressure and temperature (Charles' Law).</i>	<i>- Calculate the pressure changes with changes in temperature.</i>
<i>2.1.3 Partial pressure of gases (Dalton's Law).</i>	<i>- Calculate the partial pressure of gases at different depths.</i>
<i>2.1.4 Solubility of gases in solution (Henry's Law).</i>	<i>- Explain the solubility effect of gases in liquids and the need for decompression.</i>
<i>2.1.5 Buoyancy (Archimedes' Principle).</i>	<i>- Calculate the buoyancy of various objects at different depths.</i> <i>- Explain the effect of salt and fresh water on buoyancy.</i>

TABLE 2.2
USE OF SELF CONTAINED DIVING EQUIPMENT

<i>2.2.1 Dive safely and competently using self-contained diving equipment in sheltered and open water in varying bottom conditions and water visibility.</i>	<i>- Dive, act as a diver's attendant and standby in diving operations using self-contained diving equipment.</i> <i>- Calculate the air consumption rates and duration of dives.</i>
<i>2.2.2 Diving safely and competently to a depth of 20m using self-contained diving equipment.</i>	<i>- Explain the function and operation of reserve systems currently available.</i>
<i>2.2.3 Carry out emergency drills applicable to self-contained diving equipment.</i>	<i>- Explain the procedure to be followed in case of</i> <i>- trapped diver</i> <i>- unconscious diver</i> <i>- Explain current SCUBA emergency procedures, eg. equipment sharing, use of inflatable life jackets and buoyancy aids.</i> <i>- Perform at least one simulated rescue of an unconscious diver when acting as a diver and a standby diver.</i>
<i>2.2.4 Dress and undress divers using self-contained diving equipment.</i>	<i>- Explain safety procedures.</i> <i>- Perform pre-dive and post-dive checks.</i>
<i>2.2.5 Perform user maintenance of self-contained diving equipment and prepare equipment for use.</i>	<i>- Dismantle and re-assemble self-contained diving equipment.</i> <i>- Explain the function and operation of SCUBA and associated diving equipment.</i>

2.2.6 Perform repairs and tests to diving suits.

- Explain the testing procedures to check equipment for defects.
- Identify worn and damaged parts
- Explain the principles of porosity testing of dry suits and perform user maintenance and repair of diving suits

IN-WATER TRAINING TIMES

The following minimum in-water training times must be achieved. In-water time should include some simulated decompression stops. Trainees may require more than the minimum times to achieve the terminal objectives.

<u>Depth, m</u>	<u>In-water Time, min</u>
0 - 19	700 (with a minimum of 300 in the depth range 11 m to 20m)
At 20	200

TABLE 2.3
SEAMANSHIP

2.3.1 Outline the pattern of tidal movements and how to determine the depth of water and tidal direction in a given place at a given time.	- Calculate predicted depth and tidal movement using a chart and tide tables.
2.3.2 Recognize the standard symbols used on charts and how distance, position and direction are determined.	- Plot a course on a chart between two points and measure direction and distance. - Use a chart to calculate distance and position.
2.3.3 Outline the principles of handling a small craft in harbour and at sea in varying water conditions.	- Explain precautions to be taken when navigating in confined waters and at sea with respect to other vessels, natural hazards and structures.
2.3.4 State the essential safety equipment to be carried in a small craft.	- Explain the use of essential safety equipment.
2.3.5 Handle a small craft under supervision.	- Perform the following operations and manoeuvres: <ul style="list-style-type: none"> - start and stop engine - launch and recovery - anchoring - coming alongside - recovery of a floating object - picking up a buoy
2.3.6 Handle safely and efficiently cordage and ropes.	- Tie basic knots used in diving - Handle ropes. - Explain the main purposes of current legislation concerning the use of lifting appliances applicable to diving operations.

TABLE 2.4
DIVER COMMUNICATION SYSTEMS

2.4.1 Recognize, identify, interpret and correctly respond to hand and rope signals from diver to surface, surface to diver, and diver to diver as described in Section 3 and Appendix G of AS 2299.	- Explain the principle of tending a diver. - Explain and use hand and rope signals. - Act as a diver and attendant in a diving operation where rope signals are primary means of communication.
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2.4.2. Outline the basic principle of underwater communication and diver intercom systems.	<ul style="list-style-type: none"> - Explain the differences between two-wire and four-wire telephone systems. - Explain the principles of through-water communication systems.
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TABLE 2.5
UNDERWATER TASKS

2.5.1 Outline current underwater search methods and locate an object using two of them.	<ul style="list-style-type: none"> - Explain at least three current methods of carrying out underwater searches. - Locate an object underwater using at least two different search methods.
2.5.2 Produce a report based on an inspection/ survey of an underwater structure or natural feature.	<ul style="list-style-type: none"> - Explain the principles of producing clear, concise and well laid out reports. - Explain the essential points to be included in briefing for a survey/inspection. - Perform an underwater inspection/survey and prepare a report.
2.5.3 Outline the basic principles of various underwater inspection and measurement techniques, including video inspection.	<ul style="list-style-type: none"> - Explain the elementary principles of various underwater inspection and measurement techniques including <ul style="list-style-type: none"> - tape measurement - recording and writing - still photography - video inspection.

NOTE:

Other underwater tasks should be included in the training program. The tasks might include the use of skills and knowledge related to the profession of the trainee.

TABLE 2.6
UNDERWATER HAZARDS

2.6.1 Outline the hazards to divers of water flow around of through underwater structures (including gates, pipelines, culverts, sewers and intakes) and explain the safety precautions to be taken.	<ul style="list-style-type: none"> - Explain the safety precautions to be taken before undertaking diving operations where hazardous flow conditions may exist. - Explain the principles of differential water pressure and the operation of sluice gates and intake.
2.6.2 Outline the hazards of marine animals and explosives to divers.	<ul style="list-style-type: none"> - Explain various envenomation processes found in marine animals. - Effects of various types of venom on the human physiology. - Precautions required in handling marine animals.

TABLE 2.7
AIR COMPRESSORS

2.7.1 Outline the principles, method of operations and health and safety requirements of high pressure air compressors.	<ul style="list-style-type: none"> - Explain compressor air flow and volume. - Explain the air purity requirements specified in AS 2299. - Explain the relevant requirements of statutory provisions.
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2.7.2 Operate safely and efficiently and carry out user maintenance of high pressure air compressors.	<ul style="list-style-type: none"> - Operate high pressure air compressors. - Perform all checks and user maintenance including checking oil and water and draining filters.
2.7.3 Operate and carry out user maintenance of associated air filtration equipment.	<ul style="list-style-type: none"> - Explain the purpose of a filtration system, including the components of a filter and its replacement and the siting of air intakes. - Use a simple analyser kit to determine air purity.
2.7.4 Operate a high pressure air panel and bank to charge cylinders safely and efficiently.	<ul style="list-style-type: none"> - Explain the main safety precautions to be observed concerning the use of high low pressure air vessels. - Explain the principles of decanting. - Explain the procedure for and charge an air cylinder directly from a compressor and from an air bank.

TABLE 2.8
SURFACE COMPRESSION CHAMBERS AND THERAPEUTIC DECOMPRESSION

2.8.1 Interpret and apply standard air decompression tables.	<ul style="list-style-type: none"> - Calculate the correct decompression schedules for single, combined and repetitive dives using current decompression schedules.
2.8.2 Outline the principles of compression chamber operation and the use of air and oxygen therapeutic tables.	<ul style="list-style-type: none"> - Explain the preparation of a typical twinlock compression chamber for therapeutic recompression treatment. - Explain the provisions for maintaining the chamber atmosphere within acceptable limits. - Explain the principles of air and oxygen therapeutic tables and their application.

NOTE: It is desirable that trainees also undergo some limited practicable familiarization with decompression chambers, their fittings and their principle of operation.

TABLE 2.9
THE PHYSIOLOGY OF DIVING AND FIRST AID

2.9.1 Outline the respiratory, circulatory, basic skeletal and nervous systems of the body.	<ul style="list-style-type: none"> - Explain briefly the function of the following: Skeletal system: heart, blood vessels and circulation of blood: properties of blood; lungs and airways including control of respiration and simple gas exchange: brain: spinal cord and nerves.
2.9.2 Outline the basic need for and problems associated with maintaining the normal body temperature of the diver.	<ul style="list-style-type: none"> - Recognize signs and symptoms of hypothermia and hyperthermia and how to treat these conditions.
2.9.3 Describe the changes and symptoms caused by breathing too high or too low a concentration of oxygen or too high a concentration of nitrogen.	<ul style="list-style-type: none"> - Explain how the amount of oxygen received can be measured.
2.9.4 Apply first aid treatment in typical diving emergencies.	<ul style="list-style-type: none"> - Explain the causes, signs, symptoms and treatment of - decompression sickness; squeeze 'ears' and sinuses; reversed ears; drowning; vomiting under water; cold exposure; carbon dioxide poisoning; carbon monoxide poisoning; nitrogen narcosis; pulmonary barotrauma; air embolism.

2.9.5 Apply first aid treatment to minor injuries.	- Explain the signs, symptoms and treatment of shock, burns, bleeding (both external and internal), wounds and fractures including long bones and spine, electrocution.
2.9.6 Apply first aid treatment to an unconscious person.	- Explain causes, signs, symptoms and treatment of asphyxia. - Demonstrate external cardiac massage and artificial maintenance of respiration.
2.9.7 Describe the symptoms and treatment for injuries/illness caused by contact with dangerous marine animals.	- as for 2.6.2.

TABLE 2.10

RELEVANT LEGISLATION AND GUIDANCE

2.10.1 Outline the relevant Statutory Regulations and associated guidance notes as they relate to air diving operations. Review the requirements of AS 2299 and other relevant standards (eg. AS 2030).	<ul style="list-style-type: none"> - Explain the main duties of the employer and employee. - Explain the main duties of the diving contractor, the diving supervisor, and the diver. - Explain the main purpose of other Statutory Regulations and associated guidance notes as they apply to air diving operations using surface supplied or self-contained diving equipment where no surface compression chamber is required on site. - Explain importance of knowing the location and phone numbers of nearest recompression facilities. - Name and phone numbers of doctors knowledgeable in diving medicine. - Transportation facilities available for emergency use.
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Part 2 - Restricted Commercial Air Diving

Part of the preface, those parts of Section 1 and Section 2 that differ from Part 1 and part of Section 3 are reproduced below.

PREFACE

This draft is particularly related to the training of personnel who will be engaged in professional and/or commercial underwater operations, at limited depths, as described in AS 2299 using surface-supplied compressed air or self-contained breathing apparatus and not having access to a surface compression chamber. Such qualification is the minimum required by regulatory authorities who are responsible for the control of on-shore diving, eg. construction of jetties, dams.

Significant considerations in the development of this draft are as follows:

- (a) Alignment with regulatory (Australian and Overseas) Requirements and Compatibility with AS 2299, Underwater Air Breathing Operations. This draft is largely based on the requirements originally developed by the (UK) Manpower Services Commission (MSC) and the European

Diving Technology Committee of the EEC, which were developed to meet the (UK) Health and Safety Diving Operations at Work Regulations which require all divers entering construction or off-shore oil and gas industries in the United Kingdom to have achieved the appropriate requirements of the appropriate MSC underwater working training standard.

The SAA drafting committee has strongly supported the objective of developing requirements compatible with the UK standards and to pursue the question of reciprocal acceptance of diver qualification/certification within Australia and with the UK and European authorities. Such reciprocity is most desirable to provide uniform control and regulations for the itinerant workforce of professional divers. However, the committee has proposed more stringent requirements than the UK in this draft because it believes -

- (i) *that the requirements of this proposed standard should be compatible with AS 2299 and with those of Australian regulatory authorities; and*
- (ii) *dispensation from the more stringent requirements of AS 2299 and Australian regulatory authorities, eg. maximum depth of dives with no surface*

compression chamber available, should be the subject of special application (see Amendment 1 to AS 2299).

- (b) Implementation and Certification. Any new scheme for the assessment and certification of divers based on training to this proposed standard needs to take account of several contingencies not readily covered by standards. In the UK, the relevant Authority (Health and Safety Commission) established a Certification Board for Diving Training to advise on-
- (i) criteria by which diver training may be assessed for certification purposes;
 - (ii) criteria by which experience may be assessed for certification purposes of a standard not less than the standard of training in (i);
 - (iii) establishments providing training satisfying the criteria in (i) ;
 - (iv) equivalence to (i) and (ii) in respect of training and experience in foreign countries; and
 - (v) arrangements for -
 - A. issuing of certificates in respect of diver training;
 - B. declaring such certificates to be no longer valid; and
 - C. approval of persons taking part in diving operations as part of training.

The drafting committee is anxious to -

1. have confirmed which bodies in Australia are likely to undertake similar certification activities;
2. receive comment on how certification arrangements to take account of alternative/previous experience and competence might be handled; and
3. continue to pursue arrangements for reciprocal acceptance of interstate and overseas certification.

SECTION 1. SCOPE AND GENERAL

1.1 SCOPE. This standard specifies the training activities and terminal objectives required for the training and accreditation of divers who are required to work safely and competently -

- (a) using self-contained breathing apparatus (SCUBA) or surface-supplied compressed air to depths to 20m (see Note); and
- (b) on sites where no surface compression chambers are required by AS 2299 to be present on site or within convenient distance.

NOTES:

1. Training and certification to this standard is generally the minimum required to undertake diving in on-shore locations to undertake construction activities, eg. repair of jetties, dams.

2. Attention is drawn to the requirements of AS 2299 and of regulatory authorities which limit the depths and times of diving with no compression chamber facilities.
3. Persons who wish to be trained sufficiently to dive to greater depths need to be trained to AS XXXX, Part 3. Graduates from training courses to this standard, ie. AS XXXX, Part 2, who wish to upgrade their diving qualifications may be eligible to do so by completing approved selected modules at an approved diving school.

1.2 PURPOSE AND TERMINAL OBJECTIVES

1.2.1 Purpose. The purpose of this standard is to describe the organizational and syllabus requirements for the following:

- (a) To train underwater workers for the diving industry to operate safely and competently to depths of 20m using self-contained and surface-supplied breathing apparatus in accordance with AS 2299.
- (b) To provide a knowledge of the underwater skills required by the industry and the application of basic skills in order to complete a range of underwater tasks safely and efficiently.

The following important aspects need to be stressed:

- (i) Safety and health. The safety and health of the diver and the development of safe working practices **MUST** be integrated into all aspects of the training course.
- (ii) Team Training. The training, particularly in practical diving and underwater working, needs to be directed not only towards developing individual competence, but also to develop the trainee to think and act as a member of a team.

1.2.2. Terminal Objectives

Table 2.2 Use of self-contained and surface supplied diving equipment (including rigid helmet with free flow primary air supply).

1.3 APPLICATION. The standard recognizes that training may take place in a diving school or in company.

DRAFTING NOTES:

1. Investigations are under way to determine if reciprocal recognition of diver qualification and certification can be arranged between Australian and the European (EEC) authorities.
2. The Victorian Department of Minerals and Energy is currently working with other equivalent State regulatory bodies in Australia, under the auspices of the Australian Minerals and Energy Council (AMEC) Standing Committee on Off-shore Petroleum Legislation, to institute and implement

a uniform national system for off-shore diver accreditation. This standard is seen as the vehicle by which uniform training criteria can be set in Australia for diving activities requiring such certification.

1.5 SELECTION CRITERIA.

(b) be a competent swimmer and hold a recognized certificate of swimming competence, eg. certificate as a military diver or sports diver to PADI, FAUI, NAUI*;

- * Professional Association of Diving Instructors (PADI)
Federation of Australian Underwater Instructors (FAUI)
National Association of Underwater Instructors (NAUI)

SECTION 2. TABLES OF TERMINAL OBJECTIVES AND TRAINING TOPICS

Terminal objectives	Training Objectives
The overall standard to be achieved by the end of the training (to be able to -)	Specific topics to be achieved during the training to meet the requirements of the terminal objectives

TABLE 2.2

USE OF SELF-CONTAINED AND SURFACE-SUPPLIED DIVING EQUIPMENT (INCLUDING RIGID HELMET WITH FREE-FLOW PRIMARY AIR SUPPLY)

2.2.1 Dive safely and competently using self-contained and surface-supplied diving equipment in sheltered and open water in varying bottom conditions and water visibility.	- Dive, act as a diver’s attendant and standby diver in diving operations using self-contained and surface-supplied diving equipment.
2.2.2 Dive safely and competently to a depth of 20m using self-contained diving equipment to the reserve limit of the breathing set.	- Explain the function and operation of reserve systems currently available. - Operate the reserve safely.
2.2.3 Dive safely and competently to a depth of 20 m using two types of surface supplied diving equipment one of which must be rigid helmet with free-flow primary air supply (eg. Kirby Morgan, Swindel, Aquadine or Rat Hat).	- Act as a diver, diver’s attendant, standby diver and panel operator in diving operations involving the use of band mask/demand helmet and free flow helmet to a depth of not less than 20 m.
2.2.4 Carry out emergency drills applicable to self-contained and surface-supplied diving equipment.	- Explain the procedure to be followed in the case of : - broken helmet/face plate - “blow-up” - trapped diver - unconscious diver - loss of communications - Explain current SCUBA emergency procedures, eg. equipment sharing, use of inflatable life jacket and buoyancy aids, etc. - Carry out at least one in-water simulated rescue of an unconscious diver using both types of diving equipment when acting as a diver and standby diver.
2.2.6 Perform user maintenance of self-contained and surface-supplied diving equipment and prepare equipment for use.	- Dismantle and reassemble self-contained and surface-supplied diving equipment. - Explain the function and operation of masks, helmets, SCUBA and associated diving equipment. - Explain the testing procedures to check equipment for defects. - Identify worn and damaged parts.

2.2.7 Perform repairs and tests to diving suits.	<ul style="list-style-type: none"> - Explain the principles of porosity testing of dry suits. Perform user maintenance and repair of diving suits, including heated diving suits.
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IN-WATER TRAINING TIMES FOR TABLE 2.2

The following minimum in-water training times must be achieved. In-water time should include some simulated decompression stops. Trainees may require more than the minimum times to achieve the terminal objectives.

<u>Depth, m</u>	<u>In-water time, min</u>
0 to 19	900 (with a minimum of 400 in the depth range 11m to 19m)
At 20	300

TABLE 2.4
DIVER COMMUNICATION SYSTEMS

2.4.2 Outline the basic principles of underwater communication and diver intercom systems.	<ul style="list-style-type: none"> - Explain the differences between two- and four-wire telephone systems.
	<ul style="list-style-type: none"> - Perform a functional test on a diver intercom system.
2.4.3 Use underwater communication and diver intercom systems for communication from diver to surface, surface to diver.	<ul style="list-style-type: none"> - Explain the principles of through-water communication systems.
2.4.4 Carry out use maintenance of underwater communication and diver intercom systems.	<ul style="list-style-type: none"> - Act as a diver, telephone operator and attendant in a diving operation where a diving intercom system is the primary means of communication with a diver.
	<ul style="list-style-type: none"> - Perform user maintenance, eg. change earphones, microphone, check connections and battery, recharge battery.
	<ul style="list-style-type: none"> - Perform a test on a communication system and isolate a fault in helmet cable or box.
	<ul style="list-style-type: none"> - Explain the precautions to be taken to protect equipment.

TABLE 2.5

UNDERWATER TASKS

NOTES:

1. A substantial majority of the tasks must be completed using surface-supplied diving equipment.
2. At least one of the dives to 20m should involve an underwater task than an average diver would need at least 20 minutes to complete.
3. Tasks using power tools, cutting and welding equipment, and explosives, shall all be carried out using surface-supplied equipment incorporating communications.

Underwater search, inspection and survey

2.5.4 Outline the basic principles of non-destructive testing.	<ul style="list-style-type: none"> - Explain the basic principles and techniques of current non-destructive testing including:
<u>Rigging</u>	<ul style="list-style-type: none"> - ultrasonic - magnetic particle - cathodic protection measurement

2.5.5 Handle safely and efficiently cordage, wire, ropes, blocks and tackle, chain hoists, associated winches, Tirlors and working stages, including wet bells, on the surface and underwater.	<ul style="list-style-type: none"> - Tie basic knots used in diving. - Handle ropes and wire - Rig a working stage for a practical diving task.
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Hand tools

2.5.6 Complete underwater tasks safely and efficiently using a range of hand tools, eg. wrenches, hammers, chisels and hacksaws.

Powered tools

2.5.7 Outline the methods of operation, hazards, and safety requirements of compressed air and hydraulically operated tools, eg. jack hammers, impact wrenches, drilling machines, grinders and cut-off discs.

2.5.8 Complete underwater tasks safely and efficiently using a range of compressed air and hydraulic tools.

2.5.9 Perform user maintenance of compressed air and hydraulic tools.

Note: Some of the powered tools must be used at a depth of 20 m.

Water jetting, airlifts and lifting bags

2.5.10 Outline the principles, methods of operation and safety requirements of high pressure and low pressure water jets, air lifts and lifting bags.

2.5.11 Use a low pressure or high pressure water jet, air lift and lifting bags safely and efficiently.

2.5.12 Carry out user maintenance of water jetting equipment, air lifts and lifting bags.

Cutting and welding equipment

2.5.13 Outline the principles, method of operation, safety requirements and uses of thermal arc cutting equipment.

2.5.14 Outline the principles, method of operation and safety precautions to be taken when using oxy-arc cutting equipment.

- Use blocks, tackles, chain hoists, associated winches and Tirfors on the surface and underwater.
- Explain the principles of mechanical advantage.
- Explain the main purposes of current legislation concerning the use of lifting appliances applicable to diving operations.
- Perform user maintenance of blocks and tackle, chain hoists and Tirfors.

- Complete a range of underwater tasks to the required standards using a range of hand tools.
- Act safely and competently in a diving operation involving the use of a range of hand tools.
- Perform user maintenance of hand tools.

- Explain the safety precautions to be taken when using compressed air and hydraulic tools.

- Explain the principles, operating procedures and limitations of compressed air and hydraulic tools.

- Act as a diver in a diving operation using a range of powered tools.

- Complete a range of tasks to the required standards.

- Perform pre-dive and post-dive checks and user maintenance.

- Explain the principles of water jetting equipment, air lifts and the use of buoyancy for lifting and the safety precautions to be taken.

- Calculate the number of lifting bags and determine the procedures required to lift a given object.

- Complete underwater tasks to the required standards using a low pressure water jet, air lift and lifting bags.

- Perform post-use maintenance.

- Prepare thermal arc cutting equipment for use.
- Calculate appropriate oxygen pressure.

- Explain alternative methods of ignition.
- Explain safety precautions to be taken on the surface and underwater.
- Prepare equipment for use.
- Calculate appropriate oxygen pressure.
- Explain safety precautions to be taken on the surface and underwater.

<p>2.5.15 Use oxy-arc cutting equipment safely and efficiently to cut 'I' beam, pipe and cut flat steel plate up to 25 mm in thickness.</p>	<ul style="list-style-type: none"> - Perform pre-dive and post-dive checks. - Perform cutting tasks to the required standards. - Change cutting rods underwater.
<p>2.5.16 Perform user maintenance of oxy-arc cutting equipment.</p>	<ul style="list-style-type: none"> - Perform post dive maintenance of equipment including:- generator knife switch cables torch
<p>2.5.17 Outline the principles, methods of operation and safety precautions to be taken when using current methods of underwater electric arc welding.</p>	<ul style="list-style-type: none"> - Prepare equipment for use. - Explain safety precautions to be taken on the surface and underwater. - Explain different types of electrode and appropriate current settings.
<p><u>Underwater explosives</u></p>	
<p>2.5.18 Outline the types of explosive currently available for underwater use, their common usage and relevant Statutory Regulations.</p>	<ul style="list-style-type: none"> - Explain the procedures for the safe handling of explosives. - Explain current methods of initiation and procedures to be used in case of a misfire. - Explain the use of explosive accessories, eg. tools, exploders.
<p>2.5.19 Outline the use of explosives and the setting of firing circuits and their initiation using electrical and non-electrical methods and handle equipment under classroom conditions.</p>	<ul style="list-style-type: none"> - Explain the correct placing of explosive charges, parallel and series electrical circuits.
<p><u>Underwater construction techniques</u></p>	
<p>2.5.20 Outline the elementary principles of construction methods and practices associated with underwater structures and interpret relevant/simple engineering drawings.</p>	<ul style="list-style-type: none"> - Explain how to set up scaffolding underwater and the use of various techniques including concreting, sand bagging, shuttering and bolt tensioning. - Interpret a simple engineering drawing.

TABLE 2.6

UNDERWATER HAZARDS

<p>2.6.2 Outline the hazards from explosives, electrical apparatus and marine animals.</p>	<ul style="list-style-type: none"> - Explain types of explosives normally used in underwater work.
<p>-</p>	<ul style="list-style-type: none"> - Explain reasons for keeping explosives and detonators apart in separate boxes.
<p>-</p>	<ul style="list-style-type: none"> - Explain importance of being fully insulated when doing underwater cutting and welding.
<p>-</p>	<ul style="list-style-type: none"> - Explain difference between straight and reverse polarities in cutting and welding circuits.
<p>-</p>	<ul style="list-style-type: none"> - Explain various venom processes found in marine animals.
<p>-</p>	<ul style="list-style-type: none"> - Effects of various types of venom on the human physiology. - Precautions required in handling marine animals.

TABLE 2.7AIR COMPRESSORS

2.7.1 Outline the principles, method of operation and health and safety requirements of high pressure and low pressure air compressors and be familiar with the requirements of AS 2299, Section 5.	<ul style="list-style-type: none"> - Explain compressor airflow and volume and requirements for particular diving operations. - Explain the relevant requirements of Statutory regulations.
2.7.2 Operate safely and efficiently and carry out user maintenance of high pressure and low pressure air compressors.	<ul style="list-style-type: none"> - Operate high pressure and low pressure air compressors. - Perform all checks and user maintenance including checking oil and water and draining filters.
2.7.3 Transfer gases into and out of high pressure air banks safely and efficiently.	<ul style="list-style-type: none"> - Explain the main safety precautions to be observed concerning the use of high pressure and low pressure air vessels and compressors and the siting of air intakes. - Explain the principles of decanting. - Explain the procedure for charging and charge an air cylinder directly from a compressor and from an air bank.
2.7.4 Operate and carry out user maintenance of associated air filtration equipment.	<ul style="list-style-type: none"> - Explain the purpose of a filtration system, including the components of a filter and its replacement and the siting of air intakes. - Use a simple analyser kit to determine air purity.

TABLE 2.8SURFACE COMPRESSION CHAMBERS AND THERAPEUTIC DECOMPRESSION

.8.2 Outline procedures for surface decompression.	<ul style="list-style-type: none"> - Explain the correct schedules for surface decompression and requirements for safe transfer of diver to chamber.
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TABLE 2.9THE PHYSIOLOGY OF DIVING AND FIRST AID

2.9.3 Describe the dangers and symptoms caused by breathing too high or too low a concentration of oxygen or too high a concentration of nitrogen.	<ul style="list-style-type: none"> - Explain briefly the effects on the brain and lungs and what is meant by oxygen pulmonary toxicity. - Recognize signs and symptoms of hypoxia and anoxia, and how to treat these conditions.
2.9.5 Apply first aid treatment to injuries.	<ul style="list-style-type: none"> - Explain the signs, symptoms and treatment of shock, burns, arterial and venous bleeding (both external and internal), wounds and fractures including long bones and spine, electrocution, high pressure jetting injuries, dislocation, internal injuries, burns, blast and crush injuries (see NOTE).

NOTE: The first aid training outlined above does not include training in the more detailed examination of a patient, nor does it teach the diver how to treat or nurse the patient over an extended time period. Therefore when divers are working under conditions where a diving emergency physician is not readily available, it is recommended that a person with additional training (paramedic) should be on the worksite. This may be a diver or a chamber operator with perhaps a nursing qualification, or a medical assistant from the armed services. A person in this second category must be capable of working under pressure. Training must include the diver's first aid training and paramedical skills which must include intravenous drips, diagnosis, intramuscular and intravenous injections. This would be envisaged as a separate certificate.

TABLE 2.10RELEVANT LEGISLATION AND GUIDANCE

2.10.1 Outline the relevant Statutory Regulations and associated guidance notes as they relate to air diving operations. Review the requirements of AS 2299 and other relevant standards (eg. AS 2030).

- Explain the main duties of the employer and employee.
- Explain the main duties of the diving contractor, the diving supervisor, and the diver.
- Explain the main purpose of AS 2299 and of other current Statutory Regulations and associated guidance notes as they apply to air diving operations using surface supplied and self-contained diving equipment.

NOTE: Divers should also become familiar with requirements of regulatory authorities in other countries in which they intend to dive.

3.4 PLANNED EXPERIENCE. On successful completion of a training program to the requirements of the training standard, the graduate will be able to dive safely and completely under reasonably controlled conditions as a Restricted Air Diver. A training program cannot convert a trainee into a fully competent air diver. This will require further planned experience on the job.

The term 'planned experience' is used deliberately, as it is only be reinforcing the skills and knowledge acquired during the training program that the graduate will become fully competent. Skills and knowledge that are not reinforced in this way are likely to be lost. The range of operations varies significantly between diving companies. In some cases a company will be able to offer experience in a wide range of operations, while for another it will be narrower and probably more specialized.

Whatever the particular circumstances, the company should define what they expect a competent air diver to be able to do and ensure he receives any additional training which may be required in order to carry out specialized tasks. Careful planning will be required to integrate graduates into existing diving teams to ensure that they are used safely and effectively. During planned experience to new diver's progress should be carefully monitored. He will require close supervision especially during operations involving new systems, procedures, or techniques. Supervision should be undertaken only by competent members of staff.

Part 3. Professional Air Diving

Part of the preface, where it differs from Part 2, and parts of Section 1 and 2 where they differ from Part 2, are reproduced below.

PART 3 - PROFESSIONAL AIR DIVING WITH SURFACE COMPRESSION FACILITIES.

This draft is particularly related to the training of personnel who will be engaged in professional and/or commercial underwater operations as described in AS 2299 using surface-supplied compressed air or self-contained breathing apparatus and having access to a surface compression chamber. Such qualification is the minimum

required by regulatory authorities who are responsible for the control of off-shore diving, eg. oil and gas exploration.

Another part is also to be prepared for training of Diving Supervisors (Part 5).

SECTION 1. SCOPE AND GENERAL

1.1 SCOPE. This standard specifies the training activities and terminal objectives required for the training and accreditation of divers who are required to work safely and competently:

- (a) using self-contained breathing apparatus (SCUBA) to depths of 20 m (see note);
- (b) using surface-supplied compressed air to depths of 50 m; and
- (c) on sites with surface compression chambers present or within convenient distance.

NOTES:

1. Training and certification to this standard is generally the minimum required to undertake diving in offshore operations such as gas and oil exploration.
2. Attention is drawn to the requirements of AS 2299 and of regulatory authorities which limit the depths and times of diving under these conditions and specify the need for compression chamber facilities. In particular, the requirements of regulatory authorities and AS 2299 generally prohibit the use of SCUBA for working dives to depths greater than 20 m (see also Clause 1.2.1).

1.2 PURPOSE AND TERMINAL OBJECTIVES.

1.2.1 Purpose. The purpose of this standard is to describe the organizational and syllabus requirements for the following:

- (a) To train underwater workers for the diving industry to operate safely and competently to depths of 20 m using self-contained and to 50 m using surface-supplied diving equipment in accordance with AS 2299.

NOTE: AS 2299 and some Statutory Regulations prohibit working SCUBA diving beyond 20 m except in special circumstances (see Clause 3.3(a) of AS 2299).

- (b) To provide a knowledge of the underwater skills required by the industry and the application of basic skills in order to complete a range of underwater tasks safely and efficiently.

1.5 SELECTION CRITERIA.

Persons certificate as graduate divers to AS XXXX, Part 2 and wishing to upgrade their diving qualifications to those specified herein may be eligible to do so by completing approved selected modules at an approved diving school.

SECTION 2. TABLES OF TERMINAL OBJECTIVES AND TRAINING TOPICS

<i>Terminal objectives</i>	<i>Training Objectives</i>
<i>The overall standard to be achieved by the end of the training (to be able to -)</i>	<i>Specific topics to be achieved during the training to meet the requirements of the terminal objectives.</i>

TABLE 2.2

USE OF SELF-CONTAINED AND SURFACE-SUPPLIED DIVING EQUIPMENT (INCLUDING RIGID HELMET WITH FREE-FLOW PRIMARY AIR SUPPLY)

2.2.3 Dive safely and competently to a depth of 50 m using two types of surface-supplied diving equipment one of which must be rigid helmet with free-flow primary air supply (eg. Kirby Morgan, Swindel, Aquadine or Rat Hat).	- Act as a diver, diver's attendant, standby diver and panel operator in diving operations involving the use of band mask/demand helmet and free flow helmet to a depth of not less than 40 m.
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In-water Training Times for Table 2.2

The following MINIMUM in-water training times must be achieved. In-water time should include some decompression stops. Trainees may require more than the minimum times to achieve the terminal objectives.

The in-water time shall be achieved by proportioning the times over the range of water depths available. The time must include some dives to 50 m.

NOTE: Where available, the following schedule is recommended:

<u>Depth, m</u>	<u>In-water time, min</u>
0 to 19	1600 (with a minimum of 400 in the depth range 11 m to 19 m)
20 to 39	250 (with a minimum of 100 in the depth range 30 m to 39 m)
40 to 50	150 (with a minimum of three wet dives each of which must have a bottom time exceeding 10 min).

Chamber Times

Attention is drawn to the additional times the trainee must spend in the compression chamber (see Table 2.8).

TABLE 2.5

UNDERWATER TASKS

NOTES:

1. A substantial majority of the tasks must be completed using surface-supplied diving equipment.
2. At least one of the dives to 35 m (minimum) should involve an underwater task that an average diver would need at least 20 min to complete.

3. *Tasks using power tools, cutting and welding equipment, and explosives, shall all be carried out using surface-supplied equipment incorporating communications.*

Powered Tools

2.5.7

Note: *Some of the powered tools must be used at a depth between 25 m and 35 m.*

TABLE 2.8

SURFACE COMPRESSION CHAMBERS AND THERAPEUTIC DECOMPRESSION

2.8.1	<i>Outline the layout of a two-compartment compression chamber, safety and fire precautions, emergency procedures, method of operation, control panel, air supply and oxygen breathing system.</i>	<ul style="list-style-type: none"> - <i>Explain the purpose and operation of services to the chamber including the function of all components.</i> - <i>Explain the need for oxygen cleanliness and the safety precautions to be observed.</i> - <i>Explain the provisions specified in Section 4 of AS 2299.</i> - <i>Explain the main requirements of the Statutory Regulations concerning pressure vessels.</i>
2.8.2	<i>Perform user maintenance of a two-compartment compression chamber.</i>	<ul style="list-style-type: none"> - <i>Perform pre-dive and post-dive checks.</i>
2.8.3	<i>Operate a two-compartment compression chamber.</i>	<ul style="list-style-type: none"> - <i>Pressurize, flush through and decompress a two-compartment compression chamber.</i>
2.8.4	<i>Complete a test dive to 50 m in a two-compartment compression chamber.</i>	<ul style="list-style-type: none"> - <i>Complete a simple dexterity or comprehension test at a depth of 50 m.</i>
2.3.5	<i>Prepare a two-compartment compression chamber for therapeutic treatment.</i>	<ul style="list-style-type: none"> - <i>Perform functional tests of all appropriate systems including communications equipment.</i> - <i>Ensure appropriate fire precautions are taken and fire prevention equipment is available.</i> - <i>Ensure appropriate first aid and personal supplies are available for the patient.</i>
2.8.6	<i>Interpret and apply air decompression tables.</i>	<ul style="list-style-type: none"> - <i>Calculate the correct decompression schedules for single, combined and repetitive dives using current decompression tables.</i>

APPENDIX A

EXAMPLE OF TRAINING SYLLABUS OUTLINE SYLLABUS
FOR 12 WEEK BASIC AIR DIVING COURSE - (SUMMER 1981)

*(Operated by Prodiver Limited,
Commercial Diving Training School,
Falmouth, Cornwall)*

DRAFTING NOTE: *Comment on alternative examples of syllabus suitable for operations in Australia, acceptable to Australian authorities and, hopefully, European authorities, is especially requested.*

In particular some concern has been expressed for the high level of SCUBA content, which may not be appropriate for the training of professional air divers.

NOTES ON THE COURSE

1. *Physical training will be carried out each morning for the first six weeks of the course.*
2. *Night dives will be arranged during the second, fourth and tenth weeks of the course.*
3. *First aid training will be held on one evening per week for the first eight weeks.*
4. *Each day is divided into eight periods of instruction. 'P' denotes a period of practical instruction. 'T' denotes a period of theoretical instruction.*

Part 4. Bell Diving

Part of the preface, where it differs from the preface of Part 3, parts of Section 1 and 2 where they differ from Part 3, are reproduced below.

This draft is particularly related to the further training of experienced air divers and underwater workers to permit them to operate safely and competently as bellmen and lock-out divers. Such training and accreditation is the minimum required by regulatory authorities who are responsible for the control of deep diving off-shore, eg. oil and gas exploration.

SECTION 1. SCOPE AND GENERAL

1.1 SCOPE. *This standard specifies the training activities and terminal objectives required for the training and further accreditation of experienced air divers to operate safely and competently as bellmen and lock-out divers.*

1.2 PURPOSE AND TERMINAL OBJECTIVES.

1.2.1 Purpose. *The purpose of this standard is to describe the organizational and syllabus requirements necessary to train experienced air divers to operate safely and competently as bellmen and lock-out divers.*

1.2.2 Terminal Objectives. *Terminal objectives have been grouped under four headings (Tables) in this standard as follows:*

Table 2.1	Deck Compression Chamber Operations
Table 2.2	Diving Bell Operations
Table 2.3	Diving Theory, Physiology and First Aid
Table 2.4	Relevant Legislation and Guidance.

(c) Diving bell operations

(i) Familiarization training. *Familiarization training must be given in shallow depths. The instructor or experienced bell diver must be in the bell until he is satisfied the trainee can act safely and competently as a bellman and lock-out diver in shallow depths before carrying out dives below 50 m.*

The following minimum number of shallow training dives must be achieved:

- A. Twenty-five bell runs with lock outs
- B. Act as a bellman for 25 runs with lock-outs
- C. Complete five simulated rescues of an incapacitated diver.

(ii) Training below 50 m. *The trainee must complete safely and competently a minimum of four bounce dives acting as a bellman and lock-out diver at progressive depths from 50 m to 100 m. It is not essential for an instructor or experienced bell diver to be in the bell provided that the trainee has*

satisfied the requirements in (i) above.

NOTE: *Where, due to seasonal conditions or weather, depths of 100 m are not available at the scheduled time of the 100 m training dives, the training school must notify the Regulatory Authority of the maximum depth of water available at that time and seek approval prior to diving to any alternative depth.*

(iii) Task training. *Trainees must complete underwater rescues from 50 m to 100 m to give representative in-water times and experience of working at these depths. The tasks may be carried out during the diving bell training, ie. (ii) above.*

(iv) Saturation diving. *Trainees must be exposed to saturation conditions for a minimum of 36 hours including decompression, and should whenever possible complete a lock-out dive under these conditions. Two excursions from saturation to a depth greater than 50 m can be counted as two of the bounce dives.*

1.5 SELECTION CRITERIA

The trainee should, as a minimum -

- (b) *be a competent commercial air diver approved to AS XXXX, Part 3 with at least 12 months' experience as a commercial diver or have experience acceptable to the relevant Regulatory Authority;*
- (d) *be able to understand written and verbal communications and be able to communicate easily with one another. This is particularly important where trainees or instructors are of differing nationalities.*

DECOMPRESSION DIVING AND BONE NECROSIS

Dr RI McCallum of the Department of Occupational Health and Hygiene, The University of Newcastle-Upon-Tyne, has responded to the article "Decompression Diving can cause bone damage" which appeared in the April 1983 Barologia newsletter. The following information is of interest:

- "1. The great majority of bone lesions are quite symptomless and do not involve joints and are therefore not disabling.
- "2. Only a small minority of commercial divers have bone damage to joints and this is rare in the hip joint which is the most disabling area for joint damage to appear.
- "3. We have not found bone damage at all in commercial divers who have not gone deeper than 30 metres. We have not found this condition in sport divers and indeed I think it is most unlikely."

RI McCallum

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