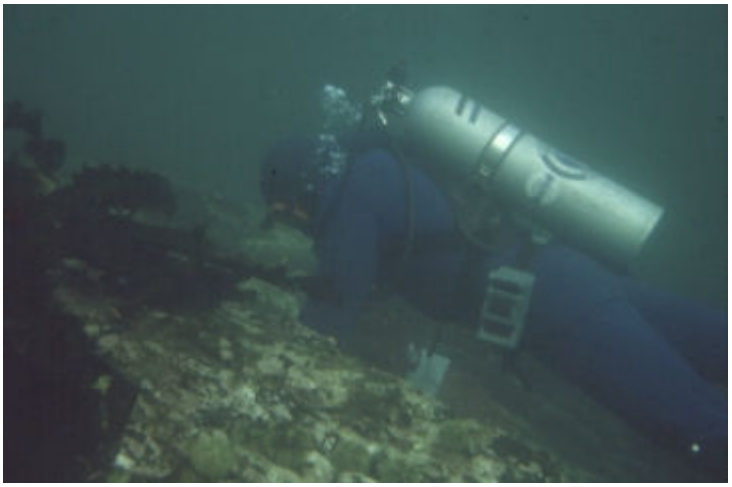
Department of Marine Resources

Diving Safety Course
REVISED DECEMBER 2009



The Department of Marine Resources makes every effort to provide accurate and complete information, and any inconsistencies are not intentional on the part of the Department and will be corrected

Administrative Procedures

6535. Sea urchin and scallop diving tender license

1. License required. A person may not operate a boat as a platform for the harvesting of sea urchins and scallops by hand, act as a diving tender on a boat engaged as a platform for the harvesting of sea urchins and scallops by hand or possess, ship, transport or sell scallops or sea urchins unless that person is licensed under this section, section 6701 or section 6748.

2. Licensed activity. A person licensed under this section may tend divers who harvest sea urchins and scallops by hand and operate a boat as a platform for the harvesting of sea urchins and scallops by hand and may possess, ship, transport and sell sea urchins and scallops harvested by licensed harvesters the tender has tended. A sea urchin and scallop diving tender license does not authorize the holder to harvest sea urchins and scallops. As used in this subsection, "tend" means to assist the diver in any way, to operate a boat as a platform for harvesting or to cull or otherwise handle the harvested product.

3. Eligibility. A sea urchin and scallop diving tender license may be issued only to an individual who is a resident.

4. Fee. Fees for licenses issued under this section are:
A. For a sea urchin and scallop diving tender license, $133; and

6. Violation. A person who violates this section commits a civil violation for which a fine of not less than $100 nor more than $500 may be adjudged.

§6701. Scallop license

1. License required. A person may not engage in the activities authorized under this section without a current hand fishing scallop license or other license issued under this Part authorizing the activities. The hand fishing scallop license with tender issued under subsection 5, paragraph B authorizes a person to engage in the activities described above in section 6535, subsection 2 aboard the licensee's boat when it is engaged in the harvesting of scallops.

2. Licensed activity. The holder of a hand fishing scallop license may take scallops by hand or possess, ship, transport or sell shucked scallops the holder has taken. A tender authorized under subsection 5, paragraph B may possess, ship, transport and sell shucked scallops the hand fishing scallop license holder has taken. A person may not act as a tender under subsection 5,

paragraph B unless that person has met the tender safety requirements adopted by rule pursuant to section 6533.

3. Eligibility. A scallop license may be issued only to an individual who is a resident of the state of Maine.

4. Exception. In any one day, a person licensed pursuant to section 6703 may take or possess not more than 2 bushels of shell scallops or 4 quarts of shucked scallops for personal use without a scallop license under this section.

5. Fee. Fees for hand fishing scallop licenses are:

A. For an individual hand fishing scallop license, $143; and

B. For a hand fishing scallop license with tender, $161.

6. Violation. A person who violates this section commits a civil violation for which the following penalties apply:

A. For the first offense, a mandatory fine of $500 is imposed and all scallops on board may be seized;

B. For the 2nd offense, a mandatory fine of $750 is imposed and all scallops on board may be seized; and

C. For the 3rd and subsequent offenses, a mandatory fine of $750 is imposed and all scallops on board may be seized. This penalty is imposed in addition to the penalty imposed under section 6728-B.

§6706. Limited entry

1. License eligibility in 2009. The commissioner may not issue a 2009 hand fishing scallop license or a 2009 scallop dragging license to a person unless that person possessed a scallop license issued pursuant to section 6701 or a scallop boat license issued pursuant to section 6702 in either:

A. The 2005, 2006, 2007 or 2008 license year; or

B. The 2008 license year prior to May 1, 2008.

2. License eligibility in subsequent years. Except as provided in subsection 3, the commissioner may not issue a hand fishing scallop license or a scallop dragging license to any person in any year subsequent to 2009 unless that person possessed that license in the previous calendar year.

3. Scallop license limited entry system. Notwithstanding subsection 2, the commissioner shall establish by rule a limited entry system under which a

person who did not hold a hand fishing scallop license in the previous calendar year may become eligible to obtain that license.

The rules for a limited entry system must include provisions for the method and administration of the program. Rules adopted pursuant to this subsection are routine technical rules as defined in Title 5, chapter 375, subchapter 2-A.

4. Repeal. This section is repealed July 1, 2012.

§6748. Handfishing sea urchin license

1. License required. A person may not engage in the activities authorized under this section without a current handfishing sea urchin license or other license issued under this Part authorizing the activities. The handfishing sea urchin license with tender issued under subsection 4, paragraph B authorizes a person to engage in the activities described in section 6535, subsection 2 aboard the licensee's boat when it is engaged in the harvesting of sea urchins.

2. Licensed activity. The holder of a handfishing sea urchin license may take sea urchins by hand or possess, ship, transport or sell sea urchins taken by that licensee. A tender authorized under subsection 4, paragraph B may possess, ship, transport and sell sea urchins the handfishing sea urchin license holder has taken. A person may not act as a tender under subsection 4, paragraph B unless that person has met the tender safety requirements adopted by rule pursuant to section 6533.

3. Eligibility. A handfishing sea urchin license may be issued only to an individual who is a resident.

4. Fee. Fees for handfishing sea urchin licenses are:

A. For an individual handfishing sea urchin license, $152; and

B. For a handfishing sea urchin license with tender, $161.

4-A. Temporary Zone 1 fee. Not withstanding subsection 4, the fees for a handfishing sea urchin license and a handfishing sea urchin license with tender issued for calendar year 2010 or 2011 to handfish for sea urchins within the area designated as Zone 1 under section 6749-N are $25 and $50 per year, respectively.

This subsection is repealed December 31, 2011.

5. Rebuttable presumption. It is unlawful for an individual to dive from

a vessel with sea urchins on board unless that individual is licensed under this section. It is a rebuttable presumption that an individual diving from a vessel with sea urchins on board at any time of the year is diving for the purpose of fishing for or taking sea urchins.

6. Violation. A person who violates this section commits a civil violation for which a fine of not less than $100 nor more than $500 may be adjudged.

FIRST AID / CPR

Properly administering first aid, CPR, and/or surface oxygen therapy can mean the difference between life and death, short- or long-term recovery, and permanent or temporary disability; it is for all these reasons that the State of Maine has made CPR and first aid part of the requirement to obtain your hand-harvesting license.

LEGAL ASPECTS OF FIRST AID: According to the law, a victim must give consent for treatment (if this can be obtained in writing, it is best to do so; if not, oral consent is acceptable). The responder must also make a statement that he or she is first aid/CPR trained. When a victim is unconscious, the law assumes the victim would give consent for emergency first aid/CPR.

Many states have "Good Samaritan" laws that cover certified first aiders who have acted in good faith and without gross negligence or willful misconduct. Make sure you know the coverage under the different state laws, as they vary from state to state. Maine's law states that you **cannot** go beyond your level of first aid/CPR training, and once first aid/CPR is started, it must be continued within the standard of care...in other words, you cannot start First Aid-CPR and then just stop.

Diving Physics

1. INTRODUCTION TO THE UNDERWATER ENVIRONMENT: People readily function within the narrow atmospheric envelope present at the earth's surface. We seldom concern ourselves with survival requirements on the surface. Outside the boundaries of the envelope, however, the environment is hostile and our existence depends on our ability to cope with these forces. For divers to function safely, we must understand the characteristics of the subsea environment and the techniques we can use to offset its effects. To accomplish this, we must have a basic knowledge of physics: the science of matter and energy and their interactions.

2. NORMAL AIR: The most common gas used in diving is atmospheric air. Air is comprised of many gases.

For most purposes and computations, diving air may be assumed to be composed of 79 % nitrogen and 21 % oxygen.

Air is compressible and can contain contaminants. Therefore the air supply source must be clean and SCUBA tanks may only be refilled from a licensed air supply station.

3. TERMINOLOGY AND VALUES USED IN PRESSURE:

On the surface of the earth we are exposed to the pressure exerted by the mass of the atmosphere above us. This is called *atmospheric pressure.*

Under the sea, pressure is a result of two factors. First, the *weight of the water* surrounding the diver, and second, the *weight* of the atmosphere over the water.

As a diver descends in the dive every 33 ft. of depth is equal to one atmosphere

(1) Atmosphere (ATM)

The pressure at sea level acts on all things in all directions. At sea level, the added pressure that the weight of seawater exerts on the body at depth is the sum of 14.7 pounds per inch (psi) + atmospheric pressure (14.7 psi) or a total of 29.4 psi which is 2 atmospheres.

(2) Gauge pressure (psig). Gauge pressure measures pressure on an object such as the pressure in SCUBA tanks.

(3) Hydrostatic Pressure (psig). Hydrostatic pressure or *ambient pressure* measures the depth in the water column. The formula for figuring pressure at depth in feet of saltwater is *.445* psi times the depth.

4. GENERAL GAS LAWS IN DIVING:

Boyle's Law — Boyle's law states that *at constant temperature*, the absolute pressure and the volume of a gas are inversely proportional – meaning that at a given temperature, the higher the pressure of the gas the lower the volume of the gas - while the density will vary directly as the surrounding pressure changes – meaning the higher the pressure the higher the density of the gas.

The effects on a diver most commonly show up as:

(a) Squeeze — felt as pressure in the ears or face when pressure cannot be equalized in the sinuses- when a diver descends rapidly

(b) Embolism— an object such as a gas bubble or blood clot which is carried through the circulatory system and may create a blockage - when a diver ascends rapidly

Charles' Law — if the pressure is kept constant, the volume of a gas will vary directly as the temperature changes.

General Gas Law — Combination of Boyle's and Charles' Laws. Boyle's and Charles' Laws demonstrate that with any gas, the factors of temperature, volume, and pressure are so interrelated that a change in one of them must be balanced by a corresponding change in one or both of the others.

Henry's Law — An equivalent way of stating the law is that the solubility of a gas in a liquid is proportional to the pressure *of that gas* above the liquid. Henry's law has since been shown to apply for a wide range of dilute solutions, not merely those of gases.

An everyday example of Henry's law is given by carbonated soft drinks. Before the bottle or can is opened, the gas above the drink is almost pure carbon dioxide at a pressure slightly higher than atmospheric pressure. The drink itself contains dissolved carbon dioxide. When the bottle or can is opened, some of this gas escapes, giving the characteristic hiss (or "pop" in the case of a champagne bottle). Because the pressure above the liquid is now lower, some of the dissolved carbon dioxide comes out of solution as bubbles. If a glass of the drink is left in the open, the concentration of carbon dioxide in solution will come into equilibrium with the carbon dioxide in the air, and the drink will go "flat".

(1) The amount of gas that will dissolve in a liquid at a given temperature is directly proportional to the partial pressure of that gas [meaning the pressure associated with that gas alone, not the total pressure of all gases in the liquid].

(2) Gas diffuses and dissolves in blood because of the difference in pressure between the air (nitrogen) in the diver's lungs at depth (higher pressure of nitrogen) and the pressure of the nitrogen in solution throughout the tissues of the body.

(3) The gases in a diver's breathing mixture will dissolve into body tissues as the diver is making a descent and during time spent on the bottom. This *absorption* is in proportion to the increase of the partial pressure of nitrogen due to Dalton's Law.

(4) Gas that has been dissolved in a diver's body at depth will remain as long as the pressure or depth is maintained.

(5) As the diver ascends toward the surface, the dissolved gas will *come out of solution.* If the rate of ascent is controlled—as through use of the decompression tables—the dissolved gas will be exchanged by the lungs and exhaled before it accumulates sufficiently to form bubbles in the blood and tissues [which bubbles may cause an embolism].

Dalton's Law — states that the total pressure exerted by a gaseous mixture is equal to the sum of the partial pressures of each individual gas in a gas mixture.

On the surface, the pressure is one atmosphere or 14.7 psi of gas which is made up of 21% Oxygen and 79% Nitrogen.

The partial pressure of oxygen is 21% times 14.7 = 3.09 psi and the partial pressure of nitrogen is 79% times 14.7 = 11.61psi. The two partial pressures added together equal the total pressure. Thus 3.09 psi added to 11.61 totals 14.7 psi.

As we descend into the water, the partial pressure of the gas increases due to the pressure.

At 33 fsw (two atmospheres absolute), the partial pressure of oxygen is (21% times 29.4) or 6.17 psi and the partial pressure of nitrogen is (79% times 29.4) or 23.27 psi..

The most important factors that affect the absorption of gases into the blood are:

(a) Depth of the dive. [The deeper the dive the higher the partial pressure of nitrogen.]

(b) Time of dive at depth. [The longer the time spent at depth, the longer the body has to endure a high partial pressure of nitrogen.]

Anatomy and Physiology

Diving Physiology

Fluid filled tissue spaces in the body can withstand tremendous pressure if the air filled spaces are in equilibrium with the pressure of the surrounding water. Air spaces in the body include the lungs, sinuses and the inner ear. When descending, the diver must equalize the pressure in these spaces with the increasing pressure

of the water. Failure to do so may result in burst ear drums or collapsed lungs. When ascending, the diver must again equalize the pressure in the air spaces with the reduced pressure of the surrounding water. Elevated air pressure on ascent may result in embolisms or burst lungs.

Primary Effects of Pressure

Tissue damage due to pressure differences between the diver's air spaces and the surrounding medium is known as barotrauma. The two major types of barotraumas are embolisms and squeezes.

1. Embolism: Embolisms most often occur when a diver holds his/her breath while ascending. As the pressure the water exerts on the body is reduced the volume of gas within the lungs expands. This may produce ruptures in alveoli (the tiny sacs within the lungs), ruptures in the fine blood vessels within the alveoli or ruptures in the lungs themselves. Embolism will result in air mixing in the tissues and bloodstream.

    a. Symptoms: Symptoms of embolism include coughing up blood, dizziness, weakness or chest pain.
    b. Treatment: Treatment includes CPR if required, administration of oxygen and immediate transport to a hyperbaric chamber.
    c. Pneumothorax: Pneumothorax is a related barotrauma which results in air in the chest cavity. This can lead to a collapsed lung as the air expands on ascent. A Pneumothorax is also treated in a hyperbaric chamber.
    d. Prevention: The NUMBER ONE rule for preventing all types of barotraumas is for the diver to never hold his/her breath when breathing compressed air. This is especially important near the surface as compressed gas expands at a faster rate when approaching the surface. A three minute stop at ten feet is a good precautionary strategy.

2. Middle Ear Barotrauma (burst ear drum) occurs when a diver descends and pressure builds in the outer ear canal that is exposed to water pressure. The outer ear is separated from the inner ear by the tympanic membrane (ear drum) and this membrane stretches and can burst allowing water into the inner ear.

    a. Symptoms: Symptoms include pain in the inner ear. If the ear drum bursts pain will increase, dizziness may ensue and, upon resurfacing, blood may appear at the nose.
    b. Treatment: In severe cases the diver should visit a doctor. If fluid is present in the inner ear it may be necessary to treat with antibiotics.
    c. Prevention: The diver should equalize the pressure across the ear drum when descending. This may be done by pinching the nose

through the side of the mask and blowing air into the nose. If clearing the ears this way does not work the diver should ascend until the pain disappears and try again. Descending feet first usually helps the process. Diving when congested or with a head cold usually makes it more difficult to clear the ears and should be avoided.

3. Squeeze: A squeeze occurs when there is an unequal pressure between the diver's equipment and skin. This can occur under a dry suit or across a face mask. In severe conditions it can cause rupture of blood vessels in the eye or under the skin. The best way to prevent mask squeeze is to add air to the mask through the nostrils. Adding air to a dry suit through the inflator hose may help a suit squeeze but it may be necessary to change the diver's position (feet down or head down) to distribute the air to the squeeze.

Secondary Effects of Pressure

Secondary effects of pressure result from prolonged breathing of gasses under pressure. These can include decompression sickness (bends) and Nitrogen narcosis.

1. Decompression sickness: The air used to fill most SCUBA tanks is 20% Oxygen and 80% Nitrogen. When inhaled under pressure, Nitrogen dissolves in the blood. The deeper the diver descends and the longer he/she stays down the more Nitrogen enters the blood. If a diver ascends after staying down too long the Nitrogen leaves the blood as bubbles. The bubbles usually lodge in blood vessels in joints in the wrist, elbows and knees. In extreme cases the bubbles can lodge near the spine or brain. Type I decompression sickness causes skin rashes and minor joint pain. Type II decompression sickness causes severe pain and may cause damage to the central nervous system and the circulatory system. In some cases numbness and loss of limb function may occur.

a. Symptoms: Mild symptoms include skin rashes and dull joint pain. More severe symptoms can involve intense pain in the joints, back and leg pain, numbness and loss of limb function. Symptoms may not appear for several hours after diving and may get progressively worse.
b. Treatment: Anyone who suspects they may have suffered decompression sickness should seek medical help as soon as possible. Untreated cases may result in permanent damage and may prevent future diving. First aid includes CPR if necessary and administration of Oxygen. The diver should be transported to a hyperbaric chamber as soon as possible.
c. Complicating factors: Diving in cold water, working hard, increased age and poor physical condition can increase a diver's susceptibility to the bends. When a working diver makes multiple dives in one day a portion of the bottom time from previous dives is carried over to the next dive. Divers should ALWAYS consult

decompression tables or use a diving computer to keep track of their allowable bottom time.

d. Strategies: Divers can follow several simple rules to reduce the risk of getting the bends.

- Rest between dives (known as a surface interval). This allows some of the dissolved Nitrogen to leave the blood stream.
- Always take a three minute stop at ten feet when ascending. Even when well within the limits of the dive tables this helps prevent the formation of microbubbles in the blood stream.
- Remember that the dive tables and dive computers are based on the response of "average divers." Don't push the limits of the tables. Some people have gotten the bends even when they stayed within the guideline given in the tables.

e. Mixed gas: Some divers have used SCUBA gas enriched with Oxygen to lengthen the time they can stay at depth without getting the bends. This introduces other dangers as too much Oxygen inhaled under pressure may cause convulsions and drowning. Divers should be certified for mixed gas before use.

2. Nitrogen Narcosis: Nitrogen narcosis or "rapture of the deep" is caused by breathing Nitrogen under pressure. The increased partial pressure of Nitrogen can depress the central nervous system, clouding judgment. Nitrogen narcosis usually occurs when breathing SCUBA air below 100 feet.

a. Symptoms: Divers suffering from Nitrogen narcosis suffer a loss of mental reasoning and reduced manual dexterity. This is especially dangerous as the diver may not recognize the symptoms because of his or her reduced reasoning capacity. In extreme cases the diver may pass out and drown. If the diver is retaining Carbon dioxide in the blood stream symptoms may be more severe.

b. Treatment: If a diver feels the onset of symptoms he/she should immediately ascend until symptoms disappear.

c. Prevention: Divers should use caution when making deep dives. In addition to increasing the risk of Nitrogen narcosis deep dives also increase the risk of decompression sickness. Divers should always breathe adequate volumes of air. Holding the breath or breathing shallowly to conserve air will lead to buildup of Carbon dioxide in the blood and increase the risk of Nitrogen narcosis. Diving in cold water and overexertion at depth also increase the risk of these diving injuries.

Respiratory Problems

When breathing atmospheric air the Oxygen in air is exchanged for Carbon dioxide in the blood circulating through the lungs. Anything which impedes the exchange of Oxygen can lead to problems for a diver. Air under pressure is more dense and therefore harder to circulate through the lungs. Using a breathing apparatus (regulator) in poor condition may not deliver enough air at depth so Carbon dioxide accumulates in the blood. Neck seals in dry suits may constrict blood vessels leading to the brain preventing adequate Oxygen supply. Divers should maintain their equipment and have it serviced regularly at authorized service centers.

Divers' Diseases and Injuries

Through training and experience, divers learn to handle a wide range of actual and potential emergency situations. Divers and their diver tenders must be able to separate the important from the trivial, while recognizing that a seemingly minor symptom or event may foreshadow an emergency. They should be able to identify and react to the warning signals of divers' diseases that may affect themselves or other divers and have a working knowledge of the most effective methods for handling these emergencies.

These disease states described below are not the only problems that a diver could encounter. The dive tender should be on the look-out for symptoms of heart attack (chest pain), muscle cramps, asthma (difficulty breathing), migraine headaches, or other ailments in anyone whether diving or not.

1. HYPOXIA and ANOXIA:

Definition: **Low amount of or no oxygen** in the tissues.

a. Symptoms: In this condition the brain and other tissues will be starved of oxygen. The symptoms that result can take different forms depending on how little oxygen is present. Look for symptoms related to diminished mental capacity such as lack of concentration, poor judgment, or giddiness and or decreased motor skill capacity such as ability to stand, handle gear, or focus eyes. This is a serious condition that may lead to the diver's becoming unconscious.

b. Prevention and Treatment: Check that the diver is breathing at least 21% oxygen.

Giving 100% oxygen on the surface will normally help the affected diver.

NOTE 1: In order to administer oxygen a person must have an oxygen administration certification card. Organizations that provide First Aid and CPR Training often provide the training for oxygen administration.

NOTE 2: Be sure the oxygen (air) is from a certified and trusted source.

Hypoxia or Anoxia may require emergency assistance. Don't hesitate to seek emergency assistance.

2. CARBON DIOXIDE EXCESS (Hypercapnia):

Definition: In diving operations, **too much** carbon dioxide in the blood and tissues.

a. Symptoms: Headache, diver turning blue (cyanosis), difficulty in breathing, and unconsciousness.

Cause: Poor or inadequate lung function/breathing in relation to work level; it is normally caused by controlled breathing or skip breathing (some divers' thoughts are "...air costs money" and "I can get more time out of my tanks than you" and try to save on air).

b. Prevention and Treatment: Divers and dive tenders must watch for symptoms and follow the recommendations:

(1) Do not "skip breathe" or practice controlled breathing.

(2) **Do** reduce the work rate.

(3) Stop work and start breathing normally.

(4) Always use enough air.

3. DECOMPRESSION SICKNESS TYPE I AND TYPE II:

Definition: When a diver's blood and tissues have absorbed nitrogen in solution at depth, the reduction of external pressure during ascent can produce a state of super-saturation of nitrogen in the body. If the elimination of excess nitrogen gas, via the circulation and the lungs, fails to keep up with the reduction of external pressure, the degree of saturation of nitrogen in blood and tissues may reach the point at which the gas can not stay in solution. (It is similar to what happens when a bottle of carbonated beverage is uncapped – the bubbles try to escape the liquid.)

a. Symptoms of Type I Pain Only Decompression Sickness:
Pain in the legs and arms (no bilateral involvement) – that is no pain on both sides at the same time). Discoloration of the skin, also known as marbling.

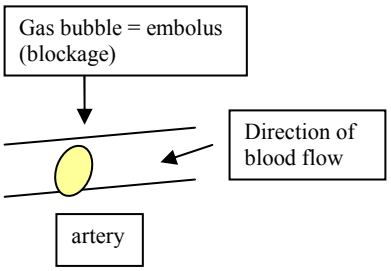
Cause: The major cause of decompression sickness is the failure of the diver to off-gas or release when ascending, the excess nitrogen absorbed by the body tissues during the dive. There are various factors that contribute to decompression sickness.

b. Prevention and Treatment of Decompression Sickness:

Follow the decompression tables. Consider reducing the exposure times when in cold water, when engaged in heavy physical exertion, or consider the combination all of the above. The only *correct* treatment for decompression sickness is to surface immediately. No attempt should be made to treat decompression sickness in the water.

4. AIR EMBOLISM:

Definition: The blockage of an artery by an air bubble that lodges in the artery (Embolus).



a. Symptoms: Any pain symptom presented by the diver—usually distinguished by rapid (less than 10 minutes) onset (arrival) of symptoms after surfacing.

Cause: Over-pressurized air in the lungs forced into the chest cavity bed. Bubbles are carried to the left chambers of the heart. From there, they are circulated into the arteries. Any bubble which is too large to go through an artery will lodge and form a plug (Embolus). The tissues beyond the blockage will then be deprived of their blood supply.

b. Prevention and treatment: The best treatment for embolism is prevention. Diver training, equipment maintenance, controlled ascents, and dive planning are all important aspects to maintaining a safe dive. The only correct treatment for an embolism is immediate surface oxygen recompression therapy recommended by authorized medical personnel.

5. PNEUMOTHORAX:

Definition: Trapped air in the potential space between the lung covering and the lining of the chest wall.

a. Symptoms: The diver will have difficulty breathing and air will not move in the affected side. The diver will complain of pain in the affected side (the side where air is trapped).

Cause: Over-inflation of the lungs caused by ascending too rapidly or bringing up an unconscious diver to the surface.

b. Prevention and Treatment: Diver training with practice in controlled ascents. Medical assistance is likely to be necessary.

6. CARBON MONOXIDE (CO) EXCESS:

Definition: Carbon monoxide molecules attach to iron molecules in the hemoglobin in the blood and prevent oxygen molecules from binding to the hemoglobin as it is supposed to. Thus the oxygen the body needs to function cannot be carried to the cells.

a. Symptoms: headache, difficulty in breathing, drowsiness, confusion, and in severe cases, unconsciousness and death.

Cause: Air supply contaminated with exhaust from internal combustion engines (motor boats, etc) or improper compressor lubrication oils.

b. Prevention and Treatment: Maintain constant watch on all exhaust sources when operating a diver's air compressor. Treatment for CO excess consists of bringing the diver to the surface and in severe cases providing recompression therapy in a special hyperbaric oxygen chamber.

NOTE: As noted elsewhere, diver and tender should know the location of the closest hyperbaric chamber. See the resources section of this manual.

Know the air purity of your air source.

7. HYPOTHERMIA:

Definition: A lowering of the body's temperature due to immersion in cold water for an extended period of time without adequate thermal protection (protection from the cold).

a. Symptoms: Loss of coordination, loss of muscle control, loss of fine motor movement (fingers, for example), sporadic shivering suppressed by voluntary movement, mental confusion leading to unconsciousness.

Cause: Improper dive planning, failure to take water temperature into account, inadequate thermal protection, exceeding the limits of diver endurance.

b. Prevention and Treatment: Proper dive training and dive preparation. Thermal protection for the task, diver re-warming prior to repetitive dives. Do not push the limits of the diver's endurance. Treatment consists of re-warming the diver, and severe cases require hospitalization.

NOTE: Dive tenders are often forgotten in the planning stages of diving—the tender will be in the cold weather and getting wet from working with the urchins while the diver is on the bottom. The possibility of a tender going overboard when no one else is on the boat to render assistance is very real and potentially dangerous. **The tender should wear a *Mustang* or other type of exposure suit that provides suitable protection**.

8. DRUGS AND ALCOHOL IN DIVING:

a. Medication Use and Misuse: There have been no government or commercial experimental dives made to determine the effects of the increased partial pressure upon divers using controlled drugs and substances. Controlled drugs and substances are those whose use is tightly controlled – prescription drugs and narcotics, for example. They are known to alter various functions within the systems of the body. Consequently the risks of encountering problems in diving are higher. Because the drug or substance might either cover-up or aggravate symptoms of decompression sickness, the treatment of diving-related accidents as soon as possible is imperative in order to avoid permanent impairment.

Any diver who is under the care of a doctor and taking prescription drugs should advise the doctor that he or she is a commercial diver and ask for a medical evaluation that will address how that prescription drug will affect behavior and health during diving.

b. Side effects of drugs and alcohol: It is known that some drugs are mind-altering and diminish mental capacity. Divers need their full mental capacity to protect themselves and their dive partners from the inherent dangers of the underwater environment.

c. All hand-harvesting urchin operations are subject to the federal requirements for commercial fishing industry vessels. Included in the requirements is the commercial transportation standards for blood alcohol levels—the limit being .04 (which is less than half that of the level allowable for driving in most states). In addition to the blood alcohol levels, the presence of a controlled substance can lead to the seizure of the vessel and catch.

Diving and Support Equipment

SCUBA DIVING EQUIPMENT:

SCUBA diving equipment available today will support the requirements to go below the surface; *however,* not all SCUBA equipment is equal in performance aspects. Commercial diving requires equipment that will support the physiological demands of the diver when performing work and withstand rough handling.

Regulators: Should support the diver's breathing demands during peak work loads to provide adequate lung ventilation to supply the tissues with oxygen and eliminate excess build up of carbon dioxide. The regulator should be capable of delivering a minimum of 1.4 actual cubic feet of air at ambient pressure in the water column.

SCUBA Cylinders: Should be in date (not expired) for tests and inspection and a J-valve installed. If a diver chooses not to dive with a J-valve and uses K-valve SCUBA cylinders, a submersible pressure gauge should also be used. The choice of the SCUBA cylinder to be used should be dictated by the dive = and dive profiles to be made. If the SCUBA cylinder is not connected to a buoyancy compensator or a backpack, the harness should be equipped with quick-release hardware.

Buoyancy Compensators and Life Vests: BCs are designed to provide the diver with buoyancy control in the water column and a means to fasten the SCUBA cylinder. BCs were not designed to be used as lifting devices such as lift bags. Cartridge-type life vests are designed to provide the lift required at a designed depth. Going beyond the designed limit of the life vest will not give you the required lift to take you off the bottom or up in the water column. On both devices the exhaust valve or relief should be in good repair. BCs should be worn at all times. Using dry suits alone for buoyancy can prove fatal if the

suit tears, the exhaust valve fails, or the suit fills up with water.

Submersible Pressure Gauges: Are a valuable asset in diving if used correctly (monitoring)—the diver can plan the dive and monitor air consumption rates while working.

Decompression Meters and Computers: Are not as accurate as the U.S. Navy Diving Tables. With careful dive planning, the U.S. Navy tables will provide the protection required in figuring out the requirements of repetitive dives and decompression if required.

Fins and Masks: Should meet the demands that will be put on them. Fins should give the required propulsion for the type of work to be accomplished in the water. Masks should be chosen for comfort and durability.

Wet and Dry Suits: Thermal protection should be the primary concern for State of Maine hand-harvesting divers. A wet suit provides thermal protection—but not for long duration dives during winter months. A dry suit will provide adequate thermal protection when undergarments are worn. All exhaust valves/relief valves should be in good operating condition.

Diver's Buoyancy: The diver should know how to be neutrally buoyant when working in all conditions. The diver should try out the various combinations of weight and weight distribution to be neutrally buoyant.

The results of not being neutrally buoyant are:

(1) Diver overweighted and too exhausted to maintain buoyancy (working too hard on the bottom, and overharvesting).

(2) Diver overweighted (the loss of a weight belt causes rapid ascent with possible embolism).

(3) Diver underweighted (cannot work on the bottom).

Chaffing Gear: Chaffing gear should be installed on the suit or worn to protect the dry or wet suit from the heavy abuse of hand-harvesting. Chaffing gear should not be of the type material to trap air (rain gear/oil skins). A good grade of heavy duty coveralls with RTV or *aqua seal* coated over the heavy chaffing points works well.

BOAT SAFETY EQUIPMENT: All commercial divers engaged in hand harvesting operations must comply with federal requirements for commercial fishing industry

vessels and follow all laws and U.S. Coast Guard requirements. If you have a question regarding these laws and regulations, contact the U. S. Coast Guard Marine Safety Office for further information.

Life Jackets All Type I, II, and III personal floatation devices (PFD) used aboard fishing craft… **must** be US Coast Guard approved. For vessels less than 40 feet in length a type I, II, III, V commercial hybrid, or immersion suit is required for each person on board.

For vessels 40 feet or more in length a type I, V commercial hybrid, or immersion suit is required for each person on board. They must be:

Marked with the name of the vessel, owner of the PFD, or individual to whom it is assigned.,
Marked with retro-reflective tape,
Have a personal marker light/whistle attached,
Readily accessible in the craft,
Maintained in good serviceable condition, and
of the appropriate size for the intended wearer.

On craft 16 feet to less than 26 feet, one 20 inch or larger orange ring buoy and 60 feet of line or Type IV throwable cushion is required. On vessels 26 feet to less than 65 feet, one 24 inch orange ring buoy with 60 feet of line is required. Ring buoys must be marked with the name of the vessel and have retro-reflective tape of approximately 2 inches in width installed in 4 evenly spaced locations around the buoy. Watercraft owners and operators must check the federal requirements for commercial fishing industry vessels for the size of the boat to be operated.

Fire Extinguishers:. Motor boats 40 feet in length but less than 65 feet in length must carry 3 U. S. Coast Guard approved type B-I fire extinguishers. Motor boats 26 feet in length but less than 40 feet in length must carry 2 B-I U. S. Coast Guard approved type B-I fire extinguishers. Motor boats less than 26 feet in length must carry 1 U. S. Coast Guard approved type B-I fire extinguisher and outboards less than 26 feet in length must carry 1 U .S. Coast Guard approved type B-I fire extinguisher if the following vessel configurations exist:

Closed compartment under thwarts and seats wherein portable fuel tanks may be stored.

Double bottoms not sealed to the hull or that are not completely filled with flotation material.

Closed living spaces.

Closed stowage compartments in which combustible or flammable materials are stowed.

Permanently installed fuel tanks.

Sound Devices: Every motorboat shall be provided with an efficient whistle and/or other sound producing device. Vessels over 39 feet 4 inches in length must have a whistle audible for 1/2 mile (120 db).

Navigation Lights: All water craft operating from sunset to sunrise must carry and exhibit lights when underway; the lights must be operated during any period of restricted visibility, and during such time, no other lights *that may be mistaken for those prescribed* shall be exhibited, U.S. Coast Guard laws clearly sets the navigation light requirements based on the of the water craft.

Visual Distress Signals: All fishing craft must have 3 Coast Guard approved flares on board which may be counted as meeting both the day and night requirement.

VHF Radios: Should be carried on board and ready to use in case of an emergency. The Coast Guard can use radio direction finding equipment to locate a disabled boat in case of emergencies. Cellular phones are a good backup in an emergency but should not be considered as primary communications.

Safe Operations: Whenever the Coast Guard detects an unsafe operation, they have the authority to declare the operation unsafe and order the fishing craft to port until the hazard or violation has been corrected to their satisfaction.

Dive Planning and Emergency Procedures:

Proper planning before any dive operations can eliminate many problems and provide for a prompt and efficient response to emergency events. All members of the dive team should be included in the planning process. Operational planning can be broken down into several elements:

- Defining the task – what is the goal of the dive; what is the make-up of the dive team; what is need to accomplish each task associated with the dive.

- **Collecting and evaluating data related to the dive and dive location** – what are the environmental conditions – weather conditions, water conditions, hazards associated with the harvest site, and what is the proper vessel to use for these conditions.

- **Establishing equipment and performance requirements –** type and amount of diving equipment, logistical requirements and support, qualified personnel. Plan each dive for bottom time and warming intervals.

- **Review of emergency notification procedures -** a crew briefing is essential in the planning process. Emergency contact numbers for medical and first responder services should be reviewed and verified. USCG notification is most effective on VHF channel 16 for all emergency calls. All emergency telephone numbers should be posted in a conspicuous place and should include working phone numbers for:

  Local hospital
  Local Coast Guard Unit or Station
  Maine State Police
  Diver's Alert Network (DAN)

  As a part of the planning process, all radios and cell phones should be checked and verified to be in operating condition, and all members of the dive team should be familiar with their operation.

The following sections provide information that can be used during the planning process:

The Diving Team:

- No dive should jeopardize safety to achieve a harvesting task – the following recommendations should be considered prior to conducting dive operations.

  Divers and Tenders:

- Should discuss a safe dive plan and inspect all equipment.

- Establish a diver/tender communication and recall signal.

- Discuss accident prevention and how it applies to each member of the team.

- Ensure all members of the team understand the emergency notification equipment and procedures.

- Discuss the dive plan.

Environmental Conditions:

High Energy Zone: Divers working in or near the surf zone may encounter surf surge hazards that impair the tender's ability to monitor the diver. The diver and tender should be aware that:

Wave crests overhead of the diver create rapid changes in the diver's depth and may cause an embolism.

Divers may lose their regulator – have a loose or cracked face mask, tear a dry suit or possibly become wedged between rocks.

There is a possibility that the tender could be thrown from the tender craft.

The tender may lose sight of the diver.

The tender may not be able to approach the diver in the surf zone.

All these elements should be evaluated and planned for in the pre-dive planning process.

Ice Conditions: all the conditions mentioned in the "high energy zone" may be compounded by the formation of "pancake" or sheet ice. Ice may cause reduced visibility, mechanical malfunction, a disorientated diver – or even a lost diver.

EMERGENCY Procedures

Don't panic – that recommendation holds true for any emergency situation. Good planning and a skilled response are the best chance for self rescue in many situations.

Fouling or entanglement of the diver:

Diver/tender signals are essential to alert the tender of an entanglement

Lost Diver:

- Notify partner diver if possible.
- Mark last position of bubbles with a buoy or data marker.

- Notify or signal other fishing craft in the area – they may be your "First responders."

- Notify USCG and Marine Patrol for search assistance.

- Have the dive partner initiate a circle line search of the area.

- Evaluate the Dive Partner and check him out – IF the dive Partner is physically ready to continue a repetitive dive – redeploy to continue search.

- Seek help from other divers that may be in the area.

Omitted Decompression:

- Any unexpected surfacing of the diver from depths in excess of 20 feet is considered a "blowup."

- If the diver is within "no-decompression limits" and asymptomatic – the diver should be observed for one hour on the surface. Recompression is not necessary unless decompression symptoms develop.

- If decompression symptoms develop, transport the diver to a recompression facility for medical evaluation.

Oxygen Administration in diving accidents and near drowning victims:

The benefits of administering oxygen to divers suffering from decompression sickness and near drowning:

Increases oxygen levels in the body

Reduces tissue edema (swelling)

Decreases the nitrogen off-gassing time

May help ease breathing

It is extremely important for tenders to recognize the symptoms of dive-related decompression sickness. Once the symptoms are recognized, emergency medical services should be notified. If the tender is certified in oxygen administration, oxygen should be administered and the diver transported to a medical facility.

Near drowning symptoms:

Cyanosis (bluish coloration)

Shortness of breath

Coughing

Frothy sputum (spit)

Treatment – If certified, administer oxygen and transport to a medical facility

Embolism symptoms:

Unconsciousness

Immediate and persistent dizziness

Immediate paralysis

Any central nervous system involvement

Treatment – If certified, administer oxygen until breathing is restored and continue delivering oxygen for the duration of the transport to a medical facility

Decompression sickness – type I and type II symptoms:

Numbness and tingling or electric sensations

Muscle weakness

Dizziness, vertigo, hearing loss

Affected speech, vision, taste, smell

Disturbances of higher brain function

Bilateral joint pain

Treatment – If certified, administer oxygen and continue oxygen use during transport to medical facility for examination and treatment.

Pneumothorax symptoms:

Lack of air sounds in the collapsed lung

Difficulty in breathing

Pain in the affected side

Treatment – If certified, administer oxygen until delivered to a medical facility

GET THE MESSAGE – !

GET CERTIFIED IN OXYGEN ADMINISTRATION AND CARRY OXYGEN ON EVERY DIVE TRIP - !

RESPONSIBILITIES OF A TENDER

The following is a list of responsibilities of a tender that should be reviewed during dive planning. The tender should

1. Be Aware of where the diver is when maneuvering the boat (don't hit the diver).
2. Be aware of your surroundings – rocks, ledges, or other obstacles.
3. Always stay in the boat
4. ALWAYS know where the diver is, i.e., watch the bubbles
5. Encourage all divers to tow small buoy to mark location
6. Know the times for tide changes
7. Know the forecasted weather and wind direction
8. Know how to operate VHF radio to monitor weather and call US Coast Guard
9. Wear a work type PFD or Work PFD Suit (Sterns/Mustang Suit or Float Coat)
10. Wear a watch or have a clock on the boat – Monitor time diver starts dive
11. Monitor diver's air supply, check pressure gauge when dive is started

12. Have a plan/system for recalling diver to surface in case of emergency. Example: Revving engine repeatedly, sending down a bag line with bags inside handle, some means of notifying diver to surface

13. Make sure boat has adequate fuel, if it is mixed, if it is ready

14. Don't spill fuel near harvested product

15. Learn basic knots, i.e., bowline, half hitch

16. Load boat evenly, assure load is secure and will not shift in bad weather

17. Keep load low in bad weather

18. Bring food and drink, extra gloves, socks

19. Wear layers of clothing. Good hat with draw strings, sunglasses or ski goggles, wind protection for face (ski mask), good boots that don't leak, oil skins and jacket

20. Make sure vessel has anchor, adequate rode (rope) and it is easily reachable and secured to boat, check boat cleats to be sure they are sturdy and secure

21. Constantly check wind direction and speed, check current direction

22. Try to get idea from diver his intentions, discuss lost diver scenario

23. Know location of first aid kit, flares, fog horn, survival suits

24. Have small mirror onboard to assist in urchin spine removal from eye (consider safety glasses or sunglasses while culling)

25. Know location of tools, spare spark plugs, plug wrench, dry gas, ether, spare prop

26. Have ditch bag prepared with lighter, waterproof matches, water, handheld VHF, cell phone, food, whistle, flares