

Recomendations for Sled Diving

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Disclaimer:

This document is by no means a substitute for proper training or a greater understanding of the risks and issues associated with freediving to depth. There is no document or understanding that can eliminate nor mitigate the risks of decompression illness in freediving. The extreme nature of these dives means that even if you do everything perfectly there is still significant risk of suffering from decompression illness or other diving related issues. This document is solely put forward to attempt to address issues being experienced with these dives. This document is neither affirming nor assuring that there will not be an issue or problem with ANY dive even if every recommendation is followed. If you choose to participate in any form of freediving to depth you assume and will likely experience an issue if you dive enough times. The risk increases as exposure increases. Deeper dives or more dives done in a day increase risk significantly. No document, person or theory can protect you. This document is for informational purposes only. Each diver MUST make his or her own decision regarding participation in any dive. The practices recommended in this document assume that all dives will be properly supported and any athlete that breathes oxygen at depth will be supervised directly by a properly trained safety support scuba diver. All participation is at your own risk. This document is based on current knowledge 2006.

1.0 General Theory

- 1.1 The depths that are being reached by freedivers in the assisted disciplines (NLT & VWT) are such that there is significant risk of decompression illness (this risk is present for all depth disciplines). Decompression illness is a whole body reaction to either inert gas bubbling in the body fluids and tissues, or lung damage due to rapid gas expansion during ascent, or a combination of the two.

- 1.2 The athlete, support staff, coaches, safety staff, and medical personnel must be aware of the risks involved in these disciplines. Even depths considered shallow in training pose significant risk. Attention to safety and not short cutting procedures must be of the utmost importance.
- 1.3 The types of dives that are experienced by freedivers put them at risk for the worst form of decompression signs and symptoms. It is known that the risk of serious neurological complications, if decompression related problems are experienced, is high.
- 1.4 The following conditions appear to relate directly to incidents that have previously occurred .
 - depth
 - time
 - rate of descent
 - rate of ascent, with different considerations at depth vs shallow
 - dehydration
 - fatigue
 - physical stress /effort during the dive
 - time spent at depth
 - psychological stress
 - blood shift and pulmonary edema
 - cold
 - Nitrogen narcosis
- 1.41 A clear understanding of decompression illness is ABSOLUTELY essential for all divers participating in any depth training.
- 1.42 Studies have shown that critical gas loading can occur on dives as shallow as 50 meters.
- 1.43 Studies have shown that repeated dives shallower than 50 meters can result in critical gas loading in the body.
- 1.44 Repeated shallower dives may pose a risk for decompression illness.
- 1.45 Signs and symptoms of decompression illness are widely varied.
- 1.46 Medical evaluation should be sought for symptoms appearing after diving, considering that symptoms may not present immediately after diving.
- 1.47 The following list of signs and symptoms of decompression illness is by no means complete.

Fatigue

Skin mottling

Itching

Bruising

Numbness

Tingling
Pain in the joints
Muscle pain
Burning in the lungs
Difficulty breathing
Inability to move a joint, limb or whole side/area of body
Weakness
Behavioral changes
Nausea
Vomiting
Inability to control bladder or bowels
Hearing difficulties
Balance problems
Unconsciousness
Respiratory arrest
Cardiac arrest
Death

- 1.48 Proper hydration should be considered mandatory throughout the day. Dehydration is one of the biggest contributing factors to decompression illness. Overhydration is neither recommended.
- 1.49 Being well rested is very important. Physiological and psychological well being should be maximized. If the athlete is not feeling well or is tense, it is not a good idea to continue with diving that day.
- 1.51 Central nervous system oxygen toxicity is not well understood. The partial pressure of oxygen in the free diver's lungs is high at depth. Although symptoms of oxygen toxicity are theoretically possible at the depths being reached, there have been no known cases associated with free diving.
- 1.52 CNS oxygen toxicity develops due to an accumulated dose over time. With which should be considered since the use of oxygen after a dive may expose the athlete to additional risk.
- 1.53 Signs and symptoms of CNS oxygen toxicity are associated with high partial pressures of oxygen in the brain. In theory, a depth could be attained in the future that exposes the diver to a critical dose of oxygen such that [the risk of](#) toxicity reaches a critical level
- 1.54 High pressure of oxygen for extended duration may cause pulmonary oxygen toxicity, this is currently not a problem for breath-hold divers.

- 1.55 These concerns emphasize the importance of minimizing exposure time at depth.
- 1.56 Signs and symptoms of CNS oxygen toxicity can be severe. Convulsions may be the first sign expressed. ConVENTID is used to remember the central nervous system signs and symptoms of oxygen toxicity. Support staff must be familiar with these signs.
- Convulsion
- Visual disturbances (most commonly tunnel vision)
- Ears ringing (tinnitus)
- Nausea (the most common symptom for long exposures)
- Twitching, generally in the facial areas (lips and cheeks)
- Irritability
- Dizziness
- 1.57 CNS oxygen toxicity is a significant issue for athletes when using oxygen at depth after diving. Direct supervision of the athlete is required at all times, regardless of depth, while he or she is breathing oxygen underwater.
- 1.58 Due to the risk of a convulsion, the ability to lift the freediver to the surface in a timely manner is essential. See Safety section.
- 1.5 Nitrogen narcosis is likely present on deep free dives, even if symptoms are not obvious, and recollection of symptoms is limited since amnesia is a common effect of narcosis.
- 1.61 Not all athletes will be able to tolerate narcosis as well as others.
- 1.62 Narcosis tolerance is not improved by repetitive diving, however it seems that the ability to perform while impaired may improve with experience, and slow progression of depth over many dives.
- 1.63 There is a time delay in narcosis impairment so that narcosis does not disappear immediately with ascent to shallow water. It is possible that the athlete may remain impaired to the surface.
- 1.6 Fluid accumulation in lung tissue due to great depths being reached poses a theoretical risk of lung expansion injury upon ascent, even in freedivers. The practice of packing over-pressurizes the lungs. The fluid shift at depth may create a risk for lung barotrauma upon ascent. Slowing of the final ascent by kicking or pulling to the surface, rather than riding an inflated device at uncontrolled speed to the surface, is highly recommended. Exhalation prior to reaching the surface is also recommended to relieve any re-expanding over-pressurization from lung packing.
- 1.7 Precautions must be taken to minimize these risks wherever possible. The consequences of not being aware of any of these theoretical points can be serious or devastating.

2.0 Safety Concepts

- 2.1 A proper safety system to recover the athlete at anytime in a rapid manner should be employed at all times.
- 2.2 All personnel involved in planning, training, and actual dive attempts should be highly qualified and experienced with the extreme nature of these dives.
- 2.3 Careful thought must be given to the evacuation of the athlete or safety support divers in the event of an emergency. This includes provision for remote locations. In the event of an incident, rapid recompression may be necessary. Recompression facilities should be immediately accessible and staff available. It is inappropriate to attempt these dives in an area that does not have a recompression facility near-by. Treatment must not be delayed simply because of a lack of access to a recompression facility. No attempts should be made to dive in areas without a fully functioning recompression chamber available locally.
- 2.4 It is recommended to have emergency medical personnel on site (physician, paramedic or other) that are current (licensed) in handling airways in unconscious patients, advanced cardiopulmonary rescue (CPR with medications), and defibrillation. This includes having the appropriate equipment ready within 60 seconds from the site where the diver will surface. The most immediate concerns are complications such as non-fatal drowning, pulmonary edema, pulmonary barotraumas and decompression illness. If the emergency personnel does not have advanced knowledge of DCI, such competence should be directly available via radio/phone or on a nearby boat. If possible an onsite recompression chamber should be considered.
- 2.5 All AIDA Safety Protocols need to be followed.
- 2.6 Proper safety and support should be utilized for all training dives.
- 2.7 Deep training dives should be limited to one per day.
- 2.8 Multiple training days should be broken up with days off. The deeper the target dive the fewer repeated training days should be made without a day off.
- 2.9 Post-dive oxygen breathing reduces the risk of decompression illness.
- 2.10 The athlete should have appropriate training to safely breathe oxygen at depth.
- 2.11 Our current recommendation is that post-dive oxygen is obtained by breathing 100% at 6 m depth for a minimum of 10 minutes.

Extended periods will add to the benefit. Total time at 6 m depth should not exceed 30 minutes unless circumstances are extraordinary. Extended breathing of oxygen while ascending to the surface and on the surface is encouraged. Oxygen has to be delivered by open circuit system (SCUBA), preferably via fullface mask (a rebreather is not acceptable).

- 2.12 Dive times at depth should be minimized.
- 2.13 Significant delays at depth should terminate the dive. Delays due to trying to fix something or difficulty equalizing on descent should be minimized.
- 2.14 Rate of descent must account for equalization needs, but should be at the maximum rate manageable by the athlete.
- 2.15 Certain individuals may be susceptible to symptoms of chest squeeze or barotrauma that might require adjustment of descent rates.
- 2.16 Ascent to the surface should be as rapid as possible from depth to around 30 metres depth where the diver will slow ascent rate to reduce the risk of decompression illness. Slowing of the ascent in the last thirty meters should be considered mandatory.
- 2.17 It is highly recommended that the athlete does not use the fast ascent device in the final thirty meters of ascent, where an ascent speed of maximum 1m/s seems to be safer.
- 2.18 The athlete is encouraged to release air (exhale) to reduce lung volume while approaching the surface on ascent. It is recommended to allow extra volume in the lungs to escape as the athlete nears the surface to prevent over-pressurization and risk of lung barotrauma. If ascent rate is rapid all the way to the surface, it may be difficult for the athlete to exhale fast enough to protect the lungs from over-expansion.
- 2.19 Rapid ascent into shallow water might complicate decompression issues as well.
- 2.20 The lifting device used by the athlete MUST allow for rapid inflation and have sufficient gas flow and lift to insure ascent begins as quickly as possible from any depth of the dive. A backup system is recommended.
- 2.21 The lifting device must allow the athlete to abandon it at anytime, particularly within the last thirty meters on ascent before the surface. The athlete must have the ability to slow the ascent.
- 2.22 The greatest risk of decompression illness may be due to delays at depth and overly rapid ascent in the last thirty meters. Depth control must be maintained such that both of these situations can be avoided.

2.23 Safety may be further enhanced by incorporating a mixed gas diving system at depth, enabling the diver to switch to heliox/trimix diving if entangled or by other means unable to ascend quickly. This would require significant additions in support for the safety divers.

3.0 Recommendations for Training

- 3.1 No more than one target dive per day.
- 3.2 Multiple training days should be broken up with days off. The deeper the target dive the more days off that should be mixed in with training days.
- 3.3 Progression of depth over subsequent dives should be gradual. Rapid jumps in target depths must be avoided.
- 3.4 When athletes are attempting to set a personal depth record, increases in depth should be limited to three meters or less.
- 3.5 Progression in depth beyond current world record depths should be done very gradually. **Fix to 3m ?**
- 3.6 The safety system should allow for rapid retrieval of the athlete from any depth at any time during the dive.
- 3.7 It is highly recommended that the athlete use all available safety systems and precautions when training independently of official training or records.
- 3.8 Official training is defined as the training that occurs when the judges are present prior to or during official record attempts.
- 3.9 All recommendations for records must be respected during official training.
- 3.10 The risks involved with training for these dives cannot be understated. Do not take these risks for granted. Serious adverse events can happen to you even if you do everything correctly.
- 3.11 Use of oxygen post-dive is considered mandatory.
- 3.12 The athlete should begin breathing oxygen as soon as possible after surfacing. The ideal situation is to have the athlete re-descend to 6M and remain there for at least 10 minutes. Remaining longer, up to 30 minutes, is highly recommended **on dives greater than 100 metres depth.**
- 3.13 When training is done to improve equalization techniques at depth, it may be advisable abort the ascent from a target dive and go to oxygen prior to reaching the surface.
- 3.14 Remaining on oxygen throughout the ascent and on the surface is also beneficial to reducing decompression risk.

- 3.15 An athlete should not remain on oxygen at 6M for longer than 30 minutes unless circumstances are extraordinary.
- 3.16 The athlete must be closely supervised the entire time he or she is breathing oxygen underwater.
- 3.17 If the athlete feels that his or her decompression status is compromised, support staff should be alerted and oxygen breathing should be started immediately under close direct supervision. The athlete should descend to 9M to 12M on 100% oxygen for five minutes, then ascend to 6M and remain there for at least thirty minutes. The athlete should remain on oxygen continuously throughout the ascent, on the surface, and during transport to the medical facility, whether symptoms have resolved or not.
- 3.18 Any diver undergoing in-water treatment must be alert, able to follow simple commands, and be able to maintain and protect his or her own airway. Anyone with a diminished level of consciousness requires urgent comprehensive medical assessment. In such a case, in-water treatment for presumed decompression illness is at high risk for serious complications.
- 3.19 If at any time the condition of the athlete worsens to the point where the risk of being underwater surpasses the benefit of breathing oxygen at depth, or if support divers are no longer comfortable with management underwater, the athlete should be moved to the surface and immediately evacuated to the nearest appropriate medical facility.
- 3.20 Use of a full-face mask may help with management of complications from oxygen toxicity. Use of a full-face mask is therefore recommended. Close supervision is required at all times.
- 3.21 Oxygen must not be used deeper than 12 metres due to a high risk of convulsions or other serious symptoms of oxygen toxicity.
- 3.22 Durations of breathing oxygen below 6M must be limited to no more than 5 minutes in total. Ascent to 6M must then begin immediately.
- 3.23 Ascent rates while on scuba must not exceed 10 meters per minute.
- 3.24 If at any time the athlete experiences signs or symptoms of oxygen toxicity, he or she must be brought to the surface and placed back on oxygen. At no time will oxygen be withheld.
- 3.25 If a convulsion occurs during oxygen breathing underwater, the diver's airway should be maintained and the mouthpiece secured manually. Ascent to the surface should not normally begin until the convulsion has stopped and breathing has resumed. If the convulsion does not stop within roughly one minute, a slow ascent to the surface should begin so as to minimize the risk of pulmonary barotrauma if there is involuntary breath holding.

- 3.26 Total time of oxygen at depth should be limited to a maximum of one hour. Durations at 6m should not exceed 45 minutes.
- 3.27 These recommendations are outside those made for recreational diving, and are based on the extraordinary nature of these dives. These only apply to the athletes. Support divers should follow prescribed procedures for the diving community.
- 3.28 Any athlete using oxygen should not conduct further diving that day.
- 3.29 Any athlete, who experiences a compromised decompression status, even if made better through the use of oxygen, should be evaluated by a hyperbaric physician. Further treatment may be necessary.
- 3.30 It is inappropriate to train in an area that does not have direct access to a recompression chamber and appropriate medical support. THIS IS DOUBLE , ALREADY SAID IN 2.3
- 3.31 Decompression illness occurring in freediving will likely show up relatively quickly. If there is any doubt, seek expert advice.
- 3.32 Athletes should only dive if well rested.
- 3.33 It is essential that the athlete remain well hydrated. It should be planned to have fluids available to the athlete at all times. It is also best to continue hydration during the period of oxygen breathing ALREADY SAID.
- 3.34 Physiological and psychological stresses can have profound impact on the outcome of these dives. Do not minimize the importance of a sense of well being prior to these dives. ALREADY SAID