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<table>
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**Notes**

FIU is considered a state agency and therefore not subject to OSHA federal regulation 26 CFR 1910 Sub-Part: “T”. The First Edition of FIU’s Diving Operations Manual (FIU-DOM-01) was established to define diving standards and diving procedures for the management of FIU’s non-scientific diving program in 2016.

**Revision 1**

**Notes:** Revision 1 reflects new standards that provide employee and participant protections for an evolving and growing diving program. A diver qualification attained under the previous standards listed in FIU-DOM-01 First Edition 2016, shall continue to apply to some existing situations, while new standards under FIU-DOM-01 Revision 1 will apply to all future cases immediately upon release. Those *initially* exempt from the new qualification standards will have limited *grandfather* rights for a period of 12 months post release date.
SECTION 1.00 GENERAL POLICY

1.10 Diving Standards

Purpose

The purpose of these Diving Standards is to ensure safe diving practices that maximize employee and participant diver protections from accidental injury and/or illness.

This manual outlines the minimum training and diving standards for the organization and safe conduct of the Florida International University non-scientific diving program.

Review of Standards

The FIU Diving Safety Officer shall inform the FIU (Scientific Diving Program) Diving Control Board Chair of the intended review of these standards for recommended changes. When these standards are reviewed for recommended changes, the Florida International University Diving Safety Officer will chair a review board with at least (3) additional qualified FIU Diving Supervisors from the non-scientific diving program that have completed the FIU Personnel Qualification System in its entirety.

All personnel involved in the revision of these standards, including the FIU Diving Safety Officer, shall sign on the revision control page prior to the release of these standards.

Scientific Diving

Scientific Diving is “diving performed solely as a necessary part of a scientific, research, or educational activity”, this is further explained in CPL 02-00-151, Effective June 13, 2011. A scientific diver is an observer of natural phenomena or responses of natural systems, and a gatherer of data for scientific analysis. These divers must be able to use research techniques in studying and
analyzing the underwater environment. Consequently, these divers are required to be scientists or scientists in training. The tasks performed by the scientific diver usually are light and short in duration; if any hand tools are used, they are simple ones (such as a small hammer, collecting jars, special hand-held measuring devices, plastic core tubes, hand net, suction fish collector, camera, or slate pencil). The following questions are provided for additional guidance; however, the list is not all-inclusive.

- Can the tasks be accomplished using simple hand tools (e.g., small hammers, pliers, chisels, wrenches, cameras, measuring tapes, nets, collection jars)?
- Do the tasks require the expertise of a scientist or scientist-in-training?
- Do the tasks involve education, observation of natural phenomena or responses of natural systems and/or gathering of data for scientific analysis?
- If moving or lifting of objects is to be conducted, are the objects easily moveable and do they weigh less than approximately 50 pounds underwater?

Scientific dives under the auspices of FIU shall comply with the FIU Scientific Divers Safety Manual.

**Breath-Hold Diving**

Breath-hold diving may be conducted when SCUBA is determined not to be necessary as part of an official FIU diving operation. Prior to approval, careful consideration must be given to the existing conditions including, but not limited to currents, sea state, diver capability, and available personnel. Approval must be given by the “on-site” Dive Supervisor or by the Diving Safety Officer and will be restricted to FIU Working Divers “only”, to a max depth 20 fsw. At least one safety diver / swimmer will be available in the water ready to render assistance.

*When access to the surface is restricted (as in under a vessel), in addition to the above, the diver shall also be line tended.*

**1.20 Operational Control**

**Scope**

These standards apply to all diving and related support operations subject to Florida International University (FIU) authority. FIU will have operational control in the application of these standards. Responsibility for ensuring compliance with these standards, shall reside with the FIU Diving Safety Officer, FIU qualified Dive Supervisors and FIU Vessel Qualified Crew Chiefs or Captains, of any diving or boating activity. This includes all cases involving the operations of employees or employees of auxiliary organizations, students, volunteers, or approved external participants where such persons are acting within the scope of their employment or approved FIU project, and the operations of other persons who may have compensated the university and are engaged in diving or boating operations under the auspices and authority of FIU.

**Diving Safety Officer**

The Diving Safety Officer (DSO) should have broad diving and technical expertise in commercial and scientific diving operations. Operational responsibility for the conduct of the local diving programs resides with the Diving Safety Officer.
Qualifications:

1. The DSO, for the purposes of providing oversight of the non-scientific diving program, shall be qualified at the supervisory level as a commercial diver, military diver, or (at a minimum) qualified to the full extent of the FIU-PQS-001 (Personnel Qualification System) or equivalent.

2. Shall have experience in the instruction of diving equipment commonly used in commercial diving operations and be an active SCUBA instructor from an internationally recognized certifying agency.

3. Shall be an active CPR, First Aid, and Oxygen Administrator instructor from an internationally recognized certifying agency.

Duties and Responsibilities

1. Shall be responsible, to the responsible administrative officer or designee, for the conduct of the FIU diving programs. The routine operational authority for this program, including the conduct of training and certification, approval of dive plans, maintenance of diving records, and ensuring compliance with this standard and all relevant regulations of the diving program, rests with the Diving Safety Officer.

2. May permit portions of this program to be carried out by a qualified delegate, although the Diving Safety Officer may not delegate responsibility for the safe conduct of the diving program.

3. Operational responsibility for the conduct of this diving program will be retained by the Diving Safety Officer.

4. Shall suspend diving operations considered to be unsafe or unwise.

Instructional Personnel Qualifications

All personnel involved in diving instruction under the auspices of the FIU diving program shall be qualified for the type of instruction being given.

Reciprocity and Visiting Divers

Operational Control shall remain with FIU when two or more organizations are engaged jointly in diving activities, or engaged jointly in the use of diving resources as defined in Section 1.20.

A Diver from an organization that meets or exceeds the minimum entry level requirements shall apply for permission to dive by submitting to the FIU Diving Safety Officer a document containing all the information detailing the applicant diver’s qualifications, signed by the visiting diver’s diving program representative.

A visiting diver may be asked to demonstrate their knowledge and skills for the planned dive. If FIU denies a visiting diver permission to dive, the DSO shall notify the visiting diver and their representative with an explanation of all reasons for the denial.

Waiver of Requirements

A waiver may be granted for specific training, examinations, depth certification and minimum activity requirements to maintain certification for employee divers only. A review by at least (3) Diving Supervisors and with the recommendation of the Diving Safety Officer is required.
1.30 Consequence of Violation of Regulations by Divers

Failure to comply with the standards and requirements of this document may be cause for the revocation or restriction of the diver’s diving privileges by the DSO.

1.40 Job Safety Analysis (JSA)

A written Job Safety Analysis (JSA) or equivalent shall be generated for diving operations. A single JSA may cover multiple dives as part of one larger activity or project. Pre-written JSAs’s may be maintained and utilized, but the JSA must be reviewed by the dive team each time a relevant activity or project is undertaken.

The objective of a Job Safety Analysis is to identify hazards associated with each step of a job, and to develop solutions that will either reduce, eliminate, or guard against hazards.

The basic procedure for completing a JSA and guidance is provided as follows:

1. Break the job into steps or activities: Don’t be too general or too detailed. The goal is to provide enough detail to identify and mitigate relevant hazards; no more and no less.
   - Non-routine activities are most likely to have insufficiently mitigated hazards, so focus on these.
2. Identify potential hazards.
   - Consider hazards which might cause injury (strain, sprain, slip, fall, cut, crush, barotrauma, asphyxia, etc.).
   - Consider environmental and long term health hazards (vapors, blood-borne pathogens, etc.).
3. Recommend safe procedures and protections.
   - Identify controls
   - List Personal Protective Equipment (PPE)
   - Identify resources for managing accidents.
4. Assign responsibility
   - Assign a specific person for implementing recommended safe procedures and protections.
   - For JSAs written prior to specific assignments, names should be added during pre-dive review of the JSA if responsibility is not clearly defined.
5. Identify personnel involved in JSA development
   - Identify the person(s) preparing, reviewing and approving the JSAs.
   - Distribute the JSA to all personnel involved in the job or task and ensure they are familiar with the content.
   - Dive supervisors should review the highlights of the JSA with the dive team prior to a dive.
6. Revise the JSA
   - Pre-written JSAs should be reviewed prior to the actual dive and modified (by hand as required) with any additions or changes.
   - JSAs for jobs or activities which occur more than once should be updated as required to capture lessons learned.
1.50 Dive Team Briefing

Before commencing with any underwater operation, the dive team members shall be briefed on:

- The tasks to be undertaken.
- Safety Procedures for the diving mode.
- Any unusual hazards or environmental conditions likely to affect the safety of the underwater operation.
- Any modifications to operating procedures necessitated by the specific underwater operation.
- Before each dive, the diver shall be instructed to report and record any physical conditions, problems or adverse physiological effects that may render the diver unfit to dive.

1.60 Record Maintenance

The Diving Safety Officer or designee shall maintain permanent records for each diver certified. The file shall include evidence of certification level, results of current physical examination, reports of disciplinary actions, and other pertinent information deemed necessary.

Dive logs may be maintained in a separate file.

Availability of Records:

Medical records shall be available to the attending physician of a diver or former diver when released in writing by the diver.

Records and documents required by this standard shall be retained by the FIU diving program for the following period:

1. Physician’s written reports of medical examinations for dive team members - 5 years.
2. Diving safety manual - current document only.
3. Records of dive - 1 year, except 5 years where there has been an incident of pressure-related injury.
4. Pressure-related injury assessment - 5 years.
5. Equipment inspection and testing records - current entry or tag, or until equipment is withdrawn from service.
SECTION 2.00 MEDICAL STANDARDS

2.10 Medical Requirements

General

The Diving Safety Officer shall determine that divers have passed a current diving physical examination and have been declared by the examining physician to be fit to engage in diving activities as may be limited or restricted in the medical evaluation report.

All medical evaluations required by this standard shall be performed by, or under the direction of, a licensed physician of the applicant-diver’s choice, preferably one trained in diving/undersea medicine.

The diver should be free of any chronic disabling disease and any conditions contained in the list.

2.20 Frequency of Medical Evaluations

Medical evaluation shall be completed:

1. Before a diver may begin diving, unless an equivalent initial medical evaluation has been given within the preceding 5 years (3 years if over the age of 40, 2 years if over the age of 60).
2. Thereafter, at 5 year intervals up to age 40, every 3 years after the age of 40, and every 2 years after the age of 60.
3. Annual Medical Evaluations are required for Saturation Diving regardless of age.
4. Clearance to return to diving must be obtained from a physician following any major injury or illness, or any condition requiring hospital care or chronic medication. If the injury or illness is pressure related, then the clearance to return to diving must come from a physician trained in diving medicine.

2.30 Information Provided to The Examining Physician

Florida International University or the Diving Safety Officer shall provide a copy of the medical evaluation requirements of this standard to the examining physician. (Appendices A-1, A-2, A-2b and A-3).

2.40 Content of Medical Evaluations

Medical examinations conducted initially and at the intervals specified in Section 2.60 shall consist of the following:

1. Applicant agreement to release APPENDIX-2 & APPENDIX-3 to the Diving Safety Officer (Appendix 2b).
2. Medical history (Appendix 3).
3. Diving physical examination (Required tests listed below and in Appendix 2).

2.50 Conditions Which May Disqualify Candidates from Diving (Adapted from Bove, 1998)

a) Abnormalities of the tympanic membrane, such as perforation, presence of a monomeric membrane, or inability to auto inflate the middle ears.

b) Hearing loss; Vertigo including Meniere’s Disease.
c) Stapedotomy or middle ear reconstructive surgery.
d) Recent ocular surgery.
e) Psychiatric disorders including claustrophobia, suicidal ideation, psychosis, anxiety states, depression.
f) Substance abuse, including alcohol.
g) Episodic loss of consciousness.
h) History of seizure.
i) History of stroke or a fixed neurological deficit.
j) Recurring neurologic disorders, including transient ischemic attacks.
k) History of intracranial aneurysm, other vascular malformation or intracranial hemorrhage.
l) History of neurological decompression illness with residual deficit.
m) Head injury.
n) Hematologic disorders including coagulopathies.
o) Risk factors or evidence of coronary artery disease.
p) Atrial septal defects.
q) Significant valvular heart disease - isolated mitral valve prolapse is not disqualifying.
r) Significant cardiac rhythm or conduction abnormalities.
s) Implanted cardiac pacemakers and cardiac defibrillators (ICD).
t) Inadequate exercise tolerance.
u) Hypertension.
v) History of pneumothorax.
w) Asthma.
x) Chronic pulmonary disease, including radiographic evidence of pulmonary blebs, bullae or cysts.
y) Diabetes mellitus.
z) Pregnancy.

2.60 Laboratory Requirements for Diving Medical Evaluation and Intervals

Initial examination under age 40:

1. Medical History
2. Complete Physical Exam, emphasis on neurological and otological components
3. Urinalysis
4. Any further tests deemed necessary by the physician.

Periodic re-examination under age 40 (every 5 years):

1. Medical History
2. Complete Physical Exam, emphasis on neurological and otological components
3. Urinalysis
4. Any further tests deemed necessary by the physician

First exam over age 40:

1. Medical History
2. Complete Physical Exam, emphasis on neurological and otological components
3. Detailed assessment of coronary artery disease risk factors using Multiple-Risk-Factor Assessment\(^1,\)\(^2\) (age, family history, lipid profile, blood pressure, diabetic screening, smoking history). Further cardiac screening may be indicated based on risk factor assessment.

4. Resting EKG
5. Chest X-ray
6. Urinalysis
7. Any further tests deemed necessary by the physician

**Periodic re-examination over age 40 (every 3 years); over age 60 (every 2 years):**

1. Medical History
2. Complete Physical Exam, emphasis on neurological and otological components
3. Detailed assessment of coronary artery disease risk factors using Multiple-Risk-Factor Assessment\(^1\) (age, family history, lipid profile, blood pressure, diabetic screening, smoking history). Further cardiac screening may be indicated based on risk factor assessment.
4. Resting EKG
5. Urinalysis
6. Any further tests deemed necessary by the physician / *Additional tests required for Saturation Diving*
   1. Tuberculin Test
   2. Urine HCG for Women

**2.70 Physician’s Written Report**

After any medical examination relating to the individual’s fitness to dive, Florida International University shall obtain a written report prepared by the examining physician that shall contain the examining physician’s opinion of the individual’s fitness to dive, including any recommended restrictions or limitations. This report will be reviewed by the Diving Safety Officer.

The Diving Safety Officer shall make a copy of the physician’s written report and retain on file.

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SECTION 3.00 ENTRY-LEVEL REQUIREMENTS

3.10 General Policy

Diver certification is a prerequisite for persons engaged in diving operations as defined in Section 1.20 of this manual. All persons engaged in diving operations under the auspices of Florida International University, shall be at least 18 years of age.

Minimum diver certifications accepted for entry-level are listed below:

a) Recreational diver certification from a national or international training agency.

b) Military or Commercial diver certification from a national or international training agency.

SECTION 4.00 DIVER QUALIFICATION

This section describes the training and performance standards for the Florida International University’s non-scientific diving program. This qualification, for the purposes of these standards, shall be reserved for university employees only. Other specific diver “designations” under these standards are reserved for non-employee divers participating in a university approved diving operation or project.

4.10 Prerequisites

The applicant/candidate must complete all prerequisites as listed below, before commencing diver training listed in section 4.20.

Diver Certification

The applicant/candidate must, at minimum, show documented proof of entry-level diver certification from an internationally recognized recreational, commercial or military diver training agency.

Military and commercial diver training certificates, meet the minimum requirements for diver qualification.

- Minimum accepted depth certification is 60 fsw

Medical Examination

The applicant/candidate must be medically qualified for diving as described in Section 2.00 of this standard.

Swimming/Waterman-ship Evaluation

The applicant/candidate must demonstrate the following in the presence of the Diving Safety Officer, instructor, or other approved examiner. All tests are to be performed without swim aids, however, where exposure protection is needed, the applicant must be appropriately weighted to provide for neutral buoyancy.

- Complete 400-yard swim in 15 minutes or less.
- Swim underwater for a distance of 25 yards without surfacing.
- Tread water for 10 minutes.
d) Transport a simulated incapacitated person for a distance of 25 yards in the water.

**Written Exam**

The candidate must pass a written examination that demonstrates knowledge of at least the following:

1. Function, care, use, and maintenance of diving equipment.
2. Physics and physiology of diving.
3. Diving regulations and precautions.
4. Dangerous marine animals.
5. Emergency procedures, including buoyant ascent and ascent by air sharing.
6. Currently accepted decompression procedures.
7. Demonstrate the proper use of USN dive tables.
8. Underwater communications.
9. Hazards of breath-hold diving and ascents.
10. Planning and supervision of diving operations.
11. Diving hazards.
12. Cause, symptoms, treatment, and prevention of the following: near drowning, air embolism, carbon dioxide excess, squeezes, oxygen poisoning, nitrogen narcosis, exhaustion and panic, respiratory fatigue, motion sickness, decompression sickness, hypothermia, and hypoxia/anoxia.
13. Additional topics at the DSO’s discretion.

**Release of Liability**

All diver candidates must submit the following Appendices (A-7, A-8) and sign a Florida International University Release of Liability Waiver (Appendix-9) and shall be retained on file. For non-employee personnel, the Release of Liability Waiver shall be valid for 12 months.

**4.20 Training**

The diver must complete theoretical aspects and practical training as described in this standard. During this period, the diver is considered to be a “Diver in Training”, and is required to dive with an FIU qualified Working Diver designated by the DSO or Dive Supervisor. All diver training must be consistent with these standards and relevant sections of the Florida International University “Personnel Qualification Standards”.

**Practical Training/Skill Development/Evaluation**

**CPR, First Aid, and Oxygen Provider**

Candidates at a minimum, must be trained and certified in Cardio Pulmonary Resuscitation, Basic First Aid, and Oxygen Administration.
Dive Equipment Familiarization

At the completion of training, the trainee must satisfy the Diving Safety Officer or the instructor of their ability to perform the following:

a) Demonstrate knowledge of the minimum dive equipment required for a working diver.
b) Demonstrate knowledge of and properly set up diving equipment.
c) Demonstrate knowledge of and proper use of a dive computer.
d) Demonstrate knowledge of and properly use an Air-2 regulator / octopus and power inflator.
e) Demonstrate knowledge of and proper use of a Buoyancy Compensating Device.

Dive Operations Familiarization

At the completion of training, the trainee must satisfy the Diving Safety Officer or the instructor of their ability to perform and have knowledge of the following:

a) Demonstrate knowledge of the minimum equipment required on dive station.
b) Demonstrate knowledge of and properly set up dive station.
c) Describe the basic elements of a “dive plan”.
d) Demonstrate familiarization of dive logs.
e) Demonstrate knowledge of the Dive Supervisors “Pre-Dive” Checklist.
f) Demonstrate knowledge of the minimum personnel requirements for SCUBA diving.
g) Demonstrate knowledge of maximum allowable depth for SCUBA diving.
h) Demonstrate knowledge of recompression chamber requirements.
i) Demonstrate knowledge of minimum psi requirements during a dive.
j) Describe the role of a Dive Supervisor.
k) Describe the role of a “Standby Diver”.
l) Demonstrate knowledge of and describe the purpose of a Reserve Valve.
m) Demonstrate knowledge of and describe the purpose of a “Bail-Out” cylinder.
n) Demonstrate knowledge of lost diver procedures.
o) Demonstrate basic knowledge of actions to be taken when no decompression limits are exceeded and basic “omitted decompression” procedures.

Confined or Shallow Open Water Skills Assessment Dive (< 30 fsw)

At the completion of training, the trainee must satisfy the Diving Safety Officer or the instructor of their ability to perform the following, as a minimum, in a pool or in shallow sheltered open water:

a) Enter and exit pool, open water, or exit and board a diving vessel, while wearing scuba gear.
b) Completely flood and clear a face mask.
c) Recover and clear second stage regulator.
d) Demonstrate understanding of underwater signs and signals.
e) Demonstrate the ability to properly operate a Reserve Valve.
f) Demonstrate buoyancy control which is acceptable to the instructor.
Open Water Evaluation

The trainee must satisfy the Diving Safety Officer or the instructor, of their ability to perform the following in open water:

a) Enter and exit open water from aboard a diving vessel, while wearing scuba gear.

b) Demonstrate air sharing, (on bottom) including both buddy breathing and the use of alternate air source, as both donor and recipient, with and without a face mask.

c) Rescue and transport, as a diver, a passive simulated victim of an accident to the surface and tow the victim to the vessel.

d) Demonstrate understanding of underwater signs and signals.

e) Demonstrate the ability to achieve and maintain neutral buoyancy while submerged.

f) Demonstrate basic underwater navigation using a compass.

g) Demonstrate the ability to use a bail out cylinder in a simulated loss of air scenario.

h) Demonstrate actions to take when no decompression limits are exceeded and basic “omitted decompression” procedures.

i) Demonstrate the ability to successfully complete a lost diver drill.

Site Orientation (Specific to Aquarius and Conch Reef)

The trainee must satisfy the Diving Safety Officer or the instructor, of their basic familiarity with the following:

a) Demonstrate knowledge of the location of Aquarius Underwater Habitat and its compartments.

b) Demonstrate basic knowledge of the interior of Aquarius Wet-Porch.

c) Demonstrate the ability to locate and name the mooring sites at Conch Reef.

d) Demonstrate the ability to navigate to the most common work sites at Conch Reef.

e) Demonstrate the ability to lead a site orientation dive.

SCUBA Cylinder Fill Station Orientation

At the completion of training, the trainee must satisfy the Diving Safety Officer or the instructor of their ability to perform the following:

a) Demonstrate knowledge of SCUBA cylinder markings.

b) Demonstrate knowledge of SCUBA cylinder hydrostatic and visual testing requirements.

c) Demonstrate basic knowledge of and properly prepare a SCUBA cylinder for filling.

d) Demonstrate knowledge of SCUBA cylinder safe handling and storage practices.

Qualification as Fill Station Operator may be obtained by meeting the requirements in the FIU Personnel Qualification Standard.

Basic Seamanship

At the completion of training, the trainee must satisfy the Diving Safety Officer or the instructor of their ability to perform the following:

a) Demonstrate the ability to tie (3) basic knots (Bowline, Square knot and Half Hitch).

b) Demonstrate the ability to properly moor a vessel at sea.

c) Demonstrate the ability to properly secure a line to a cleat.
d) Demonstrate the ability to properly moor a vessel at the dock.

**Line Pull Signals**

At the completion of training, the trainee must satisfy the Diving Safety Officer or the instructor of their ability to demonstrate knowledge of the following:

a) With a qualified Diving Supervisor, discuss the purpose and meaning of basic line pull signals in accordance with the US Navy Diving Manual.

### 4.30 FIU Working Diver

**Working Diver Qualification**

This qualification signifies that an FIU employee has successfully completed all requirements in Section 4.10, Section 4.20 and is authorized under FIU auspices, to engage in diving operations.

The Qualified Working Diver shall be designated in writing by the FIU Diving Safety Officer and may seek additional diver qualifications in accordance with the FIU Personnel Qualification System pursuant of “job” specific requirements.

FIU Working Divers pursuing additional “job” specific qualifications must dive under the supervision of another qualified diver designated by the Diving Supervisor or Diving Safety Officer.

**Commercial / Military Divers**

The scope of formal Commercial and Military Diver training is designed for the “Working Diver”, therefore, divers holding Commercial or Military Diver qualifications or certificate, meet the provisions for “Working Diver” training requirements as outlined in Section 4.10 and 4.20. A review of the driver’s training records shall be completed by the Diving Safety Officer for qualification purposes.

“Job” specific qualifications may not apply; Therefore, careful review of the diver’s record shall be completed by the FIU Diving Safety Officer before any credit is given for previous training and experience.

### 4.40 External (Non-FIU Employee) Diver Designation

The FIU diving programs (Scientific and Non-Scientific), often involve approved university compensated projects from external sources that require diving as a means to achieve the project objectives.

A mutually signed contract or agreement must exist between FIU and the external organization, company or entity.

Employees, volunteers and/or FIU approved personnel from external organizations, companies or entities shall comply with the following training requirements, standards, guidelines and restrictions prior to engaging in any project approved diving operations.

FIU qualified Diving Supervisors and Diving Safety Officer shall have sole authority and responsibility over the conduct of the project planned diving operations.
Scientific Diver

External organization, company, or entity scientific divers shall meet the minimum training requirements listed in the FIU Scientific Divers Safety Manual.

Mission / Project Support Diver

This diver designation is reserved for FIU approved external organization, company, or entity personnel participating in an approved project or diving operation that is outside the scope of the federal exemption for scientific dives.

These personnel are typically certified recreational divers. Recreational diver certification and training is not designed for the “Working Diver”, who is trained to perform underwater work consistent with commercial diving tasks for an employer. Therefore, they will NOT meet the minimum training standards to conduct underwater work consistent with commercial diving tasks at FIU.

FIU approved external organization, company, or entity personnel participating in an approved project or diving operation who do not hold a commercial diver certificate or military diver qualification, shall comply with the below standards, training requirements, and restrictions.

1. Training shall be for no more than (6) candidates and not less than 3 days
2. Candidates must possess a current CPR, First Aid and Oxygen Provider certification.
3. Complete Section 4.10
4. Complete the following “portions” of Section 4.20

Dive Equipment Familiarization

At the completion of training, the trainee must satisfy the Diving Safety Officer or the instructor of their ability to perform the following:

a) Demonstrate knowledge of the minimum dive equipment required for a working diver.
b) Demonstrate knowledge of and properly set up diving equipment.
c) Demonstrate knowledge of and proper use of a dive computer.
d) Demonstrate knowledge of and properly use an Air-2 regulator / octopus and power inflator.
e) Demonstrate knowledge of and proper use of a Buoyancy Compensating Device.

Dive Operations Familiarization

At the completion of training, the trainee must satisfy the Diving Safety Officer or the instructor of their ability to perform and have knowledge of the following:

a) Demonstrate knowledge of the minimum equipment required on dive station.
b) Demonstrate knowledge of and properly set up dive station.
c) Describe the basic elements of a “dive plan”.
d) Demonstrate familiarization of dive logs.
e) Demonstrate knowledge of the Dive Supervisors “Pre-Dive” Checklist.
f) Demonstrate knowledge of the minimum personnel requirements for SCUBA diving.
g) Demonstrate knowledge of maximum allowable depth for SCUBA diving.
h) Demonstrate knowledge of recompression chamber requirements.
i) Demonstrate knowledge of minimum psi requirements during a dive.

j) Describe the role of a Dive Supervisor.

k) Describe the role of a “Standby Diver”.

l) Demonstrate knowledge of and describe the purpose of a Reserve Valve.

m) Demonstrate knowledge of and describe the purpose of a “Bail-Out” cylinder.

n) Demonstrate knowledge of lost diver procedure

**Confined or Shallow Open Water Skills Assessment Dive (< 30 fsw)**

At the completion of training, the trainee must satisfy the Diving Safety Officer or the instructor of their ability to perform the following, at a minimum, in a pool or in shallow sheltered open water:

a) Enter and exit pool, open water, or exit and board a diving vessel, while wearing scuba gear.

b) Completely flood and clear a face mask.

c) Recover and clear second stage regulator.

d) Demonstrate understanding of underwater signs and signals.

e) Demonstrate the ability to properly operate a Reserve Valve.

f) Demonstrate buoyancy control which is acceptable to the instructor.

**Open Water Evaluation**

The trainee must satisfy the Diving Safety Officer or the instructor, of their ability to perform the following in open water:

a) Enter and exit open water from aboard a diving vessel, while wearing scuba gear.

b) Demonstrate air sharing, (on bottom) including both buddy breathing and the use of alternate air source, as both donor and recipient, with and without a face mask.

c) Rescue and transport, as a diver, a passive simulated victim of an accident to the surface and tow the victim to the vessel.

d) Demonstrate understanding of underwater signs and signals.

e) Demonstrate the ability to achieve and maintain neutral buoyancy while submerged.

f) Demonstrate basic underwater navigation using a compass.

g) Demonstrate the ability to use a bail out cylinder in a simulated loss of air scenario.

h) Demonstrate the ability to successfully complete a lost diver drill

**Site Orientation (Specific to Aquarius and Conch Reef)**

The trainee must satisfy the Diving Safety Officer or the instructor, of their basic familiarity with the following:

a) Demonstrate knowledge of the location of Aquarius Habitat.

b) Demonstrate basic knowledge of the interior of Aquarius Wet-Porch, and safety requirements.

c) Demonstrate the ability to navigate from their common work sites to the Aquarius Habitat.

d) Demonstrate actions to take when no decompression limits are exceeded and basic “omitted decompression” procedures.

**Line Pull Signals**

At the completion of training, the trainee must satisfy the Diving Safety Officer or the instructor of their ability to demonstrate knowledge of the following:
a) With a qualified Diving Supervisor, discuss the purpose and meaning of basic line pull signals in accordance with the US Navy Diving Manual.

Upon completion of Mission / Project Support Diver training, the individual may engage in approved project / mission diving operations with the following restrictions:

- Must dive with an FIU Qualified Working Diver or Mission / Project Support “Lead Diver”.
- All dives shall be shallower than 100 fsw.
- Mission / Project related tasks must be able to be accomplished using simple hand tools (e.g., small hammers, pliers, chisels, wrenches, cameras, measuring tapes, nets, collection jars).
- If moving of objects is to be conducted, objects shall weigh less than approximately 50 pounds underwater, must be easily managed by divers without the use of lift bags.
- The use of Diver Propulsion Vehicles (DPV) may be authorized for use at the discretion of the Diving Supervisor and FIU Diving Safety Officer. The use of DPV’s requires proof of training by an authorized training agency or completion of the DPV section in the FIU Personnel Qualification System.
- This designation shall remain valid for a (2) year period and Adult Cardio Pulmonary Resuscitation, Oxygen Administration and First Aid must remain current.
- If no “working dives” are conducted during this (2) year period under the supervision of a Qualified FIU Diving Supervisor, the individual must complete (1) evaluation dive with a Qualified FIU Diving Supervisor consisting of standard emergency procedures (buddy breathing, air sharing, rescue of a simulated unconscious diver, switching to reserve valve, use of bail out cylinder with controlled ascent, lost diver drill and use of compass) and review of administrative diving and safety policies.
- If no “working dives” have been conducted under the supervision of a Qualified FIU Diving Supervisor within the previous (5) years, the individual must re-qualify.

Mission / Project Support “Lead Diver”

This diver designation is reserved for FIU approved external organization, company or entity personnel participating in an approved project or diving operation who are Qualified Mission / Project Support Diver’s and have completed the following requirements:

1. Complete a minimum of 20 dives under the supervision of an FIU Qualified Working Diver or a Qualified Mission / Project Support Lead Diver, designated by an FIU Diving Supervisor or FIU Diving Safety Officer.
2. Complete (1) evaluation dive with a Qualified FIU Diving Supervisor consisting of standard emergency procedures (buddy breathing, air sharing, rescue of a simulated unconscious diver, switching to reserve valve, use of bail out cylinder with controlled ascent, lost diver drill and use of compass)
3. Demonstrate knowledge of basic “omitted decompression” procedures.
4. Demonstrate the ability to successfully complete an “omitted decompression” drill.
5. Complete an oral board with at-least (2) Qualified FIU Diving Supervisors

The Lead Diver is considered the most experienced diver on the dive team for that particular dive and specific task.
This designation is valid for a (2) year period from the last recorded dive as a lead diver. The same operational restrictions for Qualified Mission / Project Support Divers shall apply.

4.50 Depth Certifications

Depth Certifications and Progression to Next Depth Level

A diver diving under the auspices of Florida International University may progress to the next depth level after successfully completing the required dives for the next depth level. Under these circumstances, the diver may exceed their depth limit for qualification purposes. Qualification dives to the next depth level, shall be planned and executed under the supervision of an FIU qualified Working Diver or Lead Diver designated by the Dive Supervisor or Diving Safety Officer.

a) Certification to 100 Foot Depth - A diver holding a 60-foot qualification may qualify to a depth of 100 feet after successfully completing 4 dives to depths between 61 and 100 feet.

b) Certification to 130 Foot Depth - A diver holding a 100-foot qualification may qualify to a depth of 130 feet after successfully completing 4 dives to depths between 101 and 130 feet.

c) Certification beyond 130 feet – Diver’s requesting qualification deeper than 130 feet of seawater, shall submit a request to FIU Diving Safety Officer detailing the reasons for the certification. The DSO will then review the request and develop a specific qualification process and the diver must also demonstrate knowledge of the special problems of deep diving, and of special safety requirements.

4.60 Continuation of FIU Working Diver Qualification

Minimum Activity

During any 12-month period, each qualified Working Diver must log a minimum of 4 dives. Divers who fail to meet these requirements must re-qualify.

Diver Re-Qualification Requirements

Once the initial qualification requirements of Section 4.30 are met, divers whose dive certification has lapsed due to lack of activity may be re-qualified by completing the 4 dive requirement under the supervision of an FIU qualified Working Diver, who shall be assigned by the DSO or Dive Supervisor.

Medical Examination

All qualified FIU Working Divers shall maintain current medical examinations at the intervals specified in Section 2.00. After each major illness or injury, as described in Section 2.00, a diver shall receive clearance to return to diving from a physician before resuming diving activities.

Emergency Care Training

The qualified FIU Working Diver must remain current in the following:

- Adult CPR
- Emergency oxygen administration
- First aid or First aid for diving accidents
4.70 Revocation of Qualification or Designation

Violations of regulations set forth in this standard may be considered cause for revocation or restriction of an FIU’s Working Diver qualification by the Diving Safety Officer. The Diving Safety Officer shall inform the diver in writing of the reason(s) for revocation. The diver will be given the opportunity to present their case in writing for reconsideration and/or re-certification. All such written statements and requests, as identified in this section, are formal documents, which will become part of the diver’s file.

4.80 Re-Qualification after Revocation of Diving Privileges

If a diver’s qualification is revoked, they may be re-instated after complying with such conditions as the Diving Safety Officer may impose or when in compliance with this manual. The diver shall be given an opportunity to present their case before conditions for re-instatement are stipulated.

4.90 Guest Diver

Guest Divers are defined as persons who are not qualified FIU Working Divers, qualified Scientific Divers, Aquanauts or Mission/Project Support Divers and will participate as an observer diver in a university approved diving operation. The risk exposure for these dives is equivalent to that of shallow water recreational diving. As such, they are subject to the requirements presented in this section. The authorization to dive constitutes a waiver of requirements listed in Section 4.00, and is not intended to be construed as an “authorization” to make multiple dives unless specifically approved by the Diving Safety Officer and or Diving Supervisor under the following requirements:

- The visit must be related to Project Development, Education Outreach, Inspection/Certification of the Aquarius Habitat, Philanthropic Development, Media or Underwater Cinematography.
- An FIU visitor request form or service agreement must be submitted for approval.
- Evidence of diving certification from a recognized diver certifying organization (e.g., NAUI, PADI, commercial training, the military, etc.).
- Guest Divers must submit an FIU Divers Resume’ (Appendix-7).
- Guest Divers must submit a Participant Information Form (Appendix-8).
- Guest Divers must sign an FIU Release from Liability Waiver Form (Appendix - 9).
- Guest Divers must have Medical Insurance (DAN insurance is not sufficient).
- Shall only be authorized to use SCUBA during the approved dive.
- Guest Divers shall be briefed on the use of any equipment provided by FIU including, but not limited to, review of BCD-Regulator-Tank assembly, use of dive computer and use of bailout cylinder or reserve valve.
- All Guest Divers shall be escorted by FIU qualified Escort Divers (Escort Diver qualification standards are listed in the FIU Personnel Qualification Standards)
- Two escort divers are required to a maximum of six guest divers.
- Only six guest divers are allowed in the water at one time.
- The use of a descent / ascent line is recommended.
SECTION 5.00 DIVING REGULATIONS FOR SCUBA
(OPEN CIRCUIT, COMPRESSED AIR)

5.10 Introduction

No person shall engage in diving operations under the auspices of the FIU non-scientific diving program unless they hold a current certification issued pursuant to the provisions of this standard.

5.20 Pre-Dive Procedures

Dive Plans

Dives should be planned around the competency of the dive team members. Before conducting any diving operations, a dive plan should be formulated that should consider the following:

- Divers’ qualifications, and the type of certificate or certification held by each diver.
- Are any divers on the dive team under instruction for training purposes?
- An Emergency plan with the following information shall be available:
  1. Nearest operational decompression chamber.
  2. Nearest accessible hospital.
- Location(s) of proposed dives
- Estimated depth(s) anticipated.
- Decompression status and repetitive dive plans, if required.
- Proposed work, equipment, and boats to be employed.
- Any hazardous conditions anticipated.
- It is the diver’s responsibility and duty to refuse to dive if, in their judgment, conditions are unfavorable, or if they would be violating the precepts of their training, of this standard, or the FIU diving operations manual.

Equipment Evaluations

1. Divers shall ensure that their equipment is in proper working order and that the equipment is suitable for the type of diving operation.
2. Each diver shall have the capability of achieving and maintaining positive buoyancy.
3. Divers utilizing their personal equipment must submit proof of service within the past 12 months except depth gauges, which is required every 6 months.

Site Evaluation

1. Environmental conditions at the site will be evaluated, and operational risks identified.
2. Following site evaluation, additional risk mitigation steps and controls shall be implemented.

Diving Supervisor Responsibility

1. Shall complete a standardized pre-dive dive equipment function checklist prior to any dive team member entering the water.
2. No dive team member shall be required to be exposed to hyperbaric conditions against their will, except when necessary to prevent or treat a pressure-related injury.
3. Shall comply with current inclement weather policies.
4. Shall brief the Standby Diver of actions to take prior to entering the water in the case of an emergency.

5.30 Diving Procedures

Dive Location

The Dive Location is defined as a vessel or site from which diving operations originate.

Minimum Manning Levels

The following tables list the minimum personnel requirements for conducting SCUBA diving operations with and without line tending a diver. A buddy for the stand-by diver is required if the stand-by diver is not line tended.

<table>
<thead>
<tr>
<th>Position</th>
<th>Personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boat Operator/Diving Supervisor</td>
<td>1</td>
</tr>
<tr>
<td>Stand-by Diver (Line Tended)</td>
<td>1</td>
</tr>
<tr>
<td>Diver(s)</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
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<th>Personnel</th>
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<td>1</td>
</tr>
<tr>
<td>Diver (Line Tended)</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3</strong></td>
</tr>
</tbody>
</table>
**Diving Supervisor**

The Dive Supervisor is the Designated Person In-Charge and plans and conducts diving operations, briefs crew on tasks to be performed, supervises set-up / preparation of equipment and dive station, checks / verifies all components are functional and ready for use and ensures safety and emergency equipment is assembled and functional. The Dive Supervisor monitors and verifies the completion of dive logs.

Dive Supervisor shall supervise all diving operations and shall have operational authority and responsibility for all diving activities. The Dive Supervisor’s authority shall include, but is not limited to, any decisions regarding operational diving procedures, proper equipment, individual diver fitness, and diving tasks.

Dive Supervisor must remain at the “Dive Location” during all diving operations unless relieved by another designated Diving Supervisor, and is responsible for taking appropriate action in the event of a potentially dangerous situation.

For vessel operations including operational weather/ocean related judgments:

- The Dive Supervisor has authority to permit or forbid the start, and to order the termination of, any diving operations on grounds of diving safety. He or she also has authority to establish the manner in which diving operations are conducted including emergency response actions.
- The Captain has the authority to terminate any diving operations he/she feels is unsafe or unwise when the vessel poses a potential risk to personnel. The Captain has ultimate authority to assess and decide on courses of action regarding the vessel. The Captain has authority over the Diving Supervisor in regards to vessel operations when the Captain determines that safety of life and property is concerned.
- The authorities of the Captain and Dive Supervisor are of fundamental importance during an emergency. They should cooperate closely regarding the protection of life and property.
- Both the vessel Captain and Diving Supervisor will adhere to current FIU inclement weather policies that govern FIU diving and boating operations.

**Standby Diver**

The Stand-by Diver provides diving support in the case of a diver emergency. It is the Standby Diver’s responsibility to understand the dive plan, underwater tasks and any potential hazards or dangers, which might be encountered. The standby diver is the individual possessing the required training and experience to enter the water at the dive location in order to render assistance to a stricken diver. While acting as a standby diver, the diver shall:

a) Have his or her SCUBA equipment ready to don within 60 seconds, when directed by the Dive Supervisor. The standby diver shall remain in the immediate vicinity of the diver water entry location and be ready to enter the water when directed by the Dive Supervisor.

b) Remain at the location throughout the entire dive, to include all in-water decompression.

c) Constantly remain abreast of events during the dive.
d) The Standby Diver must be line tended if a dive buddy is not assigned to the Standby Diver.
e) Two standby divers are required if the in water divers’ dive location is beyond the reach of the tending line.

**Lead Diver Designation (FIU Working Divers)**

For each dive, one individual shall serve as the Lead Diver. The Lead Diver is considered the most experienced diver on the dive team for that particular dive and specific task. The Lead Diver shall be responsible for:

- Ensuring the safe conduct of the dive during the in water phase.
- Briefing buddy team members on:
  a) Dive objectives.
  b) Unusual hazards or environmental conditions likely to affect the safety of the diving operation.
  c) Modifications to diving or emergency procedures necessitated by the specific diving operation.
- Suspending diving operations if in their opinion conditions are not safe.
- Reporting any physical problems or adverse physiological effects including symptoms of pressure-related injuries.

**Buddy Teams**

With the exception of Line Tended Diving, SCUBA divers are required to maintain buddy contact throughout the dive. Each diver in the buddy team shall be familiar with their buddy’s equipment, shall monitor their buddy throughout the dive, and shall provide assistance in the event the buddy shows signs of difficulty or distress. The guidelines for effective buddy contact include staying in visual contact or within 40 feet of each other (*whichever is closest*), maintaining effective communication and being in a position to render assistance if necessary. In situations of limited or low visibility, when visual contact may be difficult or impossible, the dive team is required to maintain physical contact or use a buddy line. A buddy team may consist of more than two divers.

**Depth and Bottom Times**

The depth and no decompression bottom time standards listed in dive tables approved for use (US Navy Diving Tables) or indicated by dive computers are considered maximum limits. The Dive Supervisor on location may choose to further limit depth and bottom time based on sea conditions, personnel experience and training level, or other operational considerations.

**Air Diving Tables and Dive Computers**

For no-decompression (‘no-stop’) diving, dive computers may be utilized in place of dive tables for dive management by using the following guidelines:

- Each diver relying on a dive computer to plan dives and indicate or determine decompression status must have his or her own unit.
• On any given dive, both divers in the buddy pair must follow the most conservative dive computer.
• If the dive computer fails at any time during the dive, the dive must be terminated immediately. In this case, the diver shall not make a repetitive dive on air for 12 hours and a repetitive NITROX dive for 18 hours using a computer.
• When a dive computer has failed after a dive and the divers dive profile has been documented; a repetitive dive may be planned using US Navy repetitive dive procedures.
• Once the dive computer is in use, it must not be switched off or batteries removed until it indicates complete off gassing has occurred.
• When using a dive computer, non-emergency ascents are to be at a rate specified for the make and model of dive computer being used. Variable ascent rates programmed for dive computers shall not be exceeded during a dive.
• Multiple, deep dives require special consideration.
• Dive tables shall be available at the dive site and dive start and finish times as well as maximum depth shall be recorded in the log.

*(Only US Navy dive tables are authorized for use)*

*Decompression Diving*

Although rarely conducted, decompression diving in SCUBA is authorized by this manual. Decompression diving shall be conducted with a multi-lock, multi-place chamber on site and personnel qualified in recompression chamber operations shall be at the dive location. Personnel participating in decompression diving shall be trained and qualified in the techniques being utilized.

*Line Tended Diving*

Solo diving is strictly prohibited unless the diver is line tended as per the requirements of this section. The requirement for a buddy or line tending applies to SCUBA standby divers as well.

Line tended diving activities shall meet the following criteria:

• Tending lines shall not be longer than 200 feet in length.
• Standby divers tending line is required to be 50 feet longer than the tended diver.
• A minimum of one tender will line tend the diver.
• The tender shall be familiar with line pull signals.
• When diving in currents in excess of 1 knot.

*Entering and Leaving the Water*

There shall be a safe means for entering or leaving the water from the diving platform, such as a ladder, stage or other appropriate device such as a swim platform. If a ladder is used, this device shall extend a minimum of 3 feet below the water surface. Additionally, the means of entering and leaving the water shall be adequate to facilitate rescue of personnel.

*Live Boating*

Live boating is the practice of supporting (2) or more divers in the water from a vessel which is underway.
The vessel Captain and Dive Supervisor cannot be one in the same.

The divers progress must be monitored from the vessel via bubble watching at a minimum.

The vessel propellers must be in the neutral position when divers are entering and exiting the water, or are in close proximity to the vessel.

When live boating, a standby diver buddy team is required.

Recompression Chamber Requirements

For No Decompression Dives deeper than 130 fsw and Decompression Dives, a dual lock decompression chamber having a minimum capability of 6 ATA (equivalent to 165 fsw) shall be available and ready for use at the dive location. When a recompression chamber is required at the dive location, the following table defines the personnel requirements:

<table>
<thead>
<tr>
<th>Position</th>
<th>Personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chamber Supervisor</td>
<td>1 (Required)</td>
</tr>
<tr>
<td>Inside Tender or DMT</td>
<td>1 (Required)</td>
</tr>
<tr>
<td>Operator</td>
<td>1 (Optional)</td>
</tr>
<tr>
<td>Communications / Logs</td>
<td>1 (Optional)</td>
</tr>
<tr>
<td>Diving Physician</td>
<td>1 (Available by phone)</td>
</tr>
</tbody>
</table>

Recompression Chamber support personnel shall be qualified in accordance with FIU PQS or certified in the treatment of diving related injuries and recompression chamber operations.

Safety

The ultimate responsibility for safety rests with the individual diver. It is the diver’s responsibility and duty to refuse to dive if, in their judgment, conditions are unsafe or unfavorable, or if they would be violating the precepts of their training or the regulations in this standard.

Refusal to Dive

The decision to dive is that of the diver. A diver may refuse to dive, without fear of penalty, whenever they feel it is unsafe for them to make the dive.
Termination of the Dive

It is the responsibility of the diver to terminate the dive, without fear of penalty, whenever they feel it is unsafe to continue the dive, unless it compromises the safety of another diver already in the water. The dive shall be terminated while there is still sufficient cylinder pressure to permit the diver to safely reach the surface, including decompression time, or to safely reach a safety stop. All divers shall reach their safety stop or the surface with a minimum of 500 psi.

Emergencies and Deviations from Regulations

Any diver may deviate from the requirements of this standard to the extent necessary to prevent or minimize a situation that is likely to cause death, serious physical harm, or major environmental damage. A written report of such actions must be submitted to the Diving Safety Officer explaining the circumstances and justifications.

Maximum Number of Divers

The maximum number of divers allowed in the water at any given time, shall be determined by the Dive Supervisor, based on the tasking, diver experience and qualifications.

5.40 Post-Dive Procedures

Post-Dive Safety Checks

After the completion of a dive, each diver shall report any physical problems, symptoms of decompression sickness, or equipment malfunctions.

When diving outside the no-decompression limits, the divers should remain awake for at least 1 hour after diving, and in the company of a dive team member who is prepared to transport them to a decompression chamber if necessary.

5.50 Emergency Procedures

There shall be written and standard emergency procedures which follow the standards of care for diving related injuries which include procedures for emergency care, recompression and evacuation. (Appendix 4 and Appendix 5).

5.60 Flying after Diving or Ascending to Altitude (Over 1000 feet)

Following a Decompression Dive: Divers should have a 24-hour minimum preflight surface interval.

Following a No-Decompressing Dive: A 24-hour preflight surface interval is recommended, however the US Navy Altitude tables may be used to determine minimum preflight surface interval.

5.70 Record Keeping Requirements

Diving Log

All dives shall be logged by the Diving Supervisor or his/her appointed designee, to be reviewed, and filed. Each diver is encouraged to maintain a personal log with entries for all dives. The Diving Log includes the following:

- Name of diver, buddy, and Diving supervisor
• Date, time, and location
• Breathing gas used
• Approximate surface and underwater conditions, if applicable
• Maximum depth, bottom time and surface interval time

Required Incident Reporting

All non-diving injuries requiring treatment or diving incidents requiring recompression treatment, or resulting in moderate or serious injury, or death shall be reported to Environmental Health and Safety Office at FIU. The report will specify the circumstances of the incident and the extent of any injuries or illnesses.

Additional information must meet the following reporting requirements:

• Document and report occupational injuries and illnesses.
• If pressure-related injuries are suspected, or if symptoms are evident, the following additional information shall be recorded and retained, with the record of the dive, for a period of 5 years:
  2. Written descriptive report to include:
     • Name, address, phone numbers of the principal parties involved.
     • Summary of experience of divers involved.
     • Location, description of dive site, and description of conditions that led up to incident.
     • Description of symptoms, including depth and time of onset.
     • Description and results of treatment.
     • Disposition of case.
     • Recommendations to avoid repetition of incident.
SECTION 6.00 SCUBA DIVING EQUIPMENT

6.10 General Policy

All equipment shall meet standards as determined by the manufacturer and these standards. All equipment shall be regularly examined by the person using the equipment and serviced according to manufacturer specifications by qualified personnel. Equipment that is subjected to extreme usage under adverse conditions should require more frequent testing and maintenance.

6.20 Equipment

Regulators

- SCUBA regulators shall be inspected and tested prior to first use each diving day and serviced in accordance with manufacturer’s specifications or every 12 months, which occurs first.
- Regulators will consist of a primary second stage and an alternate air source (such as an octopus).

Reserve Breathing Gas Supply

- Each diver will carry a backup air supply. This normally takes the form of an independent SCUBA cylinder and regulator system (Bailout) OR Reserve Valve. For dives deeper than 100 fsw, a 100 cuft cylinder and bailout cylinder is required. The bailout cylinder must be of sufficient capacity to permit the diver to return to the surface at the ascent rate stated by the table or computer controlling the dive.
- Bailout cylinders must contain a minimum of 2500 psi prior to the dive.
- Guest divers are not required to carry a reserve gas supply as they are escorted divers.
- SCUBA cylinders shall be designed, constructed, and maintained in accordance with the applicable provisions of the Unfired Pressure Vessel Safety Orders.
- SCUBA cylinders must be hydrostatically tested in accordance with DOT standards (Every 5 years).
- SCUBA cylinders must have an internal and external inspection at intervals not to exceed 12 months.
- SCUBA cylinder valves shall be functionally tested at intervals not to exceed 12 months or in accordance with manufacturer’s recommendations whichever occurs first.

Timing Devices, Depth, and Pressure Gauges

- All members of the dive team must have an approved depth indicator gauge (Analog or Computer) and a submersible pressure gauge (SPG). All members of the dive team must have an underwater timing device.
- Depth Gauges shall be inspected and calibration checked every 6 months.
**Buoyancy Compensation Devises**

- Each diver shall have the capability of achieving and maintaining positive buoyancy. A buoyancy compensation device (BCD) must be capable of inflation by two separate sources, and have an automatic and manually operated exhaust valve.

- Weight integrated BCDs shall have one-handed weight quick release mechanisms. Dry suits or other variable volume BCDs shall be equipped with an exhaust valve. BCDs shall not be used to assist with lifting or moving heavy objects.

- These devices shall be functionally inspected and tested at intervals not to exceed 12 months or in accordance with manufacturer’s specifications whichever occurs first.

**Determination of Decompression Status: Dive Tables, Dive Computers**

- A set of US Navy No Decompression tables, must be available at the dive location.

- Dive computers may be utilized in place of diving tables.

**6.30 Additional Equipment**

- Face Mask – Required
- Full-Face Breathing Masks (FFM) – Optional. Training or proof of training is required for use of full-face masks. When diving a FFM a spare mask is required.

- Snorkel - Optional
- Fins - Required
- Knife - Required
- Dive Lights - Required for night dives (1 per diver)
- Compass – Optional. The use of an underwater compass is recommended for all divers for general navigation and orientation during the dive.

**6.40 Support Equipment**

**First aid supplies**

- A first aid kit approved by a physician, and emergency oxygen shall be available at the dive location.

- An Automated External Defibrillator (AED) shall be available at the dive location
  a) Personnel required to use AED’s shall be trained in the use of AED’s

**Diver Recall Device**

A device capable of recalling the divers by means of either ‘through water’ voice communications or by repetitive tones, shall be available at the dive location.

**Diver Flag**

A (1) Meter Code “A” (alpha) and a sport diver’s flag shall be displayed prominently on the dive support vessel whenever diving is conducted. For saturation operations, the dive flags shall be displayed on the Life Support Buoy.
SECTION 7.00 NITROX DIVING GUIDELINES

The following guidelines address the use of nitrox under the auspices of Florida International University. NITROX is defined for these guidelines as breathing mixtures composed predominately of nitrogen and oxygen, most commonly produced by the addition of oxygen or the removal of nitrogen from air.

7.10 Prerequisites

Eligibility

Only divers certified or trained in the use of NITROX mixtures are eligible or authorized to use NITROX. After completion, review and acceptance of application materials, training and qualification, an applicant will be authorized to use NITROX within their depth authorization, as specified in Section 4.50.

7.20 Requirements for Authorization to Use Nitrox

Submission of documents and participation in aptitude examinations does not automatically result in authorization to use nitrox. After completion of training and evaluation, authorization to use NITROX may be denied to any diver who does not demonstrate to the satisfaction of the Diving Safety Officer, Dive Supervisor or Instructor, the appropriate judgment or proficiency to ensure the safety of the diver and dive buddy.

Minimum Activity to Maintain Authorization

The diver should log at least one NITROX dive every 12 months. Failure to meet the minimum activity level may be cause for restriction or revocation of nitrox authorization.

Any diver who fails to meet this requirement may complete the required (1) dive using NITROX, with a qualified FIU Working Diver designated by the Diving Safety Officer or Dive Supervisor.

7.30 Nitrox Training Guidelines

Divers requiring training in the use of NITROX, shall meet the following guidelines, in addition to meeting the training requirements in Section 3.00 and Section 4.00.

Classroom Instruction

Topics should include, but are not limited to: review of previous training; physical gas laws pertaining to NITROX; partial pressure calculations and limits; oxygen physiology and oxygen toxicity; calculation of oxygen exposure and maximum safe operating depth (MOD); determination of decompression schedules using approved NITROX dive tables; dive planning and emergency procedures; mixing procedures and calculations; gas analysis; personnel requirements; equipment marking and maintenance requirements; dive station requirements.

Practical Training

The practical training portion will consist of a review of skills as stated for SCUBA (Section 4.20), with additional training as follows:
• Oxygen analysis of NITROX mixtures.
• Determination of MOD, oxygen partial pressure exposure, and oxygen toxicity time limits, for various NITROX mixtures at various depths.
• Demonstrate ability to use NITROX dive tables.
• Use of Nitrox dive computers.

**Written Examination (based on classroom instruction and practical training)**

Before authorization, the trainee should successfully pass a written examination demonstrating knowledge of at least the following:

- Function, care, use, and maintenance of equipment cleaned for NITROX use.
- Physical and physiological considerations of NITROX diving (ex.: \(O_2\) and \(CO_2\) toxicity).
- Diving regulations and procedures as related to NITROX diving, either scuba or surface supplied (depending on intended mode).
- Given the proper information, calculation of:
  1. \(pO_2\) exposure for a given \(fO_2\) and depth;
  2. Optimal NITROX mixture for a given \(pO_2\) exposure limit and planned depth;
  3. Maximum operational depth (MOD) for a given mix and \(pO_2\) exposure limit;
  4. For NITROX production purposes, percentages/psi of oxygen present in a given mixture, and psi of each gas required to produce a \(fO_2\) by partial pressure mixing.
- Dive table and dive computer selection and usage.
- NITROX production methods and considerations.
- Oxygen analysis.
- NITROX operational guidelines (Section 7.40).

**Open water Dives**

A minimum of (1) open water dive using NITROX is required for authorization. The mode used in the dives should correspond to the intended application (i.e., SCUBA or Surface-Supplied). If the MOD for the mix being used can be exceeded at the training location, direct, in-water supervision is required.

For the purposes of evaluation, training or qualification, an FIU qualified NITROX diver shall be assigned by the Diving Safety Officer or Dive Supervisor to dive with the trainee.

**Surface-Supplied Training using NITROX**

All training as applied to surface-supplied diving (practical, classroom, and open water) shall comply with this manual’s surface-supplied diving standards listed in **Section 8.00**.
7.40 NITROX Diving Regulations

Dive Personnel Requirements

- Nitrox Diver In-Training - A Diver In-Training, who has completed the requirements of Section 3.00 and Section 4.00 and the authorization requirements in Section 7.10 and 7.20 of these guidelines, may be authorized to use nitrox under the direct supervision of a NITROX Instructor.

- FIU Working Diver/Authorized to use NITROX – An FIU Working Diver authorized to use NITROX is one who has completed the requirements of Section 4.00 and the training and authorization in Section 7.00 of these guidelines, or is certified to use NITROX or mixed gases through an internationally recognized recreational NITROX, Commercial or Military diver certifying agency. Depth authorization to use NITROX should be the same as those specified in the diver’s authorization, as described in Section. 4.50.

- Dive Supervisor - In addition to the responsibilities listed in Section 5.30, the Dive Supervisor shall be qualified in accordance with FIU-PQS-001 to supervise NITROX Diving Operations.

- Stand-By Diver - In addition to the responsibilities listed in Section 5.30, the Dive Supervisor may elect to use air as a breathing media for Standby Diver during NITROX diving operations. In this case, the Dive Supervisor must take depth and bottom time requirements into account.

- Lead Diver (FIU Working Diver) - On any dive during which NITROX will be used, the Lead Diver shall be qualified to use NITROX, and hold the appropriate qualifications or training in order to accomplish the in water tasks.

In addition to responsibilities listed in Section 5.30, the Lead Diver should:

1. As part of the dive planning process, verify that all divers using NITROX on a dive are properly qualified.

2. As part of the pre-dive procedures, confirm with each diver the NITROX mixture the diver is using, and establish dive team maximum depth and time limits, according to the shortest time limit or shallowest depth limit among the team members.

Dive Parameters

Oxygen Exposure Limits

- The inspired oxygen partial pressure experienced at depth should not exceed 1.4 ATA.

- The maximum allowable exposure limit should be reduced in cases where cold or strenuous dive conditions, or extended exposure times are expected. The Dive Supervisor should also review on-site conditions and reduce the allowable pO₂ exposure limits if conditions indicate.

Bottom Time Limits

- Maximum bottom time should be based on the depth of the dive and the NITROX mixture being used.
• Bottom time for a single dive should not exceed the NOAA maximum allowable “Single Exposure Limit” for a given oxygen partial pressure, as listed in the current NOAA Diving Manual.

Dive Tables and Gases

• Only USN equivalent air depth (EAD) tables are authorized for use, and shall be available at the dive location.
• A dive team using air and NITROX as breathing media should be avoided unless approved by the Diving Safety Officer or Dive Supervisor.
• Air may be used as a breathing media for a reserve gas supply (Bailout Cylinder).

Nitrox Dive Computers

• Dive computers may be used to compute decompression status during NITROX dives. Manufacturers’ guidelines and operations instructions should be followed.
• Use of NITROX dive computers should comply with this manual’s dive computer guideline.
• NITROX dive computer users should demonstrate a clear understanding of the display, operations, and manipulation of the unit being used for NITROX diving prior to using the computer.
• Dive computers capable of pO₂ limit and fO₂ adjustment should be checked by the diver prior to the start each dive to assure compatibility with the mix being used.

Repetitive Diving

• Repetitive dives using NITROX mixtures should be performed in compliance with procedures required of the specific dive tables or computers used.
• The total cumulative exposure (bottom time) to a partial pressure of oxygen in a given 24-hour period should not exceed the current NOAA Diving Manual 24-hour Oxygen Partial Pressure Limits for “Normal” Exposures.
• When repetitive dives expose divers to different oxygen partial pressures from dive to dive, divers should account for accumulated oxygen exposure from previous dives when determining acceptable exposures for repetitive dives. Both acute (CNS) and chronic (pulmonary) oxygen toxicity concerns should be addressed.

Oxygen Parameters

• Authorized Mixtures - Mixtures meeting the criteria outlined in Section 7.40 may be used for NITROX diving operations, upon approval of the DCB.
• Purity - Oxygen used for mixing NITROX-breathing gas should meet the purity levels for “Medical Grade” (U.S.P.) or “Aviator Grade” standards.
Gas Mixing and Analysis

**Personnel Requirements**

a) Individuals responsible for producing and/or analyzing NITROX mixtures should be knowledgeable and experienced in all aspects of the technique.

b) Only those individuals qualified should be responsible for mixing and/or analyzing NITROX mixtures.

**Analysis Verification by User**

a) It is the responsibility of each diver to analyze the oxygen content of his/her SCUBA cylinder, each diving day, prior to each dive, and acknowledge in writing the following information for each cylinder: fO\textsubscript{2}, MOD, cylinder pressure, date of analysis, and user’s name.

b) The analyzer must be first calibrated to 20.9% or 21% prior to analyzation of the NITROX breathing mixture.

c) Individual dive log reporting forms should report fO\textsubscript{2} of NITROX used, if different than 21%.

d) Oxygen content shall be within +/- 1%.

**7.50 Nitrox Diving Equipment**

All of the designated equipment and stated requirements regarding SCUBA equipment required in Section 6.00 shall apply to NITROX SCUBA operations. Additional minimal equipment necessary for NITROX diving operations includes:

- Labeled SCUBA Cylinders
- Oxygen Analyzers

**Oxygen Cleaning and Maintenance Requirements**

Requirement for Oxygen Service

a) All equipment, which during the dive or cylinder filling process is exposed to concentrations greater than 40% oxygen at pressures above 150 psi, should be cleaned and maintained for oxygen service.

b) Equipment used with oxygen or mixtures containing over 40% by volume oxygen shall be designed and maintained for oxygen service. Oxygen systems over 125 psig shall have slow opening shut-off valves.

c) This should include the following equipment: SCUBA cylinders, cylinder valves, SCUBA and other regulators, cylinder pressure gauges, hoses, diver support equipment, compressors, and fill station components and plumbing.

**SCUBA Cylinder Identification Marking**
SCUBA cylinders to be used with NITROX mixtures should have the following identification documentation affixed to the cylinder.

a) Cylinders should be marked “NITROX”, or “EANx”, or “Enriched Air”.

b) Other markings, which identify the cylinder as containing gas mixes other than Air, may be used. A contents label should be affixed, to include the current fO\textsubscript{2}, date of analysis, and MOD.

c) The cylinder should be labeled to indicate whether the cylinder is prepared for oxygen or NITROX mixtures containing greater than 40% oxygen.

**Regulators**

Regulators to be used with NITROX mixtures containing greater than 40% oxygen should be cleaned and maintained for oxygen service, and marked in an identifying manner.

**Reserve Breathing Gas Supply**

- Each diver will carry a backup air supply. This normally takes the form of an independent SCUBA cylinder and regulator system OR Reserve Valve. For dives deeper than 100 fsw, a 100 cuft cylinder and bailout cylinder is required. The bailout cylinder must be of sufficient capacity to permit the diver to return to the surface at the ascent rate stated by the table or computer controlling the dive.
  
- The bailout cylinder may contain air as a breathing media.
  
- Bailout cylinders must contain a minimum of 2500 psi prior to the dive.

**Other Support Equipment**

a) An oxygen analyzer is required which is capable of determining the oxygen content in the SCUBA cylinder. Two analyzers are recommended to reduce the likelihood of errors due to a faulty analyzer. The analyzer should be capable of reading a scale of 0 to 100% oxygen, within 1% accuracy.

b) All diver and support equipment should be suitable for the fO\textsubscript{2} being used.

**Compressor system**

a) Compressor/filtration system must produce oil-free air.

b) An oil-lubricated compressor placed in service for a NITROX system should be checked for oil and hydrocarbon contamination every six months.

**Fill Station Components**

All components of a NITROX fill station that will contact NITROX mixtures containing greater than 40% oxygen should be cleaned and maintained for oxygen service. This includes cylinders, whips, gauges, valves, and connecting lines.

**Recompression Chamber Requirements**

When diving NITROX recompression chamber requirements shall comply with **Section 5.30**.
8.00 Surface Supplied Diving Operations

8.10 General Policy

The following training, performance guidelines and diving procedures address the use of Surface Supplied Diving (SSD) Techniques under the auspices of Florida International University. These standards represent the minimum required level of knowledge and skills presented in a generalized format. Specific guidelines for minimum diver training requirements are outlined in the Florida International University Personnel Qualification Standards.

8.20 Prerequisites

Eligibility

Only FIU qualified divers or FIU authorized divers trained in Surface Supplied Diving are eligible or authorized to use Surface Supplied Diving Equipment and Techniques. After completion or review and acceptance of application materials, training and qualification, an applicant will be authorized to use Surface Supplied Diving Equipment and Techniques within their depth authorization.

Mission / Project Support Divers must meet the requirements listed in Section 4.10 and the following portions of Section 4.20 (Dive Equipment Familiarization, Diving Operations Familiarization and Confined or Shallow Open Water Skills Assessment Dive <30 fsw) prior to the commencement of SSD training.

8.30 Requirements for Authorization to use Surface Supplied Diving Equipment

Submission of documents and participation in aptitude examinations does not automatically result in authorization to dive Surface Supplied Diving Equipment. The applicant must convince the Diving Safety Officer or Instructor, that they are proficient in the use of Surface Supplied Diving Equipment. After completion of training and evaluation, authorization to use Surface Supplied Diving Equipment and Techniques may be denied to any diver who does not demonstrate to the satisfaction of the Diving Safety Officer or Instructor, the appropriate judgment or proficiency to ensure the safety of the diver and dive buddy.

Minimum Activity to Maintain Authorization

The diver should log at least one Surface Supplied dive every 12 months. Failure to meet the minimum activity level may be cause for restriction or revocation of authorization.

Any diver who fails to meet this requirement may complete the required (1) dive using Surface Supplied Diving Equipment, with a qualified FIU diver designated by the Diving Safety Officer or Dive Supervisor.

8.40 Surface Supplied Diving Training Guidelines

Divers requiring training in the use of Surface Supplied Diving Equipment and Techniques, shall meet the following guidelines, in addition to meeting the training requirements for FIU Working Diver authorization in Section 3.00 and Section 4.00.

Divers trained at Florida International University to dive Surface Supplied Diving Equipment as
“FIU Working Divers” or other designation are only authorized to dive under the auspices of the University’s diving program.

**Classroom Instruction (8 Hours)**

The classroom instruction is intended to impart knowledge of the different types of diving Helmets and Band Masks and expose the trainees to the safe operation, diving procedures and emergency procedures used with “Surface Supplied” diving equipment.

Topics should include, but not be limited to: General description and operation of diving Helmets and Band Mask, dive consoles, minimum manifold pressure requirements, bail-out systems, diver vests and harnesses and diver umbilical assembly. Emergency procedure for flooding, breathing resistance, free flowing regulator and for loss of communications. Diver dressing and tending procedures, basic maintenance requirements, minimum manning levels, dive station requirements, diving regulations, line pull signals, pre and post dive procedures.

**Practical Training (24 Hours)**

The trainee must be able to demonstrate knowledge and competency in the following areas:

- Dive Station Requirements
- Pre and Post Dive Procedures
- Dive Console Operation
- Diver Communication System
- Diver Dressing and Tending Procedures
- Emergency Procedures
- Line Pull Signals
- Safely Enter and Exit the Water *(dressed out in full gear)*

**Written Examination (based on classroom instruction and practical training)**

Before authorization, the trainee should successfully pass a written examination demonstrating knowledge of at least the following:

- Dive Station Requirements
- Pre - Dive Procedures
- Dive Console Operation
- Minimum Manifold Pressure requirements
- Diver Dressing and Tending Procedures
- Emergency Procedures
- Line Pull Signals
- Diving Regulations
Training Dives

A minimum of (3) dives using Surface Supplied Diving Equipment is required for authorization. For the purposes of evaluation, training or qualification, (1) Aquarius Reef Base staff qualified diver shall be assigned by the Diving Safety Officer or Dive Supervisor to dive with the trainee on the first dive.

8.50 Surface Supply Diving Regulations

Dive Personnel Requirements

- **Diver In-Training (SSD)** - A Diver In-Training, who has completed the requirements of Section 3.00 and Section 4.00 may be authorized to use SSD equipment under direct supervision while in training.

- **FIU Working Diver/Authorized to use SSD** – An FIU Working Diver who has completed the requirements of Section 4.00 and the training and authorization in Section 8.00 of these guidelines, or is certified to use SSD equipment through a Commercial or Military Diver certifying agency. Depth authorization to use SSD equipment should be the same as those specified in the diver’s authorization, as described in Section 4.50.

- **Dive Supervisor** - A Dive Supervisor shall be designated for each diving operation. The diving supervisor is in charge of the planning and execution of the diving operation, including the responsibility for the safety and health of the dive team. The diving supervisor shall be qualified in accordance with the FIU-PQS-001 standards and shall be knowledgeable and familiar with all techniques, procedures, emergency procedures and operational parameters for the diving mode under his or her direct supervision. The diving supervisor must consider whether the use of any surface-tended equipment by the diver will require an additional individual to tend associated cables or hoses. This includes hand jetting, water blasting, cutting and welding, the use of any pneumatic or hydraulically operated tool, or the use of underwater video or sonar equipment requiring a power or data cable not affixed to the diver’s umbilical.

- **Diver** - Must have training and/or experience with diving procedures and techniques, emergency procedures, proper operation and use of SSD equipment being used.

- **Stand-By Diver** - In addition to the responsibilities listed in Section 5.30, the Standby Diver must be qualified in SSD. The standby diver is the individual possessing the required training and experience to enter the water at the diving station in order to render assistance to a stricken diver.

While acting as a standby diver, the diver shall:

a. Have his or her diving helmet or mask attached to the standby diver’s umbilical in a wrench-tight status and then check for proper flow of breathing medium and for adequate communications. The diving helmet or mask shall be ready to be donned by the standby diver when directed by the diving supervisor. The standby diver shall remain in the immediate vicinity of the diver water entry location and be ready to enter the water when directed by the diving supervisor.

b. Remain at the station throughout the entire dive, to include all in-water decompression.

c. Constantly remain abreast of events of the dive.
d. Not be assigned any tasks that might interfere with duties as a standby diver while there is a diver in the water.

- **Tender** - The Tender assists the diver in and out of diving equipment and tends the diver from the surface (taking in or paying out umbilical). The Tender informs the Supervisor when the diver is dressed, inspected, and ready to enter water and transmits and receives signals via the diver umbilical. The Tender is responsible for the set up and operation of all equipment as directed by the on-site Dive Supervisor. The Tender inspects and tests equipment for proper operation prior to dressing the diver. The Tender also assists with topside work for diving and vessel operations.

- **Console Operator/Communications** - The Console Operator controls the supply of gas to the diver and is primarily responsible for communications with the diver. The Console Operator monitors and maintains correct supply gas pressure for depth and breathing equipment and continually monitors the diver(s)’ depth. The Console Operator is responsible for ensuring that the proper gases are in adequate quantities and available for safe diving and emergency needs. The Console Operator (if assigned) also maintains voice communications with diver(s) and relays information to the Diving Supervisor while maintaining accurate/complete data for the dive log for each dive.

### Minimum manning requirements for surface-supplied air diving operations

<table>
<thead>
<tr>
<th>Position</th>
<th>Personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSD Supervisor</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>(Required)</td>
</tr>
<tr>
<td>Diver</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>(Required)</td>
</tr>
<tr>
<td>Standby Diver</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>(Required)</td>
</tr>
<tr>
<td>Tender</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>(Required)</td>
</tr>
</tbody>
</table>

The minimum number of personnel comprising a dive team is never less than three and each member may have multiple assignments; however, planning must take into consideration not only the direct requirements of the work to be performed, but also additional factors either known or suspected that may lead to complications during the conduct of the intended operation. A dive team comprised of three persons that may be adequate during one diving operation, does not mean the same number of persons will be sufficient to accommodate the requirements of another diving operation.

**Operational Guidelines**

1. The approximate depth of each dive shall be determined prior to the start of operations.
2. The breathing mixture supplied to the diver must be composed of a mixture of gasses that is appropriate for the depth of the dive. When using mixed gas or enriched air, all gasses must be analyzed for \( O^2 \) content and for proper mixture necessary to support the maximum depth of the planned dive.

3. Each diver shall be continuously tended while in the water by a separate dive team member.

4. Each diving operation shall have a primary breathing gas supply sufficient to support all divers for the duration of the planned dive, including decompression.

5. Each diving operation shall have a secondary breathing gas supply.

6. A diver-worn or carried emergency gas supply (EGS) is required on all dives.

7. If no decompression chamber is on site, the nearest manned operational chamber should be known, and an evacuation plan should be in place.

**Minimum Equipment Requirements**

- A primary and secondary air source of adequate volume to support the maximum number of divers and standby diver to include decompression.

- Umbilical’s shall consist of:
  1. An air hose.
  2. Strength member/strain relief. (*The strength member may be the entire hose assembly, if so designed.*)
  3. Communications cable (*Can be combination strength member and communications cable if so designed*)
  4. Pneumo-fathometer hose.
  5. One control station consisting of:
     - Communication systems.
     - Depth gauges and gas distribution system with the capability to supply and control two divers at the maximum work depth.
     - Two time-keeping devices.

6. Helmet or mask.

7. Diver-worn EGS.

8. Weight belt if needed.

9. Diver worn Safety harness or approved vest.


11. Dive Lights - Required for night dives (1 per diver)

**Reserve Breathing Gas Supply (EGS)**

Each diver will carry a backup air supply on all dives regardless of depth. This normally takes the form of an independent SCUBA cylinder. The diver-worn or carried emergency gas supply shall be of sufficient duration for use until the diver can reach the surface or the first decompression stop from the maximum depth of the dive; can reach another source of breathing media; or can be reached by the standby diver equipped with another source of breathing media.
• A minimum of 40 cuft cylinder is required to 80 fsw.
• A minimum of 80 cuft cylinder is required from 81 - 100 fsw.
• A minimum of 100 cuft cylinder is required from 101 - 130 fsw.
• EGS’s shall have a minimum pressure of 3000 psi prior to the dive.

First aid supplies

• A first aid kit approved by a physician, and emergency oxygen shall be available at the dive location.

• An Automated External Defibrillator (AED) shall be available at the dive location
  a) Personnel required to use AED’s shall be trained in the use of AED’s

Diver Flag

A (1) Meter Code “A” (alpha) and a sport diver’s flag shall be displayed prominently on the dive support vessel whenever diving is conducted. For saturation operations, the dive flags shall be displayed on the Life Support Buoy.

Recompression Chamber Requirements

For No Decompression Dives deeper than 130 fsw and Decompression Dives, a dual lock decompression chamber having a minimum capability of 6 ATA (equivalent to 165 fsw) shall be available and ready for use at the dive location. When a recompression chamber is required at the dive location, the following table defines the personnel requirements:

<table>
<thead>
<tr>
<th>Position</th>
<th>Personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chamber Supervisor</td>
<td>1 (Required)</td>
</tr>
<tr>
<td>Inside Tender</td>
<td>1 (Required)</td>
</tr>
<tr>
<td>Operator</td>
<td>1 (Optional)</td>
</tr>
<tr>
<td>Communications / Logs</td>
<td>1 (Optional)</td>
</tr>
<tr>
<td>Diving Physician</td>
<td>1 (Available by phone)</td>
</tr>
</tbody>
</table>

Recompression Chamber support personnel shall be trained or certified in the treatment of diving related injuries and recompression chamber operations.
Determination of Decompression Status: Dive Tables, Dive Computers

- A set of US Navy No Decompression tables, must be available at the dive location.

Decompression Diving

Decompression diving shall be conducted with a multi-lock, multi-place chamber on site and personnel qualified in recompression chamber operations shall be at the dive location.

Personnel participating in decompression diving shall be trained and qualified in the techniques being utilized.

Entering and Exiting the Water

There shall be a safe means for entering or leaving the water from the diving platform, such as a ladder, stage or other appropriate device such as a swim platform. If a ladder is used, this device shall extend a minimum of 3 feet below the water surface. Additionally, the means of entering and exiting the water shall be adequate to facilitate rescue of personnel.

Live Boating

Live boating is NOT authorized when diving surface supplied.

Safety

The ultimate responsibility for safety rests with the individual diver. It is the diver’s responsibility and duty to refuse to dive if, in their judgment, conditions are unsafe or unfavorable, or if they would be violating the precepts of their training or the regulations in this standard.

Refusal to Dive

The decision to dive is that of the diver. A diver may refuse to dive, without fear of penalty, whenever they feel it is unsafe for them to make the dive.

Termination of the Dive

It is the responsibility of the diver to terminate the dive, without fear of penalty, whenever they feel it is unsafe to continue the dive, unless it compromises the safety of another diver already in the water.

The dive shall be terminated while there is still sufficient air to permit the diver to safely reach the surface, including decompression time.

Emergencies and Deviations from Regulations

Any diver may deviate from the requirements of this standard to the extent necessary to prevent or minimize a situation that is likely to cause death, serious physical harm, or major environmental damage. A written report of such actions must be submitted to the Diving Safety Officer explaining the circumstances and justifications.
8.60 Post-Dive Procedures

Post-Dive Safety Checks

After the completion of a dive, each diver shall report any physical problems, symptoms of decompression sickness, or equipment malfunctions.

When diving outside the no-decompression limits, the divers should remain awake for at least 1 hour after diving, and in the company of a dive team member who is prepared to transport them to a decompression chamber if necessary.

8.70 Emergency Procedures

Each organizational member will develop emergency procedures which follow the standards of care of the community and must include procedures for emergency care, recompression and evacuation.

8.80 Flying after Diving or Ascending to Altitude (Over 1000 feet)

Following a Decompression Dive: Divers should have a 24-hour minimum preflight surface interval.

Following a No-Decompressing Dive: A 24-hour preflight surface interval is recommended, however, the US Navy Altitude tables may be used to determine minimum preflight surface interval.

8.90 Record Keeping Requirements

Diving Log

All dives shall be logged by the Diving Supervisor or his/her appointed designee, to be reviewed, and filed. Each diver is encouraged to maintain a personal log with entries for all dives. The Diving Log includes the following:

- Name of diver, buddy, and Diving supervisor
- Date, time, and location
- Breathing gas used
- Approximate surface and underwater conditions, if applicable
- Maximum depth, bottom time and surface interval time

Required Incident Reporting

All non-diving injuries requiring treatment or diving incidents requiring recompression treatment, or resulting in moderate or serious injury, or death shall be reported to the FIU Diving Safety Officer. The report will specify the circumstances of the incident and the extent of any injuries or illnesses.

Additional information must meet the following reporting requirements:

- Document and report occupational injuries and illnesses.
- If pressure-related injuries are suspected, or if symptoms are evident, the following additional information shall be recorded and retained, with the record of the dive, for a period of 5 years:
1. Complete Appendix 6 Dive Incident Report
2. Written descriptive report to include:

   • Name, address, phone numbers of the principal parties involved.
   • Summary of experience of divers involved.
   • Location, description of dive site, and description of conditions that led up to incident.
   • Description of symptoms, including depth and time of onset.
   • Description and results of treatment.
   • Disposition of case.
   • Recommendations to avoid repetition of incident.
SECTION 9.00 SATURATION DIVING

9.10 General Policy

Definition

Saturation diving is a technique that allows divers to reduce the risk of decompression sickness when they work at depths for long periods of time. "Saturation" refers to the fact that the diver's tissues have absorbed the maximum partial pressure of an inert gas possible for that depth, due to the diver being exposed at that pressure for prolonged periods. This is significant because once the tissues become saturated, the time to ascend from depth, to decompress safely, will not increase with further exposure.

In saturation diving, the divers live in a pressurized environment, which can be a saturation system or a hyperbaric environment on the surface, or an ambient pressure underwater habitat. This may be maintained for up to several weeks, and they are decompressed to surface pressure only once, at the end of the exposure. By limiting the number of decompressions in this way, the risk of decompression sickness is significantly reduced.

9.20 Prerequisites

The following addresses Saturation Diver training and performance guidelines under the auspices of Florida International University. These standards represent the minimum required level of knowledge and skills presented in a generalized format.

Eligibility

Employees, volunteers and/or FIU approved personnel from external organizations, companies or entities shall comply with the following training requirements, standards, guidelines and restrictions prior to engaging in any FIU project approved diving operations.

FIU Working Divers must meet and successfully complete the requirements listed in Section 2.00, Section 3.00 and Section 4.00, prior to participating in Saturation Diver training.

Mission / Project Support Divers must meet the requirements listed in Section 4.10 and the following portions of Section 4.20 (Dive Equipment Familiarization, Diving Operations Familiarization and Confined or Shallow Open Water Skills Assessment Dive <30 fsw) prior to the commencement of Saturation Diver Training.

9.30 Saturation Diver Requirements and Authorization to Dive

In addition to meeting the eligibility requirements, the applicant must successfully complete the training and performance requirements listed in Section 9.40, and convince the Diving Safety Officer or Instructor that they are proficient in the use of diving modes being utilized in saturation, and is familiar with saturation diving and emergency procedures. Authorization may be denied to any diver who does not demonstrate to the satisfaction of the Diving Safety Officer or Instructor, the appropriate judgment or proficiency to ensure the safety of the diver and dive buddy. Following the acceptance of application, training and qualification materials an applicant may be designated as an Aquanaut and authorized to dive as an FIU Saturation Diver in the Aquarius Underwater Habitat.
Minimum Activity to Maintain Authorization

FIU qualified saturation divers who have completed training within six months of a scheduled saturation dive, do not require saturation diver refresher training.

Qualified FIU saturation divers who have completed training beyond six months (but not greater than 2 years) of a scheduled saturation dive, shall complete saturation diver refresher training in accordance with Section 9.50.

9.40 Saturation Diver Training Guidelines

Divers trained and qualified at Florida International University as Saturation Divers, are only authorized to dive under the auspices of the University’s diving program.

Classroom Instruction (8 Hours)

The classroom instruction is intended to impart knowledge and expose trainees to the safe operation, diving procedures and emergency procedures used with saturation diving equipment.

Topics should include, but not be limited to:

- Aquarius Habitat Safety, Excursion and Diving Procedures
- Aquarius Habitat Emergency Procedures
- Saturation Excursion Emergency Procedures
- Saturation SCUBA Equipment Orientation
- Helmet and or Full Face Mask (FFM) orientation
- Emergency Gas Supply (EGS / Bailout Cylinder) procedures
- Communications
- Recompression Chamber Orientation
- Evacuation Procedures
- Medical consideration for saturation diving

SCUBA Equipment and Diving Procedures Practical Training for Saturation Diving (24 Hours)

The trainee must be able to demonstrate knowledge and competency in the following areas:

- Proper use of FFM and SCUBA equipment used in saturation diving
- FFM donning, doffing and clearing, regulator recovery and buoyancy control
- Diver rescue, buddy breathing and air sharing
- Accidental surfacing diver support
- Saturation SCUBA / FFM equipment emergency procedures drills
- Bailout cylinder procedures
- Line reel use and search procedures
- Safety buoy deployment
- Hand held VHF Radio Procedures
- Gazebo / Way Station orientation
- Tank filling procedures for Way Stations
Written Examination (based on classroom instruction and practical training)

Before authorization, the trainee should successfully pass a written examination demonstrating knowledge of at least the following:

- Aquarius Habitat Safety, Excursion and Diving Procedures
- Aquarius Habitat Emergency and Evacuation Procedures
- Saturation FFM / SCUBA Excursion Emergency Procedures

Helmet Practical Training for Saturation Diving

When helmet and umbilical diving equipment are used in Saturation Diving, the trainee must also meet the requirements listed in Section 8.40, in addition to the requirements listed in Section 9.40 less the SCUBA equipment requirements.

Written Examination (based on classroom instruction and practical training)

Before authorization, the trainee should successfully pass a written examination demonstrating knowledge of at least the following:

- Aquarius Habitat Safety, Excursion and Diving Procedures
- Aquarius Habitat Emergency and Evacuation Procedures
- Saturation Excursion Emergency Procedures
- Helmet Emergency Procedures
- Gazebo / Way Station orientation

Open water Dives using SCUBA Diving Equipment for Saturation Diving

A minimum of (3) open-water dives using Saturation Diving FFM / SCUBA Equipment is required for authorization. For the purposes of evaluation, training or qualification, at least (1) Aquarius Reef Base qualified SCUBA and saturation diving instructor shall be assigned to dive with the trainee.

(1) Training dive shall include an interior visit to the habitat prior to saturation.

Training Dives using Surface Supplied Diving Equipment for Saturation Diving

A minimum of (3) dives using Surface Supplied Diving Equipment is required for authorization. For the purposes of evaluation, training or qualification, (1) qualified Aquarius Reef Base diver shall be assigned by the Diving Safety Officer or Dive Supervisor to dive with the trainee on the first dive.

One additional dive utilizing SCUBA shall include an interior visit to the habitat prior to saturation.

9.50 Saturation Diver Refresher Training Requirements

Refresher Classroom Instruction

The classroom instruction shall consist of the following topics, but not be limited to:

- Aquarius Habitat Safety, Excursion and Diving Procedures
- Aquarius Habitat Emergency Procedures
- Saturation Excursion Emergency Procedures
- Saturation FFM / SCUBA Equipment and / or Helmet Refresher
- Evacuation Procedures

Refresher Practical Training for Saturation Diving (SCUBA and Helmet)

The diver must be able to demonstrate knowledge and competency in the following areas:

- Helmet and / or FFM / SCUBA equipment emergency procedures drills
- FFM donning, doffing and clearing, regulator recovery and buoyancy control
- EGS procedure (SCUBA or Helmet)
- Diver rescue, buddy breathing and air sharing
- Diver Dressing and Tending Procedures
- Line Pull Signals

A minimum of (1) dive is required where the diver can demonstrate competency as defined in the refresher practical training requirements.

9.60 Saturation Diving Regulations

For saturation diving regulations, see Habitat Operations and Procedures Manual (FIU-ARB-OM-REV-3)
SECTION 10.00 ADDITIONAL DIVING PROCEDURES

This standard provides guidance and diving procedures for underwater operations commonly encountered by commercial or working divers. Underwater operations requiring diving procedures not listed within this standard may be found in The International Consensus Standards for Commercial Diving and Underwater Operations Manual.

10.10 Hand Held Hydraulic or Pneumatic Power Tools

The following are minimum requirements for hand-held hydraulic / pneumatic power tools. Prior to use of any hand-held hydraulic or pneumatic power tools, personnel shall be qualified at a minimum, in accordance with the FIU Personal Qualification Standards (FIU-PQS-001).

NOTE: No person (Diver) shall engage in the use of underwater hand-held power tools (e.g., hydraulic and pneumatic tools, water blaster guns) without proper training in the use of the specific power tool. FIU Scientific Divers wishing to use such tools must request permission to do so from the DSO and receive training from a qualified FIU working diver prior to beginning diving operations using such equipment.

Electrical Hazards

• All electrical equipment, including hand-held electrical equipment, shall be de-energized at the surface before being placed into or retrieved from the water.
• All underwater AC (alternating current) electrical equipment cabled from topside shall be powered via a ground fault circuit interrupter (GFCI) between the topside power source and the tool.
• GFCIs are used to assist in protecting divers against electrocution when using AC power underwater. GFCIs used shall meet all applicable regulatory requirements.
• Have plug and receptacles compatible with cabling and dedicated ground cable.

Switches and Controls

• All hand-held power tools (e.g., hydraulic and pneumatic tools, water blaster guns) shall have a constant pressure switch or control (except for underwater welding and burning equipment).
• Hand-held power tools shall not be supplied with power from the dive location until requested by the diver.
• Pneumatic tools shall have a quick shut off valve between the tool and the air source at the diver’s location.

Communications

• Hydraulic tools require voice communications between the surface and the diver.
• When hand-held pneumatic tools are utilized, voice communications are not required.

10.20 Underwater Lift Bag Operations

Purpose

When performing tasks underwater, divers are often required to move or lift objects using the assistance of underwater lift bags. Using underwater lift bags can pose a threat of uncontrolled
ascent to the diver or object. The purpose of this section is to identify potential hazards and recommend safety precautions when working with underwater lift bags.

**Training**

No person shall engage in the use of underwater lift bags without the proper training in the use of lift bags. At a minimum, all personnel (including Scientific Divers) engaging in the use of underwater lift bags shall be trained in accordance with the FIU Personnel Qualification Standards (FIU-PQS-001).

**Precautions**

Extra precautions should be taken through the performance of pre-dive hazard assessments. No standard can cover all potentialities that might be encountered. JSAs and extra attention by the entire dive team are considered essential components for approaching operations of this nature.

**NOTE:** Underwater lift bags are not like other forms of lifting devices. The lifting action is produced by the displacement of water when the bags are filled with air. A diver must be aware of his or her position in relation to the object being lifted, the position of his or her umbilical and or lines at all times to avoid fouling. Proper management of umbilical’s and lines is essential to prevent entanglement with the underwater lift bag rigging or the object to be lifted. The use of enclosed lift bags or lift bags with multiple attachment points requires additional planning, and the user should refer to the manufacturer’s suggested guidelines for proper use and operation.

**Potential Hazards of Underwater Lift Bag Operations**

1. Over-inflation of the lift bag.
2. Accidental deflation of the lift bag.
3. Failure of the rigging or lift bag straps.
5. Utilization of a lift bag not rated for the load.
6. Obstructions in the path of the lift (water-column or surface).
7. Possible entrance of deflated air into an air space.
8. Unplanned free ascent.
9. Diver fouling on lift bag or rigging during unplanned ascent.

**Mitigation of Potential Hazards**

1. Situational awareness on the part of the diver and topside personnel.
2. Proper education and training (Boyles’ Law/Archimedes’ Principle/hydrostatic pressure/absolute pressure).
3. Ensure that an anchor/restraining line is present, when applicable, with sufficient strength to remain attached to the load and dead man anchor.
4. Ensure that dump lines are distinguishable from all other lines.
5. Ensure that diver’s personal equipment and all other tools are not in a position to get fouled with the dump line.

6. Proper maintenance, inspection and testing of lift bag and its rigging. Attachment of an inversion line to the top of the lift bag (the inversion line should be secured to an anchor point).

7. Proper education and training, combined with visible markings to indicate the ratings of the lift bag and the units of measurement used to express that rating (lbs./kg). It is important to utilize lift bags that have a lift capacity that is as close as possible to the weight of the object to prevent the potential for additional tilt on ascent.

8. A complete assessment and survey of the area must be performed prior to initiating lift (inflation of the lift bag).

9. It is important that lift bags are not deflated in the area directly underneath an air space, as this could create extra lift.

10. Ensure anchor points, when applicable, are heavier than the greatest potential lift of the lift bag(s).

NOTE: Extreme caution must be used when inflating underwater lift bags. Do not use excess buoyancy to “break out” or “free” a load from the seabed. Remember: In shallower water, air entering the bag will experience a greater percentage of change in volume as it rises than at deeper depths. Underwater lift bags inflate more rapidly at more shallow depths.

10.30 High Pressure Water Blasting

Introduction

High-pressure water jets are employed in a variety of ways to accomplish cleaning and cutting tasks underwater. These units typically operate at pressures of 1,000 to 5,000 psi.

NOTE: Water blasters can cause serious injury. Recommended practices and procedures do not replace the proper training necessary to operate high-pressure water blasting systems. Injuries caused by water blasters are highly susceptible to infection and should be given immediate treatment. Anyone who suffers an injection should immediately stop working, report to their supervisor and seek medical advice on treatment.

General

• Personnel assigned to water blasting operations, particularly diving personnel, should be trained by qualified personnel and properly demonstrate their knowledge and ability to perform a task prior to being required to do so.

• All dive team members (divers, tenders, and supervisors) should be familiar with the equipment intended for use and with the hazards associated with their operation.

• Prior to operation, all equipment should be inspected for damage and deterioration, with particular attention paid to high pressure hoses, fittings, and gun trigger function.

• Prior to use in diving operations, the water-blasting equipment should be fully assembled and functionally tested, including emergency shutdown or dump valve operation.
Potential Hazards

- The safety point for water blasters is the rupture disc. Do not use coins to replace the disc. There are reasons that cause discs to rupture (wrong tip or blockage).
- Using the wrong tips in the underwater gun will rupture the disc or lower discharge pressure.
- Diver inadvertently directs the front pressure stream onto himself or herself, his or her umbilical, or equipment.
- A hose or fitting failure allows leaking pressure stream to contact and injure topside personnel or diver.
- Topside personnel inadvertently direct the front or retro pressure stream onto themselves or others when preparing, testing, or using the system.

Prior to Commencement of Underwater Blasting Operations

A survey of the underwater site should be undertaken to identify potential hazards. A job safety analysis shall be generated and reviewed by the dive team.

The job safety analysis should include, but not be limited to, the following provisions:

- Tending procedures of the diver tending line or umbilical and the high-pressure water hose during underwater blasting operations.
- A means of communications between the surface and the diver shall be determined.
- System to be pressurized only on request from the diver.
- Ability to quickly shut down pressure to the gun or wand.
- System pressure is shut down prior to the diver leaving the worksite.
- A thorough risk assessment analysis must be conducted if more than one diver is performing high pressure water blasting operations at the same time. Safe distance and other considerations must be provided to each diver and their applicable equipment.
- Due to the high noise levels generated, commands and signals should be agreed to and reviewed between the diver and topside.
- Hearing protection for the diver may be necessary. Limit diver exposure time due to the noise hazard.
- Trigger mechanism shall not be tied back or wedged in the flow or “open” position under any circumstances.
- Nozzle selection should be appropriate for the work intended (the smaller angle of rifle barrel nozzle being the most dangerous due to its cutting ability).
- Miss-matching of high-pressure hoses, water blast guns and any high-pressure connections between different company units is not recommended.
10.40 Penetration Diving

NOTE: PENETRATION DIVES SHALL BE RIGOROUSLY RISK ASSESSED PRIOR TO SUCH DIVING OPERATIONS

Definitions

Penetration dive: A dive that requires a diver to access an area that is both a physically confining space and one in which there is no direct access to the surface or bell for recovery of the diver from the water by the tender.

Physically confining space: Any underwater space that would restrict the diver’s ability to rotate himself or herself head to toe, 180 degrees, in any plane.

Direct access to the surface: A dive location where the diver can be easily pulled to the surface by a surface tender, or to a bell by an inside bell tender. This does not necessarily mean that there is not an obstruction on the surface directly above the diver during the dive, but that there is nothing to restrict the diver from being pulled back to the point of entry at the water surface or bell by a topside tender or bell tender.

Diver working around corners: A situation where the umbilical may become fouled or where line pull signals may become dissipated due to the dive site configuration creating an impossibility of a straight line pull between a surface tender and the diver.

Confined / Enclosed Space: A space that is descriptive of topside conditions only. In certain instances, in order to access the dive site, the dive crew may have to transit or work from a confined space. Generally, a confined space:

• Is large enough and arranged so an employee could fully enter the space and work.
• Has limited or restricted entry or exit. Examples are tanks, vessels, silos, storage bins, hoppers, vaults, excavations, and pits.
• Is not primarily designed for human occupancy. Is not flooded. All topside operations performed from/in confined spaces shall conform to appropriate regulatory requirements.

Penetration Diving Procedures

When performing penetration diving, if the entrance to the penetration is underwater and not readily accessible from the surface, then the diver shall be tended at the entrance of the penetration by an in water tender at all times. The purpose of the in-water tender is to tend the penetrating diver’s umbilical and to assist should the diver require assistance in the event of a fouled umbilical or entrapment. In these conditions, the dive team must include an additional tender/diver.

When any diver is working around corners where the umbilical is likely to become fouled or line-pull signals may be dissipated, other in water diver/tenders may be sent down to tend the lines of the first diver at the obstructions and to pass along any line-pull signals. Voice communications between the top side personnel (Surface Team) and the diver(s) is required.
Minimum Personnel Requirements for Penetration Diving

- One diving supervisor.
- One diver.
- One in-water tender
- Two topside tenders. (One of the topside tenders can act as the Standby Diver)

10.50 Overhead Environments

When direct access to the surface is not possible divers shall be tended; however, when a buddy team conducting inspections and minor maintenance of FIU vessels, Life Support Buoy and Aquarius Underwater Habitat, line tending is not required.

10.60 Diver Propulsion Vehicles

Divers, including Scientific Divers, utilizing diver propulsion vehicles, at a minimum, shall be trained in accordance with FIU Personnel Qualification Standards (FIU-PQS-001). For specific diver propulsion vehicles, divers shall be familiar with the manufacturer’s instructions / procedures for use.

All diver propulsion vehicles must be equipped with a means to control energizing and de-energizing of the device by the diver.
SECTION 11.00 LIFE SUPPORT EQUIPMENT:
REQUIREMENTS, MAINTENANCE, & TESTING

11.10 General
Equipment such as helmets, masks, bailout systems, regulators, buoyancy compensators, etc., that provide direct life support shall be of a type familiar to the diver and subject to a planned maintenance system.

Due to the life-support nature of diving, personnel involved in the operation, maintenance and repair of diving systems and equipment shall have appropriate training and experience in the maintenance and use of the type of equipment being used.

The diving supervisor shall ensure that all diving systems and equipment have been examined and tested prior to diving to determine their condition and suitability for service. No diving operation shall be permitted to commence until all systems and equipment have been thoroughly tested for proper functionality.

Life support systems and equipment (hoses, penetrators, valves, etc…) associated with the Aquarius Underwater Habitat, shall be maintained and tested in accordance with the American Bureau of Shipping Underwater Vehicles, Systems, and Hyperbaric Facilities Standards. Where life support equipment is not covered under the American Bureau of Shipping Standards, the standards listed in Section 11.00, shall apply for the purposes of maintenance and testing of life support equipment where appropriate.

11.20 Maintenance Records
Suitable equipment logs shall be established and maintained in a correct and current condition. Life support equipment shall have a unique identity assigned by the manufacturer or employer, be easily visible, permanently affixed, and traceable to the equipment/maintenance log.

Entries made in the equipment log shall describe the nature of the work performed, including the dates of modification, repair or test; the name of the individual performing the work or test; and the particular piece of equipment involved. A preventive maintenance program is required for all life-support equipment.

11.30 Divers Dress
General
Diver’s dress shall be suitable for the job intended and consider such factors as biological, radiological, chemical and thermal conditions.

Dry Suits

Note: Diving personnel should be familiar with dry suit use requirements or should receive training prior to dry suit operations.
Dry Suits shall:
1. Have a means of preventing over-inflation, which could result in an uncontrolled ascent.
2. Be constructed of material suitable to the environment in which it is to be used.
3. Protect the diver from the environment, e.g., temperature or hazardous material.

*Hot Water Suits*
Hot Water suits shall:
1. Flow sufficient water to maintain the diver(s) in thermal balance at the desired temperature.
2. Be capable of withstanding an operating temperature of 110º F (44º C).
3. Have a means to allow the diver to bypass incoming water prior to it entering the suit.

*Harnesses*
A working diver using Surface Supplied Diving Equipment shall be equipped with a full body diving harness that:

a. Is designed to:
   I. Provide a method to securely attach the umbilical to the diver.
   II. Lift an unconscious or injured diver and his or her equipment from the water in an emergency.
   III. Be utilized for underwater use.
b. Has an overall breaking strength of no less than 2,000 pounds.
c. Is equipped with a positive buckling device (i.e., designed to prevent strap pull-through and accidental release by the diver). It shall not be possible to release the harness by a single action.
d. Is equipped with at least one attachment point for the umbilical that is rated to at least the same breaking strength as the lifeline or strength member in the umbilical bundle. If the harness has multiple attachment points of different strengths, those suitable for umbilical attachments are to be clearly identified.
e. Is equipped with adjustable, permanently attached leg straps.
f. Is fitted with at least one lifting (recovery) ring, accessible when the diver is fully dressed, suitable for recovery of the diver from the water in an emergency using a hoisting device or other suitable means.
g. Is designed to maintain the diver in a heads-up position during recovery (using the lifting ring) from the water in an emergency.
h. Allows for easy disconnect of the main umbilical and weights, without removal of the main bail-out harness. This may be achieved by use of a separate/independent outer harness or jacket for the bailout system and diver’s weights, or similar systems.
i. Is to be visually inspected prior to use for any signs of deterioration or damage. Any harness whose material condition is in doubt shall not be used until a determination is made by the diving supervisor.
j. Is to be regularly maintained in accordance with the manufacturer’s recommendations.
k. Is certified by the manufacturer as detailed below.
Certification and Testing of Diving Harnesses

A new diving harness shall be certified by the manufacturer or supplier to confirm that:

a. Each securing point intended for attaching an umbilical or lifting a diver out of the water in an emergency shall withstand a tensile of at least 2,000 pounds for five minutes without sustaining damage that would render it inoperable or unsafe to use.

b. Each complete full-body harness, including adjustment systems, buckles, etc., shall withstand a tensile load of at least 2,000 pounds for five minutes, applied in the direction of lift, without sustaining damage that would render it inoperable or unsafe to use.

c. Each harness is clearly marked in a durable manner with the following minimum information:
   - Manufacturer’s name.
   - Unique identifier.
   - Breaking strength.

Weight Belts

Weight belts shall:

a. Be of sufficient weight to maintain the diver at working depth.

b. Not be used as an attachment for the diving umbilical.

c. Be equipped with an appropriate release buckle.

d. Be attached to the diver in a manner to avoid accidental disengagement.

Diver Worn or Carried Emergency Gas Supply (EGS)

**NOTE:** Diver-worn or carried emergency gas supply (bailout) shall have a minimum calculated four-minute supply at the anticipated depth. (See bailout calculations in Reference Materials).

EGS / Bail Out systems shall:

1. Have a cylinder(s) meeting the requirements in **Section 11.10**

2. Have a depth-compensating regulator on the cylinder capable of delivering the proper pressure and flow to the diver, the diver’s helmet or mask in accordance with the manufacturer’s recommendations.

3. Have a means of attachment to the diver, diver’s helmet or mask, which prevents accidental disengagement.

4. The diver-carried EGS or mask/helmet shall have a positive means of isolating it from the primary gas supply.

5. When diving a gas mixture other than air, sample/test to verify contents. Bottles must be clearly marked with content, date, pressure and the name of the individual performing this verification.

6. For SCUBA diving, a reserve valve may be used as an EGS.
11.40 Helmets and Masks

General

**NOTE:** Helmets and masks and their associated diver-carried regulators are components of a critical life-support system that, if not functioning properly, can expose the diver to significant hazards. As such, all helmets and masks and their associated diver carried regulators shall be maintained and inspected in compliance with the manufacturer’s recommendations. Suitable logs shall be maintained to reflect compliance.

Helmets and masks used with an umbilical for surface supplied or saturation diving operations shall:

1. Be appropriate for the task intended.
2. Be fitted with a two-way audio communications system.
3. Be equipped with a non-return valve in the main gas supply that closes readily and positively.
4. Have non-return valves with springs not exceeding 3 psi cracking pressure.
5. Be made of corrosion-resistant materials.
6. Be maintained in accordance with manufacturer’s specifications and have all modifications that affect safety or performance documented in the equipment log.

**Built-In Breathing Systems (BIBS)**

Individual breathing equipment utilized in PVHO built-in breathing systems (BIBS) shall:

1. Be held in place by adjustable straps, hood or other suitable means that frees the diver’s hands.
2. Be capable of providing 2.0 ACFM (56.6 lpm) at maximum depth. (Some regional and regulatory requirements may differ.)
3. Be equipped to allow user to adjust for ease of breathing or constant free flow.
4. Be equipped with an exhaust valve.
5. Be equipped to prevent over-pressurization or rapid negative pressure from endangering the user.
6. Be maintained in accordance with manufacturer’s specifications.

11.50 Hoses

General (i.e. all hoses associated with the breathing gas system)

Flexible breathing gas hoses used with diving systems or equipment shall:

- Have a minimum burst pressure equal to four times the maximum allowable working pressure (MAWP) and be suitable/rated by manufacturer for work intended.
- Have a MAWP and flow rating not less than the system in which it is installed or used and be suitable for the service intended.
- Have connectors with pressure capability equal to or greater than the designed working pressure of the system on which they are installed.
- Have fittings of corrosion-resistant material that cannot be accidentally disengaged.
- Be kink-resistant or arranged to prevent kinking.
• Have a suitable temperature rating when used for hot water service.
• Be visually examined and pressure tested after each pressure boundary repair.
• Be of suitable design to prevent collapse when used for operation with higher external pressure than internal pressure.
• Have a maximum allowable working pressure equal to or greater than supply pressure plus 150 psi. (10.546 kg/sq).

**Breathing Gas Hoses** *(i.e. deck whips and all other LP hoses associated with the breathing gas system)*

Breathing gas hose assemblies shall:

1. Meet requirements of [Section 11.50](#).
2. Be suitable for breathing gas service
3. Each hose assembly will be subjected to an annual pressure test to one-and one half times the normal working pressure of the system. The test pressure should be maintained for 10 minutes.
4. When initially constructed and after any alteration / repair, a 200-pound axial load test on the hoses’ fittings will be performed unless it is contrary to the manufacturer’s recommendations.

   **Note:** The axial load weight may be removed after the initial test pressure has been applied, providing no leakage is evident.

**Umbilicals**

Diver umbilical and dive hose assemblies shall:

1. Meet the requirements of [Section 11.50](#).
2. Be marked from the diver/bell end in 10-foot intervals up to 100 feet and marked in 50-foot intervals thereafter.
3. Be marked with a unique identity and be subjected to a planned maintenance program.
4. Be subjected to an annual pressure test to one-and-one-half times the normal working pressure of the system with a 200-pound axial load applied on fittings while initial test pressure is applied. The test pressure should be maintained without loss of pressure for 10 minutes.
5. Consist of a breathing gas hose, communications cable, a means of determining the diver’s depth, and a strength member (the strength member may be the entire hose assembly, if so designed).
6. Have a minimum break strength of the hose assembly, including terminating hardware (e.g., “D” ring or attaching points), of 1,000 pounds.
7. Pneumo-fathometer hose shall be annually pressure-tested for leakage.
NOTE: The umbilical assembly used for the standby diver must be at least 50 feet longer than the primary diver in order to reach him or her at the furthest possible excursion from the dive station.

**Oxygen Hoses (LP hoses associated with the breathing gas system)**

1. Oxygen hoses shall meet the requirements of **Section 11.50** and be suitable for use intended.
2. LP hose assemblies (less than 500 psi) used in systems containing greater than 40 percent oxygen are to be cleaned for oxygen service.
3. Hoses used for oxygen (over 40 percent) service shall be identified by a consistent color code or tagged “FOR OXYGEN USE ONLY.”
4. Lubricants used to assemble fittings on hoses for oxygen service shall be compatible with oxygen.
5. Each LP oxygen hose assembly will be subjected to an annual pressure test to one-and one half times the normal working pressure of the system. The test pressure should be maintained for 10 minutes.

**Components for Oxygen use**

1. Components used in oxygen supply systems containing greater than 40 percent oxygen are to be cleaned for oxygen service.
2. Lubricants used to assemble fittings, valves and hoses for oxygen service shall be compatible with oxygen.

**High Pressure Hoses (HP hoses associated with diver life support systems and breathing gas systems)**

1. High Pressure hoses shall meet the requirements of **Section 11.50** and be suitable for use intended.
2. Each HP hose assembly will be subjected to a pressure test to one-and one half times the normal working pressure of the system, not to exceed 5000 psi, every 24 months. The test pressure should be maintained for 10 minutes.
3. Each HP hose assembly used for oxygen service will be subjected to a pressure test not to exceed 2400 psi. The test pressure should be maintained for 10 minutes.
4. HP hose assemblies used in systems containing greater than 40 percent oxygen are to be cleaned for oxygen service.
5. Hoses used for oxygen (over 40 percent) service shall be identified by a consistent color code or tagged “FOR OXYGEN USE ONLY.”
6. Lubricants used to assemble fittings on hoses for oxygen service shall be compatible with oxygen.
11.60 Compressor Systems

General
Compressors, boosters, gas transfer pumps, and filters used to provide breathing air/gas for diving shall be designed and manufactured to:
1. Have suitable personnel protection around rotating machinery that meets applicable jurisdictional requirements.
2. Have the necessary instrumentation to facilitate operations.
3. Be of the proper type, pressure and flow rate, and be suitable for service intended.
4. Have its air intake arranged to be clear of exhaust fumes and other contaminants.
5. Have flexible pressure hoses suitable for intended use.
6. Have electrical controls, wiring and drive units meeting the jurisdictional requirements, when so equipped.

Filtration
Filters, when installed to prevent contamination, must meet or exceed the flow rate and pressure rating of the compressor or piping system in which they are installed and be able to deliver breathing gas in compliance with Compressed Gas Association (or equivalent) purity standards for extended operation.

Testing
Compressors used for breathing gas shall be functionally tested per the following schedule, and shall conform to design specifications.
1. Prior to being put into service.
2. Periodically in accordance with manufacturer’s recommendations and planned maintenance schedule.
3. After any repairs that may affect the compressor’s performance.

Air Purity Standards
1. All compressors, transfer pumps, or booster pumps used for breathing air service will be subjected to an air quality test every six months. Compressors with a discharge pressure of 500 psi or less shall meet the standards of the current ANSI CGA required for Grade D air, or equivalent. Compressors with a discharge pressure that exceeds 500 psi shall meet the requirements of the current ANSI CGA for Grade E air, or equivalent.
2. Air purity tests shall be taken at the discharge point that would normally supply the breathing gas system, the diver’s hose or cylinder fill point.
3. Documentation of the latest test(s) shall be kept on file and available upon request.
4. Compressors used for breathing gas transfer other than atmospheric air shall be checked every six months to ensure they do not induce contaminants into the gas being processed.
11.70 Diver Entry and Egress Systems

_Diving Ladders, Stages and Swim Platforms_

Diving ladders, stages and swim platforms shall:

1. Be capable of supporting the weight of two divers plus their gear.
2. Be made of corrosion-resistant material or be maintained free of corrosion.
3. Be suitable for the purpose intended.
4. Ladders must extend a minimum of 3 feet below surface where installed.
5. Stages must be equipped with a safety chain and internal handholds for dive safety during launch and recovery.

11.80 Open Bottom Bells / Way Stations

Open-bottom bells and Way Stations shall:

1. Have an upper section that provides an envelope capable of maintaining a bubble of breathing mixture for a diver when the diver is standing on the lower section with his or her body through the open bottom and his or her head in the bubble.
2. Have lifting eyes rated for lifting 500 pounds for each occupant, plus the weight of the bell.
3. Be protected against and maintained free from injurious corrosion.
4. Able to accommodate two divers with gear in an un-crammed position.
5. Be fitted with internal handholds for divers (Open Bottom Bells).
6. Have provisions for mounting of breathing gas cylinder(s) and regulator for emergency breathing at all depths of intended operation.

11.90 Gauges

Gauges utilized with diving equipment or systems shall:

1. Be suitable for purpose intended.
2. Be cleaned for oxygen when installed in oxygen systems using mixtures greater than 40%.
3. When used to indicate a diver’s depth:
   • Be of appropriate range and graduation.
   • Be calibrated to a known standard every six months to less than 2% error margin up to the maximum depth of intended use.
   • Have calibrations documented in the equipment log.

11.100 Compressed Gas Equipment

_Volume Tanks / Air Receivers_

Volume tanks used in diving systems shall:
1. Be designed, fabricated, inspected, tested and certified in accordance with the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Section VIII, Div. I, “Unfired Pressure Vessels,” and/or other statutory or classification society requirements.
2. Be equipped with a pressure gauge.
3. Be equipped with a check valve on the inlet side.
4. Be pressure-rated to the maximum system pressure on which it is installed.
5. Be equipped with a relief valve as required by code of manufacturer and tested at least annually.
6. Be equipped with condensate drain valve, located at its lowest point.
7. Be equipped with slow-opening valves when used with design pressures exceeding 500 psi.
8. Be cleaned for oxygen service and have slow-opening valves when used in systems containing greater than 40 percent oxygen.
9. Be pneumatically tested to one and one half times the systems normal working pressure annually utilizing the breathing mixture normally used.
10. Have a unique identity with results of all tests being recorded in the equipment log.

Gas Storage Cylinders

High-pressure gas storage cylinders shall:
1. Be manufactured to recognized code or standard.
2. Be equipped with an overpressure relief device.
3. Be visually examined externally at least annually for damage and corrosion.
4. If rack-mounted into banks of cylinders or tubes, have valves and regulators protected from damage caused by impact or from falling objects.
5. Large or submerged gas storage cylinders shall be subjected to a Non-Destructive Test by a qualified technician according to the design standard.
6. Be labeled as to contents. Fire-hazard warning signs should be erected in the vicinity of stored oxygen.
7. Be stored in a well-ventilated area, protected from overheating and secured from falling.

SCUBA and EGS (Bail Out) Cylinders

High pressure bottles used for SCUBA diving and EGS (bailout) shall:
1. Be manufactured to recognized codes or standards.
2. Be equipped with an overpressure relief device.
3. Be inspected internally and externally at least annually for damage or corrosion by a qualified technician.
4. Be hydrostatically tested every fifth year to the requirements of the code of the manufacturer by an authorized test facility and stamped with the date of test.
5. Have a unique identity with results of all tests being recorded in the equipment log.
SECTION 12.00 PRESSURE VESSELS FOR HUMAN OCCUPANCY

12.10 General Information

Pressure vessels for human occupancy (PVHOs), associated with diving operations cover a wide range of applications, including, but not limited to, deck decompression chambers, diving bells, saturation living chambers, transfer locks, and hyperbaric emergency evacuation systems. PVHOs and associated systems are specialized equipment that are operated within the harsh environment of the diving industry. PVHOs typically have unique attributes such as acrylic viewports and quick-opening pressure closures that have requirements for maintenance and safe operation.

These diving industry recommended standards for PVHOs are specifically designed to minimize the risks involved with their safe operation. These standards were conceived as recommendations to be incorporated into industry practice. The standards cover PVHO design, fabrication, inspection, maintenance and repair. A PVHO is governed by industry standards, classification societies, and national and applicable regulatory authorities.

12.20 PVHO Design and Construction Requirements

PVHOs shall meet the following minimum requirements:

1. PVHOs and their associated systems shall be built in accordance with ASME, PVHO-1 and/or in conformance with the requirements of a classing society competent in PVHO diving systems.

2. Have a pressure relief device as per ASME, PVHO-1 or the code/standard of construction. Normally this is no more than 10 percent above MAWP (maximum allowable working pressure) of the PVHO.

3. Any doors, hatches or quick-acting closures associated with a TUP (transfer under pressure) system shall be equipped with an interlock system to prevent accidental opening under pressure. This would include medical locks, equipment locks, and bell TUP quick closures.

4. Have a control panel with a dedicated pressure gauge indicating depth for each pressurized compartment. The gauges shall:
   - Be maintained with calibration of each depth gauge within six months.
   - Be arranged so as to allow comparison with another gauge while in operation.

Surface Diving Decompression Chambers

Surface Decompression Chambers shall:

1. Be dual-lock and multi-place (except emergency rescue chambers or chambers designed to mate with another PVHO, if regulatory codes allow).

2. Have sufficient internal dimensions to accommodate a person lying in a horizontal position with another person attending (except designated diving bells, transfer locks, and emergency rescue chambers).
3. Permit ingress and egress of personnel and equipment while the occupants remain pressurized.
4. Have a means of operating all installed man-way locking devices, except disabled shipping dogs, from both sides of a closed hatch.
5. Have illumination of the interior sufficient to allow operation of any controls and allow for visual observation, diagnosis and/or medical treatment.
6. Have viewports that allow the interior to be observed from the exterior.
7. Have a minimum pressure capability of 6 ATA (165 fsw) [50.3 msw]; or the maximum depth of the dive for dives deeper than 10 ATA (300 fsw) [91.5 msw].
8. Be capable of a minimum pressurization rate of 2 ATA (18.3 meters) to 60 feet within 1 minute. The inner lock may be blown down in advance to achieve this pressurization rate. There must be adequate air capacity on site to achieve deeper treatment depths.
9. Be capable of a decompression rate of 30 fsw (9.2 msw) per minute to 33 fsw [10.06 msw].
10. Have a means to maintain an atmosphere below a level of 25 percent oxygen by volume.
11. Have a means of maintaining an atmosphere not to exceed 1.5 percent surface equivalent carbon dioxide by volume.
12. Have mufflers/silencers on blowdown and exhaust outlets.
13. Have suction guards on exhaust line openings inside each compartment.
14. Have piping arranged to ensure adequate circulation.
15. Have all installed flexible hoses meet the requirements of Section 11.50: Hoses.
16. Have all penetrations clearly marked as to service.
17. Have piping in accordance with ANSI B31.1 and/or ASME/PVHO-1 or the classification society to which it was built.
18. Have the relief valve pressure settings tested annually and the test recorded in equipment log.
19. Pressure test the chamber and associated piping annually to an established procedure, and record in the equipment log.
20. Have an installed breathing system with a minimum of one mask per occupant per lock, plus one spare mask assembly per lock.
21. Have the capability to supply breathing mixtures at the maximum rate required by each occupant doing heavy work.
22. Have a non-return valve on through hull penetrators supplying any built-in breathing system (BIBS).
23. Have a primary and secondary two-way voice communication system between the occupants and the operator.
24. Be equipped with a readily available means for extinguishing fire.
25. When fitted, have electrical systems designed and installed for the environment in which they will operate.
26. Chamber and BIBS exhaust should not vent into an enclosed space.
27. The chamber and its general area and controls should be adequately illuminated for night time operations.
28. If external lights are used to illuminate the chamber internally, they shall not be placed in a manner to subject viewports to heat buildup and damage.
30. If the chamber is located away from the dive control station, there must be a means of communications between the two locations.
31. All chambers shall have an emergency breathing media immediately available to the BIBS in addition to the treatment gas.

**Saturation Chambers and Saturation PVHO chambers**

Regardless of use, living chambers, TUP chambers, or any man-rated components of a saturation complex designed and intended for a human to be housed in shall have all the requirements of decompression chambers plus the following:

1. Have sufficient internal dimensions to accommodate the PVHO-rated occupancy of each person standing and lying on their assigned bunk in a horizontal position and personal storage.
2. The ability to analyze the ambient environment, including temperature, humidity, oxygen, and CO2, on a continuous basis.
3. Oxygen and CO2 analysis gas sampling shall be from dedicated equipment with visual and audio alarms to ensure a predetermined high or low level is brought to the attention of the saturation control life-support technicians.
4. Chambers shall have the ability to analyze the gas samples in the chambers from a low and high point in the chamber. (This ensures gas stratification is identified and monitored.)
5. Chambers shall have an environmental control system capable of maintaining a physiologically suitable temperature and humidity during normal operations.
6. Metabolic oxygen make-up shall be controlled in a manner that will maintain a constant desired level.
7. Medical or equipment locks shall be located in strategic locations to ensure the PVHO occupants have the ability to receive supplies, food, drink, and miscellaneous needs during normal operation as well as during emergency operations.
8. In chambers designated as sanitary and shower areas, the toilet receptacle shall have a raised vented seat to ensure a seal cannot be created by the occupant sitting on the toilet seat.
9. The toilet assembly shall have a safety interconnect device that will not allow the flushing of the toilet while the occupant is seated.

**12.30 Maintenance of PVHOs**

**Introduction**

The diving business is, by its nature, an industry that operates within a harsh environment. Consequently, the design, construction and maintenance of diving equipment and the associated operational procedures are governed by industry and national standards, as well as national and international regulations (Appendix A). PVHO tankage and its associated hardware and associated systems are specialized equipment, rules for which were conceived specifically to minimize the risk involved.
**General Precautions for Acrylic Windows**

These are general precautions for the cleaning, operational inspection, installation, and maintenance of acrylic viewports used in pressure vessels for human occupancy. For additional information, it is recommended that ASME PVHO-2 be referenced. This document covers design, inspection and maintenance for acrylic viewports.

**Cleaning**

When cleaning is required, viewports should be carefully cleaned, and surfaces must not be scratched. An acceptable cleaning agent is mild soap and water. Do not use solvents of any type (alcohol, acetone, etc.) for any purpose on the window, gaskets, or O-rings. **CAUTION:** Only hand-cleaning is allowed. The use of power-driven tools is not permitted. After cleaning, inspect the window for blemishes such as cracks, chips, dings, scratches, crazing, blisters, or discoloration. (Crazing is the development of a network of fine spider web-type cracks on the surface of the window; it can be caused by either stress or exposure to solvents.)

**In-Service Inspection of Acrylic Windows**

Operational inspections should be conducted prior to each chamber pressurization. Visually inspect the accessible exterior, interior and bearing surfaces for the presence of blemishes in the form of crazing, cracks, scratches, blisters and discoloration. A common flashlight will assist in locating blemishes such as chips, cracks, or crazing and in determining the condition of bearing surfaces. Blemishes on the low pressure face can serve as initiators of cracks and subsequent failure in flat disk and conical frustum viewports. For diving bells and submersible diver lock-out compartment viewports, both faces should be considered low-pressure faces. The depth of the blemish can be measured with a depth micrometer with a pointed rod (Brown and Sharpe, or equivalent, or an optical comparator). Consideration should be given to the concentration of scratches, cracks, or crazing occurring in the center of the viewing area, as this may be an indication of stress.

**Installation of Acrylic Windows**

Viewport identification markings must be preserved on each viewport during cleaning and handling. Corresponding viewport documentation should be maintained with the PVHO documentation package.

**NOTE:** Further information can be found in ANSI ASME/PVHO-1, Section 2. 6.14
**Damage by Accident**

Major structural damage may be caused by an accident or mishandling. This may include things like:

*Pressure Hull Damage*

- Dents.
- Gouges.
- Damaged penetrator (stripped threads).
- Mating flange.
- Lift lug or tie-down eye (bent, broken or hole elongation).
- Support base (frame deformation).

*Doors*

- Damaged sealing surface.
- Bent/broken hinge.
- Damaged dogging mechanism.

*Viewport Damage*

- Crazing.
- Cracked/chipped.
- Weld spatter.
- Paint thinner damage.
- Overheated/blistered (permanent deformation).

**Damage by Corrosion**

More important than damage done by an accident, and often unseen until more extensive, is the damage done by corrosion. Most damage by corrosion can be avoided with a diligent preventative maintenance program, however, even with the best preventative maintenance programs, damage can still occur.

*Typical Corrosion Damage May Include*

- Pit corrosion (shell and heads).
- Crevice corrosion.
- Penetrators.
- Viewport sealing surfaces.
- Door faces.
• Sealing surfaces.
• O-ring grooves.
• Support legs/saddles.

Corrosion Allowance

Pressure vessels are typically built with a corrosion allowance in the calculated required metal thickness. This information is usually found on the pressure vessel certificate. Examination of corrosion-affected areas should be done in a manner necessary to determine if the corrosion has gone beyond the calculated allowable amount and may require remedial action.

Repair of a PVHO

The owner should be aware of the requirements of the regulatory authority and of interested third parties, as their requirements will have a direct bearing on the repair specification. PVHO repair must be approached properly, regardless of how well the work is done or the quality of the material used. Without a conscious effort to comply with existing rules and regulations, it is possible to have an expensive repair that does not meet the requirements and is unacceptable. It is important that a defined method is used when approaching the repair of a PVHO. Recommended steps for approaching any repair are as follows:

• Appraisal.
• Plan.
• Execution.
• Documentation.

Appraisal

1. The initial step is to appraise the damage. This means more than a casual look at the vessel and agreeing that it has been damaged. All damage should be investigated to determine the cause and what measures can be taken to prevent a recurrence.

2. Measure or otherwise quantify the damage so you can answer questions about the extent of the visible damage. Be aware that there may be areas of hidden damage. Make a sketch or map of the damaged area; photos may be helpful. Make a written report, describing the nature and extent of the damage. Be accurate, and include as much detail as possible. Be honest in your appraisal; remember that the goal is to save the PVHO vessel and to put it safely back into service.

3. Damage to the pressure boundary of the vessel will require that any repairs be done in accordance with the code of manufacture. Likewise, damage to the attached piping shall be repaired to the code to which it was built. Only components meeting the applicable code requirements should be used for repairs or replacements.

4. Gather all of the existing documentation on the vessel. This information will be needed by engineering, code repair shop, authorized code inspector, insurance adjuster, classing society surveyor, etc.
5. Depending on the type and extent of damage, it may be necessary to perform a nondestructive examination (NDE) to determine the extent of damage. It may be necessary to grit-blast the vessel to bare metal to determine the exact scope of work.
6. Prepare a written report and budget for the repairs.

**NOTE:** If the decision as to the disposition of the repair is yours to make, don’t skip this step. It will become your tool to control the repair project.

*Plan*
1. Make a technical plan for the repair. The plan should clearly establish the scope of work for the fabricator, as well as the scope of responsibility. This plan, if correctly drawn up, can function as the specification for the work and as part of a purchase order.
2. The plan should clearly state the codes, standards, rules, regulations and quality of workmanship that will govern the work. Don’t forget the paperwork requirements. Be very specific about the paperwork and paper deliverables for which the fabricator or repair shop is responsible.
3. Prepare the drawings and/or calculations as necessary to affect the planned repair. An engineer, either in-house or outside, may need to be engaged to verify all details have been addressed. You should then obtain agreement from the regulator (jurisdiction) or classing society that:
   - The proposed repairs and techniques are within the code.
   - The proposed materials meet the code requirements.
   - The repair plan will be approved. Most repairs will require an initial survey to look at the vessel and assess your repair plan.

*Execution*
1. Having obtained the concurrence of the required parties, and armed with your repair plan, budget, drawings and specifications, you are now ready to talk with a qualified fabricator or repair shop.
2. The least problematic choice is the original vessel fabricator. This is not always possible, but the likelihood is that the original fabricator will have the records that will make the repair and documentation go more smoothly. Unfortunately, many of the fabricators that have built PVHOs in the last 15 years are either out of business or may not have retained the records on your vessel. The ASME requires records to be retained for only five years. It is a good idea to require, as part of your purchase agreement with any fabricator or repair facility, that you receive a copy of all paperwork. If the vessel was registered with the National Board of Pressure Vessel Inspectors, you can get copies of the certificate by contacting the National Board.
3. The next best choice would be a fabricator that is currently building and certifying PVHO vessels. The fabricator should be authorized to apply the ASME “U” stamp and/or the “R” stamp from the
National Board. The scope and criteria to differentiate between minor and major repairs is provided in the National Board Code ANSI-NB23. Alternatively, for PVHOs constructed to other codes, the repair shop should be certified to do repairs to the code to which the PVHO vessel was built.

Testing

1. Prior to, during and after repairs, various types of testing may be employed. Test results should be retained as part of the equipment record.

2. All non-destructive examinations should be done in accordance with ASME Section-V: Non Destructive Examination, by personnel competent in the type of test employed.

3. Pressure tests should be done in accordance with a written procedure and appropriate safety precautions.

Documentation

1. All repairs and alterations are to be recorded in the equipment log. This should be accompanied by references to certificates and identification markings. Pressure testing should likewise be documented and recorded in the log. Any alteration or modification should be reflected in all drawing revisions.

2. All certificates, drawings, calculations, and reports should be retained for the service life of the equipment. A professional approach to the repair of PVHOs will yield professional results, thereby preserving a valuable asset and ensuring the safety of the occupants and operators. It is impossible to guarantee that accidents will not happen. However, the probability can be significantly reduced by a good Preventive Maintenance Program and consistent safe practices.
SECTION 13.00 EMERGENCY PROCEDURES

13.10 Basic Emergency Procedures Guidelines

The following emergency procedures that may affect the health and safety of personnel are offered as minimum guidelines for emergency procedures. The steps that are listed may not be in order of preference. Each emergency will dictate its own priorities. In general, every emergency will cause the dive to be aborted until the cause has been fully remedied.

13.20 Loss of Breathing Media

1. Re-establish breathing media supply by:
   • Diver going on diver-worn or carried EGS (bailout);
   • Activating topside secondary breathing media supply; or
   • If applicable, put breathing media to diver’s pneumo hose and have diver insert pneumo hose into helmet/mask.
2. Alert standby diver.
3. Diver goes to bell/stage/surface, as applicable.
4. If required, send standby diver to diver’s assistance.
5. Terminate dive.

13.30 Loss of Communications

1. Attempt to reestablish electronic communications.
2. If communication cannot be reestablished, attempt to communicate through line-pull signals.
3. If applicable, put breathing media to diver’s pneumo.
5. Diver proceeds to downline/bell stage or surface as applicable (if bell, attempt to use bell communications).
6. Bring diver to first stop once line-pull signals are established.
7. If required (unable to establish any form of communications with diver), send standby diver to diver’s assistance prior to bringing diver to his or her first stop.
8. Terminate dive.

13.40 Fouled or Trapped Diver

1. Avoid panic and ensure diver does not ditch equipment.
2. Diver informs topside.
3. Alert standby diver.
5. Diver attempts to free himself or herself.
6. If required, send standby diver to diver’s assistance.
7. When diver is free, if unable or unwilling to continue the dive, or if standby diver was required to go to diver’s assistance, terminate dive.
13.50 Injured Diver in the Waster

1. Diver informs topside, and dive is aborted.
2. Alert standby diver.
3. Diver determines nature and extent of injury.
4. If required, send standby diver down to assist diver, administer first aid and evaluate injury. Standby diver should remain with injured diver.
5. Monitor diver’s breathing. If diver stops breathing, overpressure his or her regulator, if possible.
6. If applicable, standby diver assists injured diver to surface, following proper decompression procedures, except when severity of injury indicates a greater risk than omitting decompression.
7. Institute planned diver recovery procedure.
8. Request medical assistance and emergency evacuation, if required.

13.60 Severance of Divers Umbilical, Gas Hose Only

1. Activate breathing media to diver’s pneumo hose.
2. Diver activates bailout bottle.
3. Alert standby diver.
4. If required, diver inserts pneumo hose inside helmet/mask.
5. Diver returns to bell/stage/surface.
6. If applicable, diver activates and uses emergency breathing media on bell/stage.
7. Terminate dive and follow proper decompression procedure.
8. If required, send standby diver down with additional bailout bottle or hose.

13.70 Severance of Complete Umbilical

1. Diver activates bailout bottle and returns to bell/stage/surface. If applicable, diver activates and uses emergency gas on bell/stage.
2. Alert standby diver.
3. Deploy standby diver if the diver has not immediately surfaced.
4. If applicable, deploy marker buoy at diver’s last known location.
5. If applicable and available, standby diver provides new hose/bailout bottle. Otherwise, send standby diver down the downline or bell stage cable.
6. Terminate dive and follow proper decompression procedure.

13.80 Fire

Topside Fire

1. Employ standard fire emergency procedures.
2. If required, suspend diving activities and evacuate diving station.
Fire inside PVHO

1. Each chamber must have a means of extinguishing a fire in the interior.
2. Notify topside there is a fire in the chamber; evacuate to another chamber or lock if available or possible.
3. Divers inside the chamber should put on the BIBS with emergency gas.
4. Secure electrical power to non-essential systems.
5. Extinguish fire.
6. Vent the chamber.
7. Establish condition of the chamber occupants.

13.90 Adverse Environmental Conditions

As a minimum, a JSA or specific procedure should be developed to address the following, as applicable:

- Adverse environmental conditions, including but not limited to:
  - Weather.
  - Sea state.
  - Currents.
  - Lightning.
  - Winds.
  - Methane/swamp gas.
  - Dangerous marine life.

13.100 Oxygen Toxicity in the Water

1. Supervisor notes signs, or diver reports symptoms to topside.
2. Reduce oxygen partial pressure (switch to air), or lower PPO2 of mixed gasses.
3. Deploy standby diver.
4. Continue decompression on appropriate table unless a 50/50 nitrox mix is available for in-water decompression use.

13.110 Oxygen Toxicity during Treatment

1. Diver reports to topside.
2. Instruct diver to remove oxygen mask for 15 minutes. After all symptoms disappear, start oxygen again. Do not count time not on oxygen. Recommence decompression where oxygen stopped.
3. Tender shall be locked in.
4. If oxygen toxicity symptoms occur for the second time, or if a convulsion occurs;
   - Discontinue oxygen
   - When diver is breathing normally and symptoms have subsided, ascend 10 fsw at 1 fpm and recommence oxygen breathing
   - Contact Diving Physician ASAP
5. If oxygen toxicity symptoms occur for the third time, discontinue oxygen and immediately request medical advice and assistance from designated point of contact.
13.120 Lost Diver

1. Avoid panic and ensure diver does not ditch equipment.
2. Diver does a 360-degree visual search / Diver informs topside.
3. Alert standby diver.
4. Diver determines location of where lost diver was last seen
5. If required, send standby diver to diver’s assistance.
6. Top Side personnel look for bubbles
7. Begin searching for the lost diver
TO THE EXAMINING PHYSICIAN:

This person, ___________________, requires a medical examination to assess their fitness for certification as a Working Diver for Florida International University. Their answers on the Diving Medical History Form (attached) may indicate potential health or safety risks as noted. Your evaluation is requested on the attached Diving Fitness Medical Evaluation Report. If you have questions about diving medicine, you may wish to consult one of the references on the attached list or contact one of the physicians with expertise in diving medicine whose names and phone numbers appear on an attached list, the Undersea Hyperbaric and Medical Society, or the Divers Alert Network. Please contact the undersigned Diving Safety Officer if you have any questions or concerns about diving medicine.

Thank you for your assistance.

________________________       ______________________
Diving Safety Officer               Date

________________________       ______________________
Printed Name               Phone Number

Scuba and other modes of compressed-gas diving can be strenuous and hazardous. A special risk is present if the middle ear, sinuses, or lung segments do not readily equalize air pressure changes. The most common cause of distress is Eustachian insufficiency. Recent deaths in the scientific diving community have been attributed to cardiovascular disease. Please consult the following list of conditions that usually restrict candidates from diving. (Adapted from Bove, 1998: bracketed numbers are pages in Bove)

CONDITIONS WHICH MAY DISQUALIFY CANDIDATES FROM DIVING
1. Abnormalities of the tympanic membrane, such as perforation, presence of a monomeric membrane, or inability to auto inflate the middle ears. [5, 7, 8, 9]
2. Vertigo, including Meniere’s Disease. [13]
4. Recent ocular surgery. [15, 18, 19]
5. Psychiatric disorders including claustrophobia, suicidal ideation, psychosis, anxiety states, untreated depression. [20 - 23]
6. Substance abuse, including alcohol. [24 - 25]
7. Episodic loss of consciousness. [1, 26, 27]
8. History of seizure. [27, 28]
9. History of stroke or a fixed neurological deficit. [29, 30]
10. Recurring neurologic disorders, including transient ischemic attacks. [29, 30]
11. History of intracranial aneurysm, other vascular malformation or intracranial hemorrhage. [31]
12. History of neurologic decompression illness with residual deficit. [29, 30]
13. Head injury with sequelae. [26, 27]
14. Hematologic disorders including coagulopathies. [41, 42]
15. Evidence of coronary artery disease or high risk for coronary artery disease. [33 - 35]
16. Atrial septal defects. [39]
17. Significant valvular heart disease - isolated mitral valve prolapse is not disqualifying. [38]
18. Significant cardiac rhythm or conduction abnormalities. [36 - 37]
19. Implanted cardiac pacemakers and cardiac defibrillators (ICD). [39, 40]
20. Inadequate exercise tolerance. [34]
21. Severe hypertension. [35]
22. History of spontaneous or traumatic pneumothorax. [45]
23. Asthma. [42 - 44]
24. Chronic pulmonary disease, including radiographic evidence of pulmonary blebs, bullae, or cysts. [45,46]
25. Diabetes mellitus. [46 - 47]
26. Pregnancy. [56]

SELECTED REFERENCES IN DIVING MEDICINE

Available from Best Publishing Company, P.O. Box 30100, Flagstaff, AZ 86003-0100, the Divers Alert Network (DAN) or the Undersea and Hyperbaric Medical Society (UHMS), Durham, NC

APPENDIX 2
MEDICAL EVALUATION OF FITNESS FOR DIVING REPORT

_______________________________________________
<table>
<thead>
<tr>
<th>Name of Applicant (Print or Type)</th>
<th>Date of Medical Evaluation (Month/Day/Year)</th>
</tr>
</thead>
</table>

To The Examining Physician: Divers require periodic diving medical examinations to assess their fitness to engage in diving with compressed air or mixed gases. Their answers on the Diving Medical History Form may indicate potential health or safety risks as noted. Diving is an activity that puts unusual stress on the individual in several ways. Your evaluation is requested on this Medical Evaluation form. Your opinion on the applicant's medical fitness is requested. Diving requires heavy exertion. The diver must be free of cardiovascular and respiratory disease. An absolute requirement is the ability of the lungs, middle ears and sinuses to equalize pressure. Any condition that risks the loss of consciousness should disqualify the applicant. Please proceed in accordance with the Florida International University Medical Standards (Sec. 6.00). If you have questions about diving medicine, please consult with the Undersea Hyperbaric Medical Society or Divers Alert Network.

TESTS: THE FOLLOWING TESTS ARE REQUIRED:

DURING ALL INITIAL AND PERIODIC RE-EXAMS (Regardless of age)

• Medical history
• Complete physical exam, with emphasis on neurological and ontological components
• Urinalysis
• Any further tests deemed necessary by the physician

FOR SATURATION DIVING ONLY: Tuberculin Test  Females: Urine HCG

ADDITIONAL TESTS DURING FIRST EXAM OVER AGE 40 AND PERIODIC RE-EXAMS (OVER AGE 40):

• Chest x-ray (Required only during first exam over age 40)
• Resting EKG
• Assessment of coronary artery disease using Multiple-Risk-Factor Assessment
  (age, lipid profile, blood pressure, diabetic screening, smoking)
  Note: Exercise stress testing may be indicated based on Multiple-Risk-Factor Assessment

PHYSICIAN'S STATEMENT:

_____ 01 Diver IS medically qualified to dive for:  
- 5 years (under age 40)  
- 3 years (age 40-59)  
- 2 years (over age 60)  
- Annual for Saturation Diving

_____ 02 Diver IS NOT medically qualified to dive:  
- Permanently  
- Temporarily.

I have evaluated the above mentioned individual according to the standards and required tests in Sec. 6.00 and Appendix 1 and, in my opinion, find no medical conditions that may be disqualifying for participation in diving. I have discussed with the patient any medical condition(s) that would not disqualify him/her from diving but which may seriously compromise subsequent health. The patient understands the nature of the hazards and the risks involved in diving with these conditions.

__________________________________________  __________________________
<table>
<thead>
<tr>
<th>MD or DO Signature</th>
<th>Date</th>
</tr>
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</table>

Name (Print or Type)

Address

Telephone Number  E-Mail Address

FIU-DOM-01 Revision-1  12/2019  83
APPENDIX 2b
APPLICANT'S RELEASE OF MEDICAL INFORMATION FORM

________________________________________________________________________________________________

Name of Applicant (Print or Type)

I authorize the release of APPENDIX-2 and APPENDIX-3 in association with my diving physical exam to the
_____________________________________ Diving Safety Officer or their designee. (date) __________________

Signature of Applicant __________________________    Date_____________________

________________________________________________________________________________________________
APPENDIX 3

DIVING MEDICAL HISTORY FORM
(To Be Completed by Applicant-Diver)

Name _______________________________ Sex ___ Age ___ Wt. ___ Ht. ___

Sponsor _______________________________ Date ___/___/___
(Dept./Project/Program/School, etc.) (Mo/Day/Yr)

TO THE APPLICANT:
Diving places considerable physical and mental demands on the diver. Certain medical and physical requirements must be met before beginning a diving or training program. Your accurate answers to the questions are more important, in many instances, in determining your fitness to dive than what the physician may see, hear or feel as part of the diving medical certification procedure.

This form shall be kept confidential by the examining physician. If you believe any question amounts to invasion of your privacy, you may elect to omit an answer, provided that you shall subsequently discuss that matter with your own physician who must then indicate, in writing, that you have done so and that no health hazard exists.

Should your answers indicate a condition, which might make diving hazardous, you will be asked to review the matter with your physician. In such instances, their written authorization will be required in order for further consideration to be given to your application. If your physician concludes that diving would involve undue risk for you, remember that they are concerned only with your well-being and safety.

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Please indicate whether or not the following apply to you</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>Convulsions, seizures, or epilepsy</td>
<td></td>
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<tr>
<td>2</td>
<td></td>
<td></td>
<td>Fainting spells or dizziness</td>
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<td>3</td>
<td></td>
<td></td>
<td>Been addicted to drugs</td>
<td></td>
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<td>4</td>
<td></td>
<td></td>
<td>Diabetes</td>
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<td>5</td>
<td></td>
<td></td>
<td>Motion sickness or sea/air sickness</td>
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<td></td>
<td>Claustrophobia</td>
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<td>7</td>
<td></td>
<td></td>
<td>Mental disorder or nervous breakdown</td>
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<td>8</td>
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<td>Are you pregnant?</td>
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<td>9</td>
<td></td>
<td></td>
<td>Do you suffer from menstrual problems?</td>
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<td>10</td>
<td></td>
<td></td>
<td>Anxiety spells or hyperventilation</td>
<td></td>
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<tr>
<td></td>
<td>Frequent sour stomachs, nervous stomachs or vomiting spells</td>
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<td></td>
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<td></td>
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<tr>
<td>12</td>
<td>Had a major operation</td>
<td></td>
<td></td>
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<tr>
<td>13</td>
<td>Presently being treated by a physician</td>
<td></td>
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<tr>
<td>14</td>
<td>Taking any medication regularly (even non-prescription)</td>
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<td>15</td>
<td>Been rejected or restricted from sports</td>
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<tr>
<td>16</td>
<td>Headaches (frequent and severe)</td>
<td></td>
<td></td>
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<tr>
<td>17</td>
<td>Wear dental plates</td>
<td></td>
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<tr>
<td>18</td>
<td>Wear glasses or contact lenses</td>
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<tr>
<td>19</td>
<td>Bleeding disorders</td>
<td></td>
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<tr>
<td>20</td>
<td>Alcoholism</td>
<td></td>
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<tr>
<td>21</td>
<td>Any problems related to diving</td>
<td></td>
<td></td>
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<tr>
<td>22</td>
<td>Nervous tension or emotional problems</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>Please indicate whether or not the following apply to you</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td></td>
<td>Take tranquilizers</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
<td>Perforated ear drums</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td>Hay fever</td>
<td></td>
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<tr>
<td>26</td>
<td></td>
<td>Frequent sinus trouble, frequent drainage from the nose, post-nasal drip, or stuffy nose</td>
<td></td>
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<tr>
<td>27</td>
<td></td>
<td>Frequent earaches</td>
<td></td>
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<tr>
<td>28</td>
<td></td>
<td>Drainage from the ears</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td></td>
<td>Difficulty with your ears in airplanes or on mountains</td>
<td></td>
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<tr>
<td>30</td>
<td></td>
<td>Ear surgery</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td></td>
<td>Ringing in your ears</td>
<td></td>
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<tr>
<td>32</td>
<td></td>
<td>Frequent dizzy spells</td>
<td></td>
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<tr>
<td>33</td>
<td></td>
<td>Hearing problems</td>
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<tr>
<td>34</td>
<td></td>
<td>Trouble equalizing pressure in your ears</td>
<td></td>
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<tr>
<td>35</td>
<td></td>
<td>Asthma</td>
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<tr>
<td>36</td>
<td></td>
<td>Wheezing attacks</td>
<td></td>
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<tr>
<td>No.</td>
<td>Condition</td>
<td></td>
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<tr>
<td>37</td>
<td>Cough (chronic or recurrent)</td>
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<tr>
<td>38</td>
<td>Frequently raise sputum</td>
<td></td>
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<tr>
<td>39</td>
<td>Pleurisy</td>
<td></td>
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<td>40</td>
<td>Collapsed lung (pneumothorax)</td>
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<tr>
<td>41</td>
<td>Lung cysts</td>
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<tr>
<td>42</td>
<td>Pneumonia</td>
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<td>43</td>
<td>Tuberculosis</td>
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<td>44</td>
<td>Shortness of breath</td>
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<td>45</td>
<td>Lung problem or abnormality</td>
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<td>46</td>
<td>Spit blood</td>
<td></td>
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<td>47</td>
<td>Breathing difficulty after eating particular foods, after exposure to particular pollens or animals</td>
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<td>48</td>
<td>Are you subject to bronchitis</td>
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<td>49</td>
<td>Subcutaneous emphysema (air under the skin)</td>
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<td>50</td>
<td>Air embolism after diving</td>
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<tr>
<td>51</td>
<td>Decompression sickness</td>
<td></td>
<td></td>
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<tr>
<td>52</td>
<td>Rheumatic fever</td>
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<tr>
<td>53</td>
<td>Scarlet fever</td>
<td></td>
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<tr>
<td>54</td>
<td>Heart murmur</td>
<td></td>
<td></td>
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<tr>
<td>55</td>
<td>Large heart</td>
<td></td>
<td></td>
</tr>
<tr>
<td>56</td>
<td>High blood pressure</td>
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<tr>
<td>57</td>
<td>Angina (heart pains or pressure in the chest)</td>
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<tr>
<td>58</td>
<td>Heart attack</td>
<td></td>
<td></td>
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<tr>
<td>59</td>
<td>Low blood pressure</td>
<td></td>
<td></td>
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<td>60</td>
<td>Recurrent or persistent swelling of the legs</td>
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<tr>
<td>61</td>
<td>Pounding, rapid heartbeat or palpitations</td>
<td></td>
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<tr>
<td>62</td>
<td>Easily fatigued or short of breath</td>
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<tr>
<td>63</td>
<td>Abnormal EKG</td>
<td></td>
<td></td>
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<tr>
<td>64</td>
<td>Joint problems, dislocations or arthritis</td>
<td></td>
<td></td>
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<tr>
<td>65</td>
<td>Back trouble or back injuries</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please indicate whether or not the following apply to you

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Please indicate whether or not the following apply to you</strong></td>
<td><strong>Comments</strong></td>
</tr>
<tr>
<td>59</td>
<td>Low blood pressure</td>
</tr>
<tr>
<td>60</td>
<td>Recurrent or persistent swelling of the legs</td>
</tr>
<tr>
<td>61</td>
<td>Pounding, rapid heartbeat or palpitations</td>
</tr>
<tr>
<td>62</td>
<td>Easily fatigued or short of breath</td>
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<td>Abnormal EKG</td>
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<tr>
<td>65</td>
<td>Back trouble or back injuries</td>
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</tr>
<tr>
<td>66</td>
<td>Ruptured or slipped disk</td>
</tr>
<tr>
<td>67</td>
<td>Limiting physical handicaps</td>
</tr>
<tr>
<td>68</td>
<td>Muscle cramps</td>
</tr>
<tr>
<td>69</td>
<td>Varicose veins</td>
</tr>
<tr>
<td>70</td>
<td>Amputations</td>
</tr>
<tr>
<td>71</td>
<td>Head injury causing unconsciousness</td>
</tr>
<tr>
<td>72</td>
<td>Paralysis</td>
</tr>
<tr>
<td>73</td>
<td>Have you ever had an adverse reaction to medication?</td>
</tr>
<tr>
<td>74</td>
<td>Do you smoke?</td>
</tr>
<tr>
<td>75</td>
<td>Have you ever had any other medical problems not listed? If so, please list or describe below;</td>
</tr>
<tr>
<td>76</td>
<td>Is there a family history of high cholesterol?</td>
</tr>
<tr>
<td>77</td>
<td>Is there a family history of heart disease or stroke?</td>
</tr>
<tr>
<td>78</td>
<td>Is there a family history of diabetes?</td>
</tr>
<tr>
<td>79</td>
<td>Is there a family history of asthma?</td>
</tr>
<tr>
<td>80</td>
<td>Date of last tetanus shot? Vaccination dates?</td>
</tr>
</tbody>
</table>

Please explain any “yes” answers to the above questions.

____________________________________________________________________________________________________
____________________________________________________________________________________________________
____________________________________________________________________________________________________
____________________________________________________________________________________________________

I certify that the above answers and information represent an accurate and complete description of my medical history.

____________________________________________________________________________________________________

Signature  Date
APPENDIX 4

EMERGENCY ASSISTANCE PLAN

Sources of Emergency Assistance

Medical Advice - Nearest Operable Chamber Location: Updated: December 2019

Divers Alert Network (919) 684-2948 Information
Duke University Medical Center (919) 684-6726 Hyperbarics
Durham, NC 27710

South Florida Hyperbaric Center (305) 285-2172 Emergency
at Mercy Hospital
Miami, Florida 33133

Navy Experimental Diving Unit (850) 230-3100 24 Hours
Panama, City Fl.

US Navy Diving & Salvage CTR. (850) 234-4651 Quarter Deck
NDSTC Panama City, FL

Dept. of Hyperbaric Medicine (410) 328-6152 Chamber
Maryland Institute for Emergency Medical Services Systems
University of Maryland
22 South Green Street
Baltimore, MD 21201

Mariners Hospital (305) 434-3600
E.R Mile Marker 91.5 Tavernier, Florida 33070

Search, Rescue and Casualty Evacuation:

Atlantic SAR Coordinator
Southeast (D-7):
Area Command Center (305) 415-6800

Pacific SAR Coordinator
Pacific Southwest (D-11):
Area Command Center (510) 437-3701

Emergency Communications Frequencies:

500 kHz International CW/MCW distress and calling
2182 kHz International voice distress, safety and calling (particularly useful for communications between aircraft and vessels)
156.8 MHz FM, US voice distress and international voice safety and calling (VHF ch.16)

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APPENDIX 5

EMERGENCY ASSISTANCE CALL IN PLAN

Have the following emergency information available BEFORE calling USCG for assistance.

VESSEL INFORMATION (Required in all cases)

Name of vessel ________________________________ Call sign ____________________________
Description of vessel __________________________
Position (LL or Loran) # __________________________ Vessel Speed __________________________
# of persons on board __________________________
Type of distress and assistance requested __________________________

MEDICAL INFORMATION:

Patient Name __________________________ Age ______ Sex __________
Pertinent medical history ____________________________________________
Vital Signs: ________________ Conscious ___________ Breathing __________ Pulse ______
Medical equipment you have on board __________________________

DIVING INFORMATION:

Dive profile:  Depth _______ Bottom time ___________ Breathing Mix _________
Repet dive? ___________  If so, info of earlier dive(s) depths, Bottom times, and Surface intervals?

How long after dive before symptoms occurred? ________________________________
Does Buddy have any symptoms? ____________________________________________

CALL LIST:

USCG Upper Keys / Miami .................................................................VHF CH 16 or 22A
Fire and Rescue ..........................................................................................911
Mariners Hospital Emergency Room (Upper Keys)..............................(305) 434-3600
Mercy Hospital (Miami/ER).................................................................(305) 285-2172
Divers Alert Network (Duke University)... ...........................................(919) 684-2948
James Fourqurean...............................................................................Cell. (305) 815-0287
Roger Garcia ..................................................................................Cell. (305) 509-2523

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APPENDIX 6

DIVE INCIDENT REPORT

Personnel Data

________________________________________________________________________

Name of Diver

______________________________________________________________________

Certification: Date, Level, Certifying Official

______________________________________________________________________

Date and Place of Last Physical Examination

Dive Data

Divemaster

________________________________________________________________________

Divers Involved

________________________________________________________________________

________________________________________________________________________

Names of Other Persons

________________________________________________________________________

Aboard Vessel

________________________________________________________________________

Equipment Used

________________________________________________________________________

________________________________________________________________________

Weather and Sea Conditions

________________________________________________________________________

Depth and Time of Dive

________________________________________________________________________

Breathing Mixture

________________________________________________________________________
Description of Incident

Date __________________________________________________________

Location ______________________________________________________

Name of Vessel ________________________________________________

Symptoms, Treatment and Source of Medical Advice

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Follow-Up Actions

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

Narrative

____________________________________________________________________
____________________________________________________________________
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APPENDIX 7  

DIVER RESUME

Name ____________________________ ____________________________ Date of Birth __ / __ / __

(Last) (First)

Address ____________________________ City & State, Zip code ______________

Institution ____________________________ P.I. ____________________________

Telephone: Work ____________________________ Home ____________________________

Diving training or certifications. (Attach Xerox copies of each card or certificate.) Also list certifications such as CPR, WSI, EMT, etc.

<table>
<thead>
<tr>
<th>Level</th>
<th>Date</th>
<th>Location</th>
<th>Organization</th>
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</table>

Complete the following scuba dive history:

0 - 30 FSW # dives __________

30 - 60 FSW # dives __________

60 - 100 FSW # dives __________

100-150 FSW # dives __________

150+ FSW # dives __________

Total # to date __________

Most recent scuba dive (Depth, BT and Location): ________________________________________________
Complete the following surface-supplied dive history: Most recent surface-supplied dive: ________________________________

<table>
<thead>
<tr>
<th>Depth Range</th>
<th># Dives</th>
<th>Date, Depth and BT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 50 FSW</td>
<td>_______</td>
<td></td>
</tr>
<tr>
<td>50 - 100 FSW</td>
<td>_______</td>
<td></td>
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<tr>
<td>100 - 130 FSW</td>
<td>_______</td>
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<tr>
<td>130 - 170 FSW</td>
<td>_______</td>
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<tr>
<td>170 + FSW</td>
<td>_______</td>
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</tbody>
</table>

Total # to date _______

Place an X next to the activity (ies), environment(s), and equipment for which you have diving experience:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Ocean</th>
<th>Surface supplied air</th>
<th>Dry suit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lakes</td>
<td>Surface supplied HeO2</td>
<td>Hot-water suit</td>
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<tr>
<td></td>
<td>Rivers</td>
<td>Mixed gas diving</td>
<td>Band mask</td>
</tr>
<tr>
<td></td>
<td>Altitude</td>
<td>Surface decompression</td>
<td>Full-face mask scuba</td>
</tr>
<tr>
<td></td>
<td>Strong current</td>
<td>Decompression diving</td>
<td>Twin scuba tanks</td>
</tr>
<tr>
<td></td>
<td>Cold-water</td>
<td>Recompression chamber</td>
<td>U/W still photography</td>
</tr>
<tr>
<td></td>
<td>Tropical water</td>
<td>Saturation (air)</td>
<td>U/W video photography</td>
</tr>
<tr>
<td></td>
<td>Ice diving</td>
<td>Enriched Air Nitrox</td>
<td>Helmet diving</td>
</tr>
<tr>
<td></td>
<td>Wreck diving</td>
<td>5’ or less visibility</td>
<td>Lift bags</td>
</tr>
<tr>
<td></td>
<td>Cave diving</td>
<td>Jacket-type B.C.</td>
<td>Night diving</td>
</tr>
</tbody>
</table>

Have you ever experienced decompression sickness, air embolism, or other diving accident(s)?

No _____ Yes _____

If yes, fill in details:

Date _______ Location _____________________________________________

Dive profile: Depth _____ fsw / Bottom time _____ min.

Equipment used _______________________________ Type problem _______________________________

Physical symptoms observed ____________________________________________

Initial treatment __________________________________________________________

Follow-up treatment or problems ___________________________________________

Have you been cleared to resume diving by a qualified Diving Physician?

Yes _____ No _____ Physician's Name: ________________________________

Your signature _______________________________ Date: _________________________________
APPENDIX 8

PARTICIPANT INFORMATION FORM

Principal Investigator: ____________________________  Mission #: ____________

Duration of Participation: From ______/_____/______  To ______/_____/______

Name of Participant: ____________________________  Birth Date: ____________

Home Address: __________________________________________________________________________

City and State: _______________________________________________________________________

Zip Code: ____________________________  Phone #: ____________________________

Institution: ____________________________  Phone #: ____________________________

In An Emergency, Notify: ____________________________  Relationship: ______________

Home Phone #: ____________________________  Work Phone #: ____________________________

Address: _____________________________________________________________________________

City and State: ________________ Zip Code: ______________

Insurance Company’s Name: ____________________________

Will you be covered by your employer’s Workman’s Compensation Policy during the period that you will be participating in FIU research activities (Circle one)?  Yes  No

I understand that marine related activities, including boating and diving, are strenuous activities that require stamina and good health as essential prerequisites for my safety and wellbeing. I understand and agree that there are risks and hazards inherent to boating and diving activities that include the possible consequences of serious injury or death. I hereby confirm that I have no emotional or health problems incompatible with boating and diving activities. I understand that I need the approval of a licensed physician to conduct diving activities, and that I should seek the approval of a physician if I am uncertain as to my physical fitness for the rigors of boating activities. I understand that I may be required to seek approval from a physician if there is a health or safety question relative to my condition before being allowed to participate in boating or diving activities.

I understand that the availability of medical emergency assistance will be limited or non-existent while participating in-at-sea research activities, and that successful treatment of injuries requires early and immediate treatment. Consequently, FIU often provides staff that are certified to render immediate basic, and when available, advanced life-support care for all medical emergencies occurring during boating and diving activities. I have read the above statement and affirm that it is correct, and being fully informed of the possibility of injury and even death during boating and diving activities, I do hereby grant qualified FIU staff permission to treat any injury that may occur including first aid, cardio-pulmonary resuscitation, emergency oxygen first aid, recompression therapy, and transfer to a medical facility for treatment by a physician.
Check the appropriate blank for any that applies to you, and explain under remarks.

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</thead>
<tbody>
<tr>
<td>5. Physical handicap</td>
<td>16. High blood pressure</td>
<td>27. Severe or frequent headache</td>
</tr>
<tr>
<td>6. Regular medication</td>
<td>17. Respiratory problems</td>
<td>28. Ear or hearing problems</td>
</tr>
<tr>
<td>7. Allergies, including drugs</td>
<td>18. Persistent cough</td>
<td>29. Alcohol or drug problems</td>
</tr>
<tr>
<td>8. Dizziness or fainting</td>
<td>19. Pregnant</td>
<td>30. Mental or emotional problems</td>
</tr>
<tr>
<td>11. Sinus trouble</td>
<td>22. Dental plates</td>
<td>33. Any medical problem not listed</td>
</tr>
</tbody>
</table>

Print or type remarks:
__________________________________________________________________________________________
__________________________________________________________________________________________

I certify that the above information is correct to the best of my knowledge. I further understand that treatment for any medical problems I may suffer is my responsibility and will be paid for by me.

________________________________________  ____________________________________________
Signature of Participant                Date

If participant is a minor (under 18 years of age), a parent or guardian must also sign this form.

________________________________________  ____________________________________________
Signature of Parent/Guardian                Date
APPENDIX 9

RELEASE OF LIABILITY WAIVER

FLORIDA INTERNATIONAL UNIVERSITY (FIU)
RELEASE OF LIABILITY, WAIVER OF CLAIMS, ASSUMPTION OF RISK AND INDEMNIFICATION FOR BOATING, DIVING, RESEARCH AND RELATED ACTIVITIES

PLEASE READ CAREFULLY BEFORE SIGNING

In consideration of being allowed to participate in the ______________________________________ (the “Mission”) at the Aquarius Reef Base located off of the coast of Islamorada, Florida, which, along with the related onshore and off-shore facilities supporting the Aquarius Reef Base (collectively, the “ARB”) is operated by FIU, I hereby agree as follows:

I am voluntarily participating in the Mission and related activities, including but not limited to, boating and boating related activities, snorkeling, skin diving, scuba diving, surface-supplied diving and/or saturation diving, housing/accommodations, as well as the use of any of ARB facilities and equipment and all additional ancillary activities to the above items (collectively, the “Mission Activities”).

I, __________________________, for myself and my estate, heirs, administrators, executors, and assigns, hereby release and hold harmless the State of Florida, The Florida International University Board of Trustees, FIU, the Florida Board of Governors and their respective officers, directors, employees, representatives, trustees, agents, students and volunteers (collectively, the “Releasees”), from any and all liability and responsibility whatsoever, however caused, for any and all damages, claims, or causes of action that I, my estate, heirs, administrators, executors, or assigns may have for any loss, illness, personal injury, death, or property damage arising out of, connected with, or in any manner pertaining to the Mission or the Mission Activities, WHETHER CAUSED BY THE NEGLIGENCE OF RELEASEES or otherwise.

I fully understand that there are inherent risks and hazards associated with the Mission and the Mission Activities, including, but not limited to, possible injury, illness, paralysis, permanent disability or loss of life to me or to my property. I understand that the Mission Activities are inherently dangerous and I have made the decision to participate despite the inherent dangers. I understand the nature of the Mission and the Mission Activities I will be undertaking, I agree no one has a better understanding of my experience and capabilities, and I hereby represent and affirm that I am qualified and able to participate in the Mission and the Mission Activities. I understand I can and will immediately decline to participate further in the Mission or the Mission Activities in the event that I deem them unsafe for my participation. I further understand that by participating in the Mission and the Mission Activities, I will be interacting with persons that are not associated with or under the control or supervision of the Releasees. Despite the inherent risks and hazards associated with the Mission and the Mission Activities, I wish to proceed, and freely accept and assume all risks and hazards that may arise from my participation. I acknowledge that my participation in the Mission and the Mission Activities is purely optional and I am freely and voluntarily participating; if a student, that I will receive no academic or other credit for such participation; and that I am in no way required to participate.
I further hereby agree to defend, indemnify, and hold harmless the Releasees from any judgment, settlement, loss, liability, damage, or costs, including court costs and attorney fees for both the trial and appellate levels (collectively, “losses”) that Releasees may incur as a proximate result of any negligent or deliberate act or omission on my part during my participation in the Mission or in the Mission Activities, including but not limited to any damage which I directly or indirectly cause to the ARB or to the surrounding aquatic habitat, including but not limited to, damage to sea coral or other aquatic ecosystems in and around the ARB. I further expressly agree that this Release of Liability, Waiver of Claims, Assumption of Risk and Indemnification (Agreement) is intended to be as broad and as inclusive as the Laws of the State of Florida will allow, and that, if any portion thereof is held to be invalid, it is agreed that the balance shall, notwithstanding the invalid portion, continue in full force and effect.

In signing this Agreement, I acknowledge and represent that I have read and understand it; that I sign it voluntarily and for full and adequate consideration, fully intending to be bound by the same; and that I am at least eighteen (18) years of age and fully competent. I understand that this is a legal document which is binding on me, my heirs and assigns and on those who may claim by or through me.

I further represent and state that I am not relying on any oral or written representation or statements made by the Releases, other than what is set forth in this Agreement. I further agree that this Agreement shall be governed by and interpreted in accordance with the laws of the State of Florida.

I HAVE READ THIS AGREEMENT, UNDERSTAND THAT I AM GIVING UP SUBSTANTIAL RIGHTS BY SIGNING IT, AND VOLUNTARILY AGREE TO BE BOUND BY IT.

_____________________________
Signature

_____________________________
Date

_____________________________
Printed Name

_____________________________
Title

_____________________________
Organization

_____________________________
Address

WITNESS (PRINTED) ____________________________

WITNESS SIGNATURE ____________________________ DATE ____________________________
APPENDIX 10

GUEST DIVER REGISTRATION

Candidate Name: ____________________________________________________________

Representing: _______________________________________________________________________________________________________

Reason for participation: __________________________________________________________________________________________________

Candidate has provided:

_____ Proof of Diving Certification (Copy of C-Card)

_____ FIU Participant Information Form

_____ FIU Release

_____ Completed Diving Resume Form (Appendix B-2) with the following:

___________ # Dives to date

___________ Level of certification

___________ Date of last dive

This Candidate proposes to participate in the following dive activity:

Dive Plan: ______________________________________________________________________________________________________________

Are you scheduled to fly within 24 hours after your last dive (Circle One)?  Yes       No

If yes, please provide flight information (Date and Time) ________________________________________________________________

************************************************************************************

Approved: _______ by: ________________________________________________________________________________________________

Disapproved: _______ by: ________________________________________________________________________________________________

Comments: ________________________________________________________________________________________________

FIU-DOM-01 Revision-1  12/2019  99
GLOSSARY OF TERMS

ACFM (acfm)
Actual cubic feet per minute. Refers to the actual volume of gas supplied to a diver, bell, etc., at ambient pressure.

Ambient Pressure
The surrounding pressure at depth (actual or simulated, in a hyperbaric chamber) to which the diver, bell, etc., is subjected.

Appropriate Breathing Mix
A breathing mixture that, having regard to the system and equipment used in the diving operations, the work undertaken in those operations, and the conditions in which and the depth at which they are to be carried out, is suitable in content and temperature and of adequate pressure.

ARB
Aquarius Reef Base

Ascent Time
The time interval between leaving the bottom when the dive is terminated and reaching the surface.

ATA (ata)
Atmosphere absolute. Total pressure, including atmospheric, to which a diver, bell, etc., is subjected.

ATM (atm)
Atmospheric (atm) unit equivalent to 14.7 psi or 760 (mm) of mercury.

Bailout Bottle (EGS)
See Diver-Worn or Carried Emergency Gas Supply.

Bar
A unit of pressure equal to 1 atmosphere (atm).

Bell (Open Bell and Way Station)
An enclosed compartment, pressurized (closed bell) or un-pressurized (open bell also known as Way Station), that allows the diver to be transported to and from the underwater work area and that may be used as a temporary refuge during diving operations.

BIBS
Built-in breathing system. A breathing gas system built into all deck chambers and SDCs by which emergency breathing gas or a treatment gas can be supplied to the diver through an oral-nasal mask or hood.

Bottom Time
The total elapsed time, measured in minutes, from the time that the diver leaves the surface in descent to the time that the diver begins ascent.
Breathing System
Device or apparatus for delivering appropriate breathing mixture.

Bursting Pressure
The pressure at which a pressure containment device would fail structurally.

Cleaned for Oxygen Service
Cleaning of equipment or system to ensure elimination of all hydrocarbons and other potentially dangerous contaminants when system is to be used in oxygen service. See also Oxygen Cleaning.

CNS
Central nervous system.

Compressor
A machine that raises air or other gases to a pressure above 1 atmosphere.

CPR
Cardio-pulmonary resuscitation. A combination of artificial respiration and artificial circulation.

Cylinder
A pressure vessel for the storage of gases.

DDC
Deck decompression chamber, PVHO (pressure vessel for human occupancy). A deck chamber capable of controlled pressurization and depressurization.

Decompression
Releasing from pressure or compression following a specific decompression table or procedure during ascent; ascending in the water or experiencing decreasing pressure in the chamber.

Deck Decompression Chamber
A hyperbaric chamber which is an integral part of a deep diving system, located on a surface platform from which diving is conducted.

Decompression Chamber
An enclosed space used to gradually decrease pressure to which a diver is exposed from ambient underwater pressure back to 1 atmosphere.

Decompression Schedule
A time-depth profile with a specific bottom time and depth, whose application is calculated to safely reduce the pressure on a diver.

Decompression Sickness (DCS or DCI)
A condition with a variety of symptoms that causes the formation of bubbles of gas in the blood or other tissues of the diver during or subsequent to ascent or other pressure reduction.

Decompression Table
A set of decompression schedules developed and available from a recognized source of expertise (such as the U.S. Navy) or developed by a recognized diving physiologist on behalf of a company. Such table must have been thoroughly field tested and evaluated before being used in operational practice.

Design Working Pressure of the System
The lowest pressure rating of any component of the system.
Differential Pressure (Delta P)
Occurs when there is suction of water, or where water moves from an area of high pressure to one of low pressure. This flow may be the result of the movement of water under its own weight or an active process involving powered machinery (e.g., pumps or thrusters).

Dive Location
The site or other structure from where dives are conducted.

Dive Station
The site from which diving operations are directly controlled. This site shall also include any auxiliary or peripheral equipment necessary to the conduct of the diving operation.

Dive Team
Tender/divers, divers and diver support personnel involved in a diving operation, including the diving supervisor.

Diver-Worn or Carried Emergency Gas Supply (Bailout)
The gas required to be worn/carried by the diver, while underwater.

Diving Bell
A tethered underwater support system providing life-support services and used to transport divers.

Diving Operations
Any work operation requiring some type of diving or work underwater that involves planned human exposure to increased pressures to perform the job.

Diving Operating Personnel
Any member of the dive team whose activities are regularly scheduled as necessary to conduct diving operations at or from the dive station.

Diving Supervisor
An individual who, through training, experience, demonstrated competency, and certification, is appointed as the person responsible for executing the diving operation, ensuring the safety protocols are followed, and ensuring the overall safety of the diving operation.

DMT
Diver Medical Technician.

DPIC
Designated person in charge.

Dual-lock Chamber Multi-lock chamber.

Dry Suit
A diving suit designed to exclude water from the surface of the body.
Dynamic Positioning (DP)
A system that automatically controls a vessel’s position and heading by means of thrusters. A typical DP system consists of a control system (including power management and position control), reference systems (such as position, heading, and environmental references) and power systems (including power generation, distribution and consumption). There are many different levels of redundancy for DP systems. DP 2 is the minimum required for diving operations.

EGS
Emergency gas supply (bailout).

Embolism See Gas Embolism.

Excursion Tables
Two tables for use with saturation excursion diving that limit upward and downward excursions and provide a zone in which the diver can move freely without regard to the number of excursions or their duration without incurring a decompression penalty.

Exhaust Valve
A valve controlling the venting of gas from any higher pressure source such as a DDC, diver’s helmet, suit, buoyancy system, volume tank, etc.

FSW (fsw)
A foot of seawater. A unit of pressure at sea level generally defined as representing the pressure exerted by a foot of seawater having a specific gravity of 1.027, and is equal to approximately 0.445 pounds per square inch.

Gas Embolism
A condition caused by expanding gasses that have been taken into and retained in the lungs while breathing under pressure, being forced into the bloodstream or other tissues during ascent or decompression.

GFCI (GFI)
A ground fault circuit interrupter attached to the topside AC power source having receptacles, any of which may be attached to underwater cables supplying power to tools or lighting.

Harness
The combination of straps and fasteners used to attach equipment and umbilical to the diver that can be utilized as a lifting point to remove the diver from the water in the event of an emergency.

High-pressure Nervous Syndrome (HPNS)
A group of symptoms, including a lack of coordination, tremors of the extremities, disorientation, nausea, dizziness, and brief lapses of consciousness occurring at depths of 500 feet or deeper.

HPU
Hydraulic power unit.

Hyberbaric Conditions
Pressure conditions in excess of surface pressure.

Hypothermia
Profound loss of body heat.
Inside Tender
An inside tender is familiar with all treatment procedures and the signs, symptoms, and treatment of all diving-related disorders.

JSA
Job Safety Analysis. Also called job hazard analysis, evaluation analysis, and task risk assessment.

Live Boating
Live boating is a diving technique where SCUBA divers perform work while the vessel is being manually operated by the vessel master and is underway using its main propulsion system.

LP Low pressure (less than 500 PSI).

Manifold
Panel for the distribution of diver breathing gas.

Master (Captain)
Normally considered to be the person in charge of a marine asset.

MAWP
Maximum allowable working pressure. See Maximum Working Pressure

Maximum Working Pressure
The maximum pressure to which a pressure containment device can be exposed under operating conditions.

Med-lock
A lock located in the inner lock of a hyperbaric chamber, to facilitate the transfer of medical supplies, food or other articles between the chamber occupants and personnel outside.

Mixed-gas Diving
A diving technique in which the diver is supplied with a gas mixture other than air for respiration.

MSW
Meters of sea water.

NDT
Non-destructive Testing

No-decompression Diving
Diving that involves depths and times shallow and short enough so that the ascent can be made to the surface without water stops or subsequent chamber decompression.

Non-return Valve (Check Valve)
A one-way check valve installed in a fluid or gas system to permit flow in one direction only. All diving helmets must have a non-return valve at the gas supply inlet to prevent depressurization of the helmet and the resultant squeeze, should the gas supply be lost.

Oxygen Cleaning
Special cleaning process for equipment to be used in oxygen systems.
**Oxygen Compatibility**
The ability of a substance to come in contact with oxygen without reaction.

**Oxygen Toxicity (CNS O₂)**
A condition usually not encountered unless PPO₂ approaches or exceeds 1.6 ATA. However, could be encountered as low as 1.4 ATA.

**Oxygen Toxicity (Pulmonary O₂)**
A condition from long exposures to increased PPO₂, causing a direct pulmonary irritation. Can occur during treatment tables 4, 7, 8, and also through back-to-back administration of treatment table 6.

**Partial Pressure**
That portion of the total gas pressure exerted by a particular constituent of the breathing mixture.

**Pneumofathometer (Pneumo)**
A depth-measuring device consisting of an open-end hose fixed to the diver, with the surface end connected to a gas supply and pressure gauge (usually marked in msw). Gauge measures pressure required to discharge water to depth of diver.

**PSIA**
Pounds per square inch absolute (pounds per square inch gauge plus 1 atmosphere (14.7)).

**PSI (psi)**
Pounds per square inch. An expression of pressure; for example, 1 atmosphere equals 14.7 psi.

**PSIG**
Pounds per square inch gauge (pounds per square inch absolute minus 1 atmosphere).

**PVHO**
Pressure vessel for human occupancy.

**Relief Valve**
A pressure-relieving device that prevents pressure from rising above a preset level.

**Risk Assessment**
The process by which every perceived risk is identified, evaluated, and assessed, prior to commencement of operations. The findings and actions will be documented. A risk assessment is part of the risk management process.

**ROV**
Remotely operated vehicle.

**Saturation Diving**
Procedures in accordance with which a diver is continuously subjected to an ambient pressure greater than atmospheric pressure so that his or her body tissues and blood become saturated with the constituent elements of the breathing gas. Once the diver’s body becomes saturated, he or she can remain within a specified zone for an unlimited time without incurring any additional decompression obligation.
SCUBA
Acronym for self-contained underwater breathing apparatus. Used to describe apparatus in which the inspired air is delivered by demand regulator and exhaled into the surrounding water (open-circuit); the air supply is carried on the diver’s back. Primarily used for relatively shallow, recreational-related diving.

SWL
Safe working limit/load.

Squeeze
A lack of equalization between parts of the body or between the body and the equipment. Extreme cases can cause severe injury or death.

Standby Diver(s)
Another qualified diver at the dive location who is in a state of readiness to assist the diver in the water.

Surface-Supplied Diving
A diving mode in which the diver receives his or her breathing gas from a supply on the surface.

Tender
A term reserved for an apprentice diver or diver helper.

Transfer Under Pressure Lock/Chamber (TUP)
A lock or chamber that allows the transfer to and from of diving personnel between the worksite and living chambers (also called deck decompression chambers) without disturbing off-duty divers in the complex. Transfer under pressure locks/chambers are essential where being subjected to ambient pressure may be life-threatening.

Treatment Tables
A depth, time and breathing gas profile designed to treat a diver for gas embolism or decompression sickness.

Umbilical
A hose bundle between the dive location and the diver or bell that supplies a lifeline, breathing gas, communications, power and heat as appropriate to the diving mode or conditions. Underwater television cameras and cabling can also be carried as a component part of the umbilical or can be taped or banded to it on a temporary basis.

Valve
A device that starts, stops or regulates the flow of fluids or gas.

Volume Tank
A pressure vessel connected to the outlet of a gas supply and used as a gas reservoir.

Working Pressure
The pressure to which a pressure containment device is exposed under normal operating conditions.
PHYSICS AND FORMULAS

PSIG to PSIA

\[ PSIA = PSIG + 14.7 \] Round up to the next whole number.

PSIA to PSIG

\[ PSIG = PSIA - 14.7 \] Round up to the next whole number.

Depth (fsw) to PSIG

\[ PSIG = \text{Depth} \times .445 \] Round up to next whole number.

PSIG to Depth (fsw)

\[ \text{Depth} = \frac{PSIG}{.445} \] Round up to next whole number.

PSIG to Atmosphere Absolute (ATA)

\[ \text{ATA} = (PSIG + 14.7) \]

14.7

Carry two decimal places.

Atmospheres Absolute (ATA) to PSIG

\[ (\text{ATA} - 1) \times 14.7 = PSIG \]

Depth (fsw) to Atmospheres Absolute (ATA)

\[ \text{ATA} = \text{Depth} + 33 \]

33

Carry two decimal places.

ATA to Depth (fsw)

\[ \text{ATA} - 1 \times 33 = \text{Depth (fsw)} \]

Round up to next whole number.
### DALTON’S LAW (‘T’ Formula)

<table>
<thead>
<tr>
<th>PP</th>
<th>ATA</th>
<th>% of Gas</th>
</tr>
</thead>
</table>

PP = Partial Pressure  
% = Percent by Volume of the Identified Gas  
ATA = Atmospheres Absolute

### GAY-LUSSAC’S LAW

\[
P_2 = \frac{P_1 \times T_2}{T_1}
\]

Volume is constant.  
T1 = Initial Temperature (absolute)  
T2 = Final Temperature (absolute)  
P1 = Initial Pressure (absolute)  
P2 = Final Pressure (absolute)

### CHARLES’ LAW

\[
V_2 = \frac{V_1 \times T_2}{T_1}
\]

Pressure is constant.  
T1 = Initial Temperature (absolute)  
T2 = Final Temperature (absolute)  
V1 = Initial Volume (absolute)  
V2 = Final Volume (absolute)

### Boyles’ Law (Pressure/Volume Relationship)

\[
\frac{DL + 33}{DA + 33} \times OV = NV
\]

DL= Depth Left  
DA = Depth Arrived  
OV = Original Volume  
NV = New Volume
Henry’s Law

*(The Law of Gas Absorption and Solubility)* EXPLANATION:

“The amount of any given gas that will dissolve in a liquid at a given temperature is directly proportional to the partial pressure of that gas.”

General Gas Law (Pressure/Volume/Temperature Relationship)

\[
\frac{P_1 \times V_1}{T_1} = \frac{P_2 \times V_2}{T_2}
\]

Degrees Fahrenheit to Rankine

\[Rº = Fº + 460º\]

Degrees Celsius to Absolute

\[Cº + 273º = Degrees Kelvin\]

Degrees Fahrenheit to Celsius

\[5 \times (Fº - 32º) ÷ 9 = Celsius\] (carry 1 decimal place)

Degrees Celsius to Fahrenheit

\[(9 \times Cº) ÷ 5 = 32º = Fahrenheit\] (carry 1 decimal place)

Gas Volume Requirement Formula if Using an LP Compressor

\[SCFM = ATA \times ACFM \times N\]

Gas Volume Requirement Formula if Using an HP Gas Bank

\[SCF = ATA \times ACFM \times N \times T\]

SCFM = Standard Cubic Feet per Minute

SCF = Standard Cubic Feet

ATA = Atmospheres Absolute

ACFM = Actual Cubic Feet per Minute

N = Number of Divers

T = Time (always expressed in minutes)

Minimum Manifold Pressure

\[MMP = D \times .445 + Over Bottom Pressure\]

*(OBP is established by company or a set standard used.)* Round up to next whole number.
Average Gas Consumption Based Upon Moderate

<table>
<thead>
<tr>
<th>Free-flow Type Hat (Desco, MK V)</th>
<th>4.5 ACFM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand Type Hat (Superlite/Miller)</td>
<td>1.4 ACFM</td>
</tr>
<tr>
<td>Built-in Breathing System (BIBS)</td>
<td>0.3 ACFM</td>
</tr>
</tbody>
</table>

Treatment Gas Mixtures (O₂/HeO₂/N₂O₂)

<table>
<thead>
<tr>
<th>Depth (fsw)</th>
<th>Gas Mixture</th>
<th>PPO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 60 fsw</td>
<td>100 % O₂</td>
<td>1.00 – 2.81 ATA</td>
</tr>
<tr>
<td>61 – 165 fsw</td>
<td>50/50% HeO₂ or N₂O₂</td>
<td>1.42 – 3.00 ATA</td>
</tr>
<tr>
<td>166 – 225 fsw</td>
<td>64/36% HeO₂</td>
<td>2.17 – 2.80 ATA</td>
</tr>
</tbody>
</table>

Example of Calculating Surface Interval Reached
surface (RS) @ 2305 hrs.
Left surface (LS) @ 0317 hrs. (carry over 24-hr. clock)
0317 hrs. could be expressed, ONLY FOR THE PURPOSE OF CALCULATION, as 2717 hrs. 2717 minus (-) 2305 = 4:12 4 hrs. and 12 min.

Calculating In-water Travel Time
1. Depth left (ft/m) minus (-) depth arrived (ft/m) = distance traveled (ft/m).
2. Distance traveled divided (÷) by ascent/descent rate = minutes (and/or percentage of a minute in decimal.
3. Whole number is minute(s). Decimal is percentage of minute. Take decimal and multiply (x) by 60 (number of seconds in a minute). Decimal will then convert to actual seconds.

EXAMPLE:
215 fsw – 87 fsw = 128 fsw Ascent rate: 30 fpm
128 fsw ÷ 30 fpm = 4.26 (4 minutes and .26 or 26% of a minute)
26 x 60 = 15.6 seconds (round up to next whole second) = 16 seconds
4 minutes and 16 seconds is your travel time from 215’ to 87’
# PRESSURE EQUIVALENTS

<table>
<thead>
<tr>
<th>Atmosphere</th>
<th>Bars</th>
<th>Pounds Per Square Inch (PSIG)</th>
<th>Columns of Mercury at 0°C</th>
<th>Columns of Water at 15°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.01325</td>
<td>14.696</td>
<td>.76 meters / 29.92 inches</td>
<td>10.33 MSW / 33.06 FSW</td>
</tr>
<tr>
<td>0.986923</td>
<td>1</td>
<td>14.50</td>
<td>.75 meters / 29.59 inches</td>
<td>10.20 MSW / 32.63 FSW</td>
</tr>
<tr>
<td>0.967841</td>
<td>.98066</td>
<td>14.22</td>
<td>.73 meters / 28.95 inches</td>
<td>10.00 MSW / 32.00 FSW</td>
</tr>
<tr>
<td>.068046</td>
<td>.068947</td>
<td>1</td>
<td>.05 meters / 2.03 inches</td>
<td>.70 MSW / 2.25 FSW</td>
</tr>
<tr>
<td>1.31579</td>
<td>1.33322</td>
<td>19.33</td>
<td>meters / 39.37 inches</td>
<td>13.60 MSW / 43.50 FSW</td>
</tr>
<tr>
<td>.0334211</td>
<td>.0338639</td>
<td>.4911</td>
<td>.0254 meters / 1 inch</td>
<td>.345 MSW / 1.10 FSW</td>
</tr>
<tr>
<td>.09674</td>
<td>.09798</td>
<td>1.421</td>
<td>.0735 meters / 2.89 inches</td>
<td>MSW / 3.19 FSW</td>
</tr>
<tr>
<td>.002456</td>
<td>.002489</td>
<td>.0360</td>
<td>.0018 meters / .0735 inches</td>
<td>.025 MSW / .0812 FSW</td>
</tr>
<tr>
<td>.029487</td>
<td>.029877</td>
<td>.4333</td>
<td>.0224 meters / .8822 inches</td>
<td>.304 MSW / .975 FSW</td>
</tr>
<tr>
<td>.030242</td>
<td>.03064271</td>
<td>.4444</td>
<td>.0229 meters / .9048 inches</td>
<td>.3126 MSW / 1 FSW</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACF</td>
<td>Actual Cubic Feet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACFM</td>
<td>Actual Cubic Feet per Minute</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATA</td>
<td>Atmospheres Absolute</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATM</td>
<td>Atmospheres</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFM</td>
<td>Cubic Feet per Minute</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Diameter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FFW</td>
<td>Feet of Fresh Water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSW</td>
<td>Feet of Sea Water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FV</td>
<td>Floodable Volume</td>
<td></td>
<td></td>
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<td>Low Pressure</td>
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<tr>
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<td>Meters of Fresh Water</td>
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<td>Meters of Sea Water</td>
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<tr>
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<td>Maximum Working Pressure</td>
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<tr>
<td>PP</td>
<td>Partial Pressure</td>
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<tr>
<td>PPO²</td>
<td>Partial Pressure of Oxygen</td>
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<td>Volume</td>
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### ENGLISH METRIC EQUIVALENTS

#### MASS EQUIVALENTS

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<th>Kilograms</th>
<th>Grams</th>
<th>Ounces</th>
<th>Pounds</th>
<th>Tons (short)</th>
<th>Tons (long)</th>
<th>Tons (metric)</th>
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#### LENGTH EQUIVALENTS

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<th>Inches</th>
<th>Feet</th>
<th>Yards</th>
<th>Fathom</th>
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## VOLUME AND CAPACITY EQUIVALENTS

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<th>Cubic Feet</th>
<th>Cubic Yards</th>
<th>Pint</th>
<th>Quart</th>
<th>Gallon</th>
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**APPENDIX 12**  
**VERIFICATION OF DIVER TRAINING AND EXPERIENCE**

Diver: ________________________________  
Date: ______________

Having met the requirements listed in the Florida International University Diving Operations Manual Section 3.00 and Section 4.00, you are hereby qualified as a:

**FIU WORKING DIVER**

You are responsible for remaining familiar with all changes and revisions to the Florida International University Diving Operations Manual, and any other pertinent changes to diving related policy. Furthermore, you will ensure that all procedures you are subject to are followed, and that all equipment employed by you during diving operations are in good working order. Additionally you are required to take action in the event of a potentially dangerous situation and report any unsafe condition to the Dive Supervisor or Diving Safety Officer.

The following is a brief summary of this diver's personnel file regarding dive status and qualifications:

<table>
<thead>
<tr>
<th>Certification Date</th>
<th>Organization: _________________________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written diving examination</td>
<td>Grade: _______</td>
</tr>
<tr>
<td>Last diving medical examination</td>
<td>Medical examination expiration date ________</td>
</tr>
<tr>
<td>Swim Test: (400 yrd Swim, 25 yrd Underwater swim, Tread water, Tow incapacitated person 25 yrd)</td>
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</tr>
<tr>
<td>Skills Evaluation Dive</td>
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</tr>
<tr>
<td>Diver Rescue</td>
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</tr>
<tr>
<td>Bail out cylinder &amp; Reserve valve familiarization</td>
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</tr>
<tr>
<td>CPR training (Agency)</td>
<td>CPR Exp. _____________</td>
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<tr>
<td>Oxygen administration (Agency)</td>
<td>02 Exp. _______________</td>
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<tr>
<td>First aid (Agency)</td>
<td>F.A. Exp. ______________</td>
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<tr>
<td>Fill Station Familiarization</td>
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<tr>
<td>Dive Equipment Familiarization</td>
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<tr>
<td>Basic seamanship &amp; mooring familiarization</td>
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<tr>
<td>Site and Aquarius UW Habitat Orientation Dives</td>
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<tr>
<td>Basic Underwater Navigation</td>
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<tr>
<td>Line Pull Signals</td>
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</tr>
</tbody>
</table>

Number of dives completed for qualification ______  
Depth Certification________ fsw

Any restrictions? (Y/N)______ if yes, explain:

Indicate any pertinent specialty certifications or training:

This is to verify that the above individual is currently a certified Working Diver at Florida International University.

Diving Safety Officer:  

__________________________  
(Signature)  
__________________________  
(Date)  

__________________________  
(Print)

FIU-DOM-01 Revision-1  
12/2019
APPENDIX 13

DIVE COMPUTER GUIDELINES

1. Only those makes and models of dive computers approved may be used.

2. Any diver using a dive computer as a means of determining decompression status must complete an appropriate practical training session.

3. Each diver relying on a dive computer to plan dives and indicate or determine decompression status must have his/her own unit.

4. On any given dive, both divers in the buddy pair must follow the most conservative dive computer.

5. If the dive computer fails at any time during the dive, the dive must be terminated and appropriate surfacing procedures should be initiated immediately.

6. A diver should not dive for 18 hours before activating a dive computer to use it to control their diving.

7. Once the dive computer is in use, it must not be switched off until it indicates complete out gassing has occurred or 18 hours have elapsed, whichever comes-first.

8. When using a dive computer, non-emergency ascents are to be at a rate specified for the make and model of dive computer being used.

10. Whenever practical, divers using a dive computer should make a stop between 10 and 30 feet for 3 minutes, especially for dives below 60 fsw.

11. Multiple deep dives require special consideration.