PADI Recompression Chamber Orientation (RCO) Specialty Course Instructor Outline

A. Course Overview

The purpose of the 'Recompression Chamber Orientation' Distinctive Speciality is to provide a safe and well-supervised introduction into the work of a hyperbaric facility. It is designed to introduce divers to a brief history and evolution of hyperbaric chambers and familiarise them with facilities available, the procedures used, problems and hazards associated with a recompression chamber and possible treatments available. Course participants have an ***optional opportunity*** of taking part in a recompression chamber dive to a maximum depth of 30 metres.

[This is NOT a recompression chamber operator's course]

B. RCO Course Requirements

1. Prerequisite certification: Participants must be 15 years of age or older and hold a current medical certificate indicating fitness to dive.
2. Advanced Open Water Diver.
3. Recommended course hours: 4
4. Student-instructor ratio is 8:1 during skill development sessions, 2:1 during optional dry dive exercise.
5. Training dives: Optional Dry dive to 30metres.

C. Student and Instructor Equipment Requirements

1. Student equipment
    a. Slate and pencil
    b. Warm clothing
2. Instructor equipment
    a. Slate and pencils
    b. Puzzles/simple language & numeracy tests
    c. Oxygen delivery system/s

3. Instructor Materials

   PADI RCO Distinctive Specialty Instructor Outline

4. Recommended Student Materials

   a. PADI Rescue Diver Manual
   b. PADI Divemaster Manual
   c. PADI the Encyclopaedia of Recreational Diving.

5. Recognition materials

   a. PIC envelopes

   b. Specialty Diver Certificates

[Much of the following text has been taken from both the PADI Scientific scuba diver specialty course work and literature from http://londondivingchamber.co.uk/index.php]

Text recommendations:

AS/NZS 2299.2. 2002. *Occupational diving operations: Part 2: Scientific diving.* Sydney, NSW: Standards Australia International and Wellington, NZ: Standards New Zealand.

Bove, A. A. and Davis, J. C. (2004). *Bove & Davis' Diving Medicine* (4th ed.). Philadelphia : W.B. Saunders.

Edmonds, C., Lowry, C., Pennefather, J. and Walker, R. (2005). *Diving and Subaquatic Medicine.* (4th ed.). Oxford University Press

Haux, G. F. K. and Workman, W. T. (2000). *History of Hyperbaric Chambers*. Flagstaff, AZ: Best Publishing Company.

Professional Association of Diving Instructors. (2009). Scientific Scuba Diving Operations Manual: Perform Diving for Scientific Purposes. Sydney, NSW: PADI Asia Pacific.

Phillips, J. L. (1998). *The Bends: compressed air in the history of science, diving and engineering*. New Haven, CT: Yale University Press.

Lippmann. J and Mitchell, S. *Deeper into Diving*. (2nd ed.). Victoria, Australia: J.L. Publications

Particular thanks is made to Adam Pantlin of Camplin Dive Services Pty Ltd for reviewing this outline and providing all of the hyperbaric chamber photos.

D. Academic Topics

1. Introductions, course overview and welcome to the course:

- Introduce yourself and your assistants.
- Student introductions: Have students introduce themselves and explain why they are interested in recompression chamber orientation.
- Course goals:

a. Overview history of hyperbaric medicine and the need for recompression chambers.

b. Review Dive Tables

c. Review of diving injuries assisted by recompression therapy

d. Review of oxygen therapy

e. Review the operational aspects of recompression chambers.

f. Explain the functions and procedures for operating a two-compartment recompression chamber.

g. Outline the pre and post dive procedures for operation of a two-compartment recompression chamber.

h. ***[Optional]*** Undertake a simulated or actual chamber dive to 30 metres. This dive is to ensure that layout, functions, uses and limitations of recompression chambers can be explained by the diver and that the symptoms and effects of nitrogen narcosis are experienced.

i. As an inside attendant in a recompression chamber, each diver will explain the conduct of a therapeutic recompression. Through a classroom simulation, under the instruction of the recompression chamber supervisor, participants will outline the conditions under which a patient, during therapy, is assessed and monitored to ensure recovery is progressing satisfactorily and how the results of observations are reported regularly to the recompression chamber supervisor.

j. Post-dive, students will demonstrate how a recompression chamber is made ready for the next dive including the appropriate actions to be taken in accordance with hygiene and maintenance procedures, with the aid of an authorized check list and outline how a recompression chamber is shut down in accordance with operational procedures with the aid of an authorized check list.

- Course overview:

a. Presentations. This course will be performed on-site at a recompression chamber facility. [Most notes for the instructor to complement key points, particularly in the history section are square bracketed]

b. Performance assessment. [Note to instructor: Academic assessment may be accomplished through discussions with students and oral quizzes. Practical assessment will take place on review of student demonstrations. Tell the class how their performance will be evaluated.]

c. Certification: Upon successful completion of the course, you will be awarded the PADI Distinctive Specialty in Recompression Chamber Orientation.

d. Class requirements: Course costs, equipment and materials used during the course and attendance requirements.

e. Administration: Collect course fees, enrolment forms, Standard Safe Diving Practices Statement of Understanding, PADI Medical Statement, Liability Release and Express Assumption of Risk.

2. Hyperbaric history

Learning Objectives.

By the end of this session, you will be able to:

- ***Describe the beginnings of hyperbaric medicine***
- ***List the contributions of early pioneers***
- ***Discuss present day development in hyperbaric technology***

Robert Boyle 1670 discoverer of first study and causation of DCI

[The emergence of undersea and hyperbaric medicine is closely linked to the history of Diving itself, although it would not be until Robert Boyles' experiments in 1670 that the first trace of the study and causation of DCI would begin.

Robert Boyle made important contributions to both physics and chemistry and is best known for a law of physics experienced by all divers describing the behaviour of an ideal gas. Boyles Law appears in an appendix his work "New Experiments Physio-Mechanical, Touching the Spring of the air and its Effects" (1660).

Boyle's law states that at constant temperature, the absolute pressure and the volume of gas are inversely proportional. As pressure increases, the gas volume is reduced; as pressure is reduced, the gas volume increases. This law, especially when combined with the work of Gay-Lussac and Charles produce the General Gas Law; invaluable to Diving and Recompression Chamber operations.

Boyle first described the effects of Decompression Illness when in 1670 he used the vacuum pump to decompress a snake (undoubtedly somewhat rapidly) and reported: "I once observed a viper furiously tortured in our exhausted receiver… that had manifestly a conspicuous bubble moving to and fro in the waterish humour of one of its eyes."] *[http://www.answers.com/topic/robert-boyle]*

Edmund Halley 1690 Diving bell - River Thames - middle ear barotrauma

[In 1690, Halley developed plans for a diving bell, in which the atmosphere was replenished by way of weighted barrels of air sent down from the surface. In a demonstration of his apparatus, Halley and five companions dived to 60feet in the River Thames, and remained there for over one and a half hours. Halley's bell was likely to be very heavy and possibly of little use for actual salvage work, although he did make improvements to his bell over time, later extending his underwater exposure time to over 4 hours. Halley suffered one of the earliest recorded cases of middle ear barotraumas.] *[http://en.wikipedia.org/wiki/Edmond_Halley]*

Henshaw 1662 Domicilium – therapeutic treatments

[In 1662, a British clergyman, Henshaw without scientific basis thought it would be a good idea to raise the ambient pressure around a patient for therapeutic purposes. He later built the "domicilium" which was a sealed chamber that could either raise of lower pressure depending on adjustment of the valves. Henshaw reported that acute diseases of all kinds would respond to increased ambient pressure. In the 19th century following Henshaw's ideology, pneumatic institutes began to sprawl around the European continent. These large chambers where often able to accommodate more than 1 person and could sustain pressures of two or more atmospheres. These pneumatic institutes started to rival the popularity of the mineral water spas.] *[http://www.vet.utk.edu/vhms/review.html]*

Junod 1834 - first hyperbaric chamber described and built

[Junod in 1834 first made the observation that exposures of between 2 and 4 atmospheres absolute were stated to increase the circulation to the internal organs, improve the cerebral blood flow, and produce a feeling of well being. In 1837, Pravaz built a large hyperbaric chamber using it to treat a variety of ailments. The chambers were promoted and used specifically for pulmonary diseases, including tuberculosis, laryngitis, tracheitis and pertussis, as well as apparently unrelated diseases such as deafness, cholera, rickets, menorrhagia and conjunctivitis.] [http://www.hbot4u.com/strokeresearch12.html]

Fontaine 1877 – first mobile hyperbaric chamber

[Fontaine (1877) developed the first mobile hyperbaric operating theatre and by this time hyperbaric chambers were available in all major European cities. Interestingly, there was no general rationale for hyperbaric treatments and as a result, prescriptions varied from one physician to another. In those days, no methods were available to estimate the partial pressure of oxygen in blood, which at 2 ATA of air is about double that at sea level. In comparison, if pure oxygen is breathed at 2 ATA, the partial pressure of oxygen in the arterial blood is twelve times higher than normal.*[http://www.hyperbaric-concept.com/]*
The chamber was recommended to facilitate the reduction of hernia, and for patients with asthma, emphysema, chronic bronchitis and anaemia. Twenty-seven operations were performed within a 3-month period in this chamber. Success was so great that a large hyperbaric surgical amphitheatre which would hold 300 people was planned, although never actually came into being. Fontaine had an accident whilst at the Pneumatic Institute which resulted in his death, the first physician martyr to Hyperbaric Medicine.] *[http://www.mild-hyperbaric-oxygen-therapy.com/history-mild-hyperbaric-oxygen-therapy.html]*

Paul Bert 1878 - N2 narcosis

[His classical work, La Pression barometrique in 1878 embodies researches that gained him the biennial prize of 20,000 francs from the Academy of Sciences in 1875, and is a comprehensive investigation on the physiological effects of air-pressure, both above and below the normal. The eponymous "Paul Bert effect" describes nitrogen narcosis at hyperbaric pressures.] *[http://en.wikipedia.org/wiki/Paul_Bert]*

Theodore Williams 1885 – seminal paper

[Williams, in the British Medical Journal of 1885 wrote one of the seminal papers regarding hyperbaric medicine. This paper was titled "Lectures on the compressed air bath and its use in the treatment of disease. This outlined improvements in particular with the treatment of whooping cough and asthma]
[http://www.bmj.com/cgi/reprint/1/1271/936]

Corning and Chambers 1920 - 1937
The first hyperbaric chambers in North America

[The first hyperbaric chamber on the North American continent was constructed in 1860 in Oshawa, Ontario, Canada. The first such chamber in the United States was built by Corning a year later in New York to treat 'nervous and related disorders'.

The Chamber that received the most publicity and was the most actively used, was that of a Dr Cunningham in Kansas City during the 1920's. Cunningham first used his chamber to treat the victims of the Spanish influenza epidemic that swept across the USA during the closing days of the First World War. Cunningham had observed that mortality from this disease was higher in areas of higher elevation, and he reasoned that a barometric factor was therefore involved. He claimed to have achieved remarkable improvement in patients who were cyanotic and comatose. One night however, a mechanical failure resulted in a complete loss of compression and all his patients died. This tragedy was a sobering lesson but ultimately did not deter Dr Cunningham. His enthusiasm for hyperbaric air continued, and he started to treat diseases such as syphilis, hypertension, diabetes mellitus, and cancer. His reasoning was based on the assumption that anaerobic infections play a role in the aetiology of all such diseases.

In Cleveland, in 1928 Cunningham constructed the largest chamber ever built – five stories high and 64 feet in diameter. Each floor had 12 bedrooms with all the amenities of a good hotel. At that time it was the only functioning hyperbaric chamber in the world.

Dr Cunningham was repeatedly requested by the Bureau of Investigations of the American Medical Association (AMA) to document his claims regarding the effectiveness of Hyperbaric Therapy. Apart from a short article in 1927, Cunningham made no efforts to describe or discuss his technique in medical literature. He was eventually censured by the AMA in 1928 in a report that stated: "Under the circumstances, it is not to be wondered that the Medical Profession looks askance at the 'tank treatment' and intimates that it seems tinctured much more strongly with economics than with scientific medicine. It is the mark of the scientist that he is ready to make available the evidence on which his claims are based."

Dr Cunningham was given repeated opportunities to present such evidence but never did so. The Cunningham chamber was dismantled for scrap in 1937, which brought to a temporary end the era of Hyperbaric Oxygen Therapy for medical disorders.] *[http://www.mild-hyperbaric-oxygen-therapy.com/history-mild-hyperbaric-oxygen-therapy.html]*

Drager 1917 – 1937 O2 treatment of DCS

[In 1917 Drager devised a system for treating diving accidents realising the potential benefits of using oxygen under pressure for the treatment of decompression sickness. For some unknown reason, however, Drager's system never went into production. It was not

until 1937 – the very year that Cunningham's "air chamber" hotel was demolished – that Behnke and Shaw actually used hyperbaric oxygen for the treatment of decompression sickness.]
[https://www.draeger-medical.hu/Catalog/sqlimage.]

Boerema and Brummelkamp 1956 HBO for cardiopulmonary surgery

[A flurry of interest in therapeutic hyperbaric medicine was fostered by Dr I. Boerema, who, while in Amsterdam in 1956, reported hyperbaric oxygen (HBO) as an aid in cardiopulmonary surgery, particularly for congenital conditions such as tetralogy of Fallot, transposition of great vessels, and pulmonic stenosis. A colleague of Boerema's, W. H. Brummelkamp, also interested in hyperbaric medicine, discovered in 1959 (and subsequently published in 1961) that anaerobic infections were inhibited by hyperbaric therapy. Meanwhile, Boerema had published an article, "Life without blood," a report of fatally anaemic pigs treated successfully with volume expansion and pressurised hyperoxygenation. Boerema often is credited as the father of modern-day hyperbaric medicine.] *[http://www.mild-hyperbaric-oxygen-therapy.com/history-mild-hyperbaric-oxygen-therapy.html]*

Smith & Sharp 1962 HBO for further maladies – Undersea Medical Society

[In 1962, Smith and Sharp reported the enormous benefits of HBO in carbon monoxide poisoning. International interest thus was rekindled, and HBO therapy was thrust into the modern era. Hyperbaric units subsequently were built at Duke University, New York Mount Sinai Hospital, Presbyterian Hospital and Edgeworth Hospital in Chicago, Good Samaritan in Los Angeles, St. Barnaby Hospital in New Jersey, Harvard Children's Hospital, and St. Luke's Hospital in Milwaukee. Further chambers were installed in numerous international sites.

The benefits of hyperbaric medicine subsequently were observed for split-thickness skin graft acceptance, flap survival and salvage, wound re-epithelization, and acute thermal burns. These studies lent credibility to the therapeutic employment of HBO therapy. This fostered the establishment of organized scientific congresses and societies such as the International Congress on Hyperbaric Oxygen and the Undersea Medical Society. Unfortunately, as the availability of hyperbaric medicine chambers increased, the indiscriminate and inappropriate use of the chamber for a variety of medical conditions by practitioners searching for a "cure-all" therapy resulted in a backlash from the scientific society, once again tarnishing the credibility of hyperbaric medicine. As a result, by the late 1970s, the Undersea Medical Society had formulated guidelines for the use of hyperbaric therapy.] *[http://www.mild-hyperbaric-oxygen-therapy.com/history-mild-hyperbaric-oxygen-therapy.html]*

Research to date – MRI - SPECT

[Researchers conducting wound-healing studies continued to try to take advantage of the angiogenic properties of increasing oxygen gradients resulting from hyperbaric therapy. Foot wounds from diabetes, radiation ulcers, and other ischemic wounds have been manipulated and successfully treated with HBO. Prospective blinded randomized trials and well-executed laboratory studies continue to further define the role of hyperbaric therapy in medical therapeutics.

The most recent and most significant documented advances with Hyperbaric Medicine, have emerged with the utilization of high tech investigation including isotopic tracers with Magnetic Resonance Imaging (MRI) and Single Photon Emission Computed Tomography (SPECT). MRI and SPECT performed as a pre and post hyperbaric evaluation have provided valuable insights into the mechanisms and actions of Hyperbaric Medicine through oxygenation. Conditions that have previously been considered to have a poor prognosis, including brain injuries, stroke and neurological based conditions, have been greatly improved with Hyperbaric Medicine and continue, today, to be among the areas of research.] *[deBeurs, J. 2008. Anaesthesia in the hyperbaric chamber. Natal: University of Kwazulu]*

3. Review of Dive Tables

Learning Objectives.

By the end of this session, you will be able to:

- ***Describe the Dive Tables commonly used locally to ensure safe decompression***

DCIEM (Defence and Civil Institute for Environmental Medicine, Canada) table use: 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 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 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 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 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 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 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 1
TIME LIMITS FOR DIVES, DEPENDING ON LEVEL OF RECOMPRESSION CHAMBER SUPPORT

MAXIMUM Depth m.	MAXIMUM BOTTOM TIME		
	A chamber within 2 h	B chamber 2-6 h	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

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 2
LIMITS FOR REPETITIVE DIVES, DEPENDING ON LEVEL OF RECOMPRESSION CHAMBER SUPPORT
(BASED ON DCIEM TABLES)

MAXIMUM Depth m.	MAXIMUM BOTTOM TIME		
	A chamber within 2 h	B chamber 2-6 h	C chamber over 6 h
3	No limit	G (*H*)	G
6	G (*J*)	G (*H*)	G
9	H	G	F
12	H	E	F
12 to 30	DCIEM no deco limits	One repetitive group less than DCIEM no deco limits	Two repetitive group less than DCIEM no deco limits

Divers should note that UDT [Underwater Demolition Team], the licensee and manufacturer of DCIEM tables have recommended amendments covering the use of these tables.

Dive computers may be used for the diver's own information and **must not** be used to plan dives, control the dive profile or to plan decompression stops. They may be used, however, as an ancillary aid, a dive log facility, to monitor depth and time and an aid to ascent rates.

4. Diving injuries assisted by recompression therapy

Learning Objectives.

By the end of this session, you will be able to:

- ***Explain the nature of diving injuries***
- ***Describe the consequences of near drowning***
- ***Describe decompression illness, arterial gas embolism (AGE) and decompression sickness (DCS)***
- ***Outline the first aid and treatment protocols for the above diving injuries***

Diving injuries

Recognition is based on recent history of diving and presence of signs and symptoms. The range of signs and symptoms are broad and may be similar to many other illnesses or injuries. However, if they occur within 24 hours of diving, consultation should be made immediately with a physician trained in hyperbaric medicine.

Near drowning

Occurs from suffocation by immersion in water. This impairs the lung's ability to exchange gases and results in hypoxia. Aspiration of water into the lungs is associated with complex vascular responses that may cause sudden death. Anyone suspected of near drowning should be taken to a medical facility immediately.

Decompression illness (DCI)

This term describes the signs and symptoms of injuries sustained by breathing compressed gases at depth. It includes arterial gas embolism and decompression sickness injuries. Decompression sickness is due to inadequately decompressing and the subsequent release of gas from the body tissues after the absorption of excess nitrogen gas whilst under pressure. The first aid treatment is the same for both problems.

AGE (Arterial gas embolism)

May result from overexpansion injury where gas enters the bloodstream and travels to the heart and arterial system. The gas may block arteries, cut off oxygen transfer and cause hypoxia. Accompanying complications could be subcutaneous and mediastinal emphysema and pneumothorax.

First aid and treatment for DCI

ABCD's

Lay victim flat

Provide 100% oxygen

Arrange EMS (phone DES 1800 088 200 in Australia)

Fluids as appropriate

Assist in transfer to recompression facility

Record details of dive profile, signs and symptoms, first aid and response.

5. Oxygen

Learning Objectives.

By the end of this session, you will be able to:

- ***Define oxygen***
- ***Explain oxygen cylinder filling***
- ***Ensure oxygen safety***
- ***Describe the benefits of using oxygen***

Oxygen is a colourless, odourless and tasteless gas. It is essential to support life and is used for medical purposes to prevent or treat hypoxic conditions.

Oxygen cylinder filling

For medical purposes, only medical grade oxygen should be used. Cylinder supply is restricted in Queensland and may only be rented by such entities as BOC gases. Oxygen is often decanted form these cylinders to produce cylinders for enriched air diving. Care should be taken during these operations. It is recommended that the PADI Gas Blender specialty course be undertaken.

Oxygen safety

Breathing high concentrations of oxygen may cause pulmonary or central nervous system (CNS) toxicity. This could result from diving on enriched air or pure oxygen sources at depth. Enriched air and technical dive courses are highly recommended to give appropriate training on these issues.

On land issues to avoid are to avoid naked flames, use well ventilated areas, use only equipment designed and well maintained for oxygen use.

Benefits of oxygen

Diving injuries can cause reduced blood supply and/or damaged tissues preventing adequate gas exchange.

Provision of oxygen offers the benefits of reducing (N2) bubble size, oxygenating hypoxic tissue, reducing tissue oedema, relieve symptoms and may reduce the risk of residual symptoms after hyperbaric treatment.

[It is recommended that the diver complete the PADI Emergency Oxygen Provider course to complement this understanding]

6. Operational aspects of recompression chambers

Learning Objectives.

By the end of this session, you will be able to:

- ***Explain basic recompression chamber construction and layout and general safety standards***
- ***Explain the functions and procedures for operating a two-compartment recompression chamber***
- ***Explain pre and post dive checklists for chamber operators and pre-dive procedures for compression dives***

RECOMPRESSION CHAMBER AND HYPERBARIC UNITS:

A Recompression chamber or hyperbaric units usefulness is not limited to therapy for diving injuries. They are commonly associated with hospitals and are often used in treating many illnesses and conditions, for example:

- Carbon monoxide poisoning
- Compromised circulation
- Gas gangrene
- Non-healing wounds
- Osteomyelitis (infection of the bone marrow)

Construction

The construction can be cylinder shaped and single chambered but more commonly consist of a low-pressure complex with two self-contained compartments connected by an air lock and a high pressure, single compartment vessel. Low-pressure complexes generally have a number of compressors, which supply medical grade air to a maximum working pressure of 2.4bar (3.4ata) (24msw). High-pressure vessels generally have a maximum working pressure of 10bar (11ata)(100msw) from a single 300bar working pressure compressor, which also supplies and maintains air in emergency air banks.

Hyperbaric chambers use pumps and valves to recreate the increased air pressure experienced by divers under water. Medical grade oxygen or other saturated gas mixtures may also be pumped into a hyperbaric chamber for medical purposes.

Mechanical Layout

Hyperbaric unit layout will vary with unit however all will have the following:

- Viewing ports – often fitted with video cameras
- Medical transfer lock – to all medicines to be passed into the unit

- Doors – close and seal with pneumatic lock

• Built-In Breathing System (BIBS) – to provide medical grade oxygen, air, Nitrox or Heliox by hood, mask or ventilator

And may include some or all of the following features:

• Closed circuit television monitoring – to view all compartments by external camera
• Communications system – headsets and loud speakers
• Fire suppression system – water nozzles and hoses. (the BIBS system is fitted with emergency oxygen to air change over in case of emergency).
• Patient monitoring systems – haemodynamic monitoring
• Air conditioning – hot or cold to regulate temperature

• Control panel – outside the chamber to operate gas valves and pressure requirements.

Recompression chambers are required to comply with Australian Standards for safety and air quality and are operated by qualified recompression chamber staff.

Hyperbaric Chamber Safety

Includes the observation of the following:

1. Standards (in particular those laid out by AS2299)
2. Fire and Electrical Safety Regulations
3. Fire Fighting Drills
4. Gas Levels
5. Noise Protection
6. CO2 Absorbents and Caustics

This class will follow all procedures and safety precautions as directed by the trained hyperbaric unit operators. General safety precautions also include cleanliness, i.e. wash hands/wear gloves; cover outdoor shoes with disposable shoe covers. Static free overalls will be worn in the chamber. No shoes but socks or other soft foot covering should be worn. Do not touch or operate anything you are not trained to.

[Absolutely no carrying of lighters, matches or anything that in anyway can create sparks or ignition within the chamber]

Dive Medic shall be in attendance.

Pre-Dive Checklist for chamber operators:

1. Chamber Exterior and Interior:

a. Damage

b. Hatches and Seals

c. Gauges

2. Gas Supply:

a. Adequate Supply for Treatment

b. Reserve Supply

c. Regulators

d. Valve Positions

i. Supply

ii. Exhaust

iii. Equalizers

e. Compressor

3. Electrical:

a. Lights

b. Communications

c. Analyzers and Monitors Fire:

a. Suppression Materials

b. Safe Clothing and Supplies

5. Scrubbers

6. Ancillary Equipment (Outside):

a. Medical Kit

b. Record Keeping Supplies

c. Charts, Tables, Reference Materials

Post-Dive Checklist for chamber operators:

1. Chamber Exterior and Interior

a. Clean and Air Out

b. Repair Damage

c. Clean and Replace Equipment

2. Gas Supply

a. Proper Position of Valves

b. Record Gas Supplies, Refill or Recharge

c. Reset Regulators

d. Fuel Compressor, Maintenance

3. Electrical

a. Repair Damage

b. Turn Off

c. Ready Equipment for Next Use

4. Fire

a. Restock Items as Needed

b. Safe Materials in Chamber

5. Scrubbers

6. Ancillary Equipment

a. Restock Medical Kit

b. Store Record Keeping Equipment

Pre-dive procedures for compression chamber dives

A dive in a recompression chamber creates the same conditions that makes divers susceptible to air embolisms, decompression sickness, and nitrogen narcosis in an in-water dive. Therefore a current fitness to dive medical is required prior to compression chamber dive. A dive in a recompression chamber builds up nitrogen in the body the same as a normal dive. Decompression protocols often state that divers are clear of residual nitrogen prior to diving so, generally, divers are asked not to dive 24 hours prior to a chamber dive. Following a chamber dive, divers are generally advised not to dive for 24 hours and not plan to travel to altitude for at least 24 hours following the chamber dives (aircraft, mountain passes, altitude chambers, etc.)

In actual recompression incidents the diver will generally be admitted to the High pressure vessel, if available, to allow use of low pressure vessel if required by other patients or divers This arrangement will also allow Doctors to have access to the diver if required. The doctor can enter the low pressure vessel, which can be pressurised up to 2.4bar (3.4ata), so that if the diver required higher pressure decompression the pressure would not need to be reduced in the high pressure chamber to zero to allow access, thereby optimising treatment with minimum interruptions.

For on-site recompression 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.

Optional 'Dry-dive'

This shall be supervised by the chamber operators and performed to a 30 metre schedule for a bottom time of ten minutes.

Prior to the dive, medical statements and liability statements will be signed and reviewed. The release form to be used will be the current 'Special Event Voluntary Liability Release and Assumption of Risk Agreement' form #10085.

Dive objectives

- ***Execute a descent while seated in a hyperbaric chamber***

- ***Compare the amount of time needed to complete a task on the surface and at simulated depth.***

- ***Compare your own depth gauge to your instructor's and/or other student diver's depth gauges.***

- ***Use a depth gauge and timing device (or a decompression computer with an ascent-rate indicator) to measure an ascent rate not to exceed 18 metres/60 feet per minute.***

- ***Perform a 3-minute safety stop at 5 metres before surfacing.***

a. Briefing

1. Dive sequence – review Dive One tasks

b. Predive procedures

c. Dive One Tasks

1. Student divers repeat timed task at depth for comparison with time taken to complete the same task on the surface.

2. Student divers compare depth gauge or dive computer readings with buddy's and instructor's. Write down each reading on a slate.

d. Post-dive procedures

e. Debriefing

1. Student divers discuss the timed task performed at the surface to that performed at depth. In addition, discuss the comparison of

personal depth gauge or computer readings with instructor's and other student divers'. Guide discussions to address what worked, what didn't work, and how things may be done differently the next time. Specifically focus the discussion on descents using a reference, their timed tasks, the comparison of depth gauge or dive computer readings, their ascents and procedures/communications with chamber supervisor for monitoring ascent rate, and the 3-minute safety stop at 5 metres/15 feet before surfacing.

f. Log dive (instructor signs log)

Knowledge Review

1. Explain the purpose of a ‘dry dive’

2. Name two of the main contributors to hyperbaric technology and what were those contributions?

3. For a dive of 30 metres for 15 minutes you will become what pressure group?

4. List at least three features of a recompression chamber and describe their significance.

5. What are key points that you have personally learned from this course.