AMERICAN SOCIETY OF CIVIL ENGINEERS

Diver Training Standard for Underwater Investigations

Prepared by
Ports and Harbors Committee
Coasts, Oceans, Ports, and Rivers Institute

12 May 2009

Abstract

This standard provides minimum diver training requirements for individuals performing underwater engineering investigations. The purpose of this standard is to improve the level of safety for individuals engaged in underwater investigations as defined in *"Underwater Investigations: Standard Practice Manual," ASCE Manuals and Reports on Engineering Practice No. 101*. This standard provides minimum requirements for diver training participants, instructors, training facilities, and training programs. Completion of a training program in accordance with this standard alone does NOT qualify that person to practice engineering or claim the title of an engineer-diver.

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[To be completed by ASCE CSC]

Foreword

The Board of Direction approved revisions to the ASCE Rules for Standards Committees to govern the writing and maintenance of standards developed by ASCE. All such standards are developed by a consensus standards process managed by the ASCE Codes and Standards Committee (CSC). The consensus process includes balloting by a balanced standards committee, and reviewing during a public comment period. All standards are updated or reaffirmed by the same process at intervals between five to ten years.

In 2001, the Ports and Harbors Committee of ASCE's Coasts, Oceans, Ports, and Rivers Institute (COPRI) published *"Underwater Investigations: Standard Practice Manual," ASCE Manuals and Reports on Engineering Practice No. 101*. The manual provides guidelines and recommended practices for conducting underwater engineering investigations. The scope of the manual is limited to the technical engineering qualifications of individuals performing underwater investigations and underwater investigation methods. Diving qualifications and competence are recognized as a significant component of this subject, but they are not addressed within the manual.

Occupational Safety and Health Administration (OSHA) regulations establish minimum safety requirements for commercial diving operations in the United States. Commercial diver training standards in compliance with OSHA's requirements for personnel qualifications exist. However, existing standards for commercial diver training in the United States do not specifically address the prerequisites, diver training requirements, responsibilities, and restrictions for the engineers, scientists, and technicians performing only commercial underwater engineering investigations.

The purpose of this standard is to improve both the training and proficiency of divers performing commercial underwater engineering investigations in accordance with *"Underwater Investigations: Standard Practice Manual," ASCE Manuals and Reports on Engineering Practice No. 101*. By establishing minimum diver training requirements, this standard is intended to reduce the risks of diving accidents resulting from inadequate or inappropriate diver training.

This standard has been prepared in accordance with recognized engineering principles and should not be used without the user's competent knowledge for a given application. The publication of this standard by ASCE is not intended to warrant that the information contained therein is suitable for any general or specific use, and ASCE takes no position respecting the validity of patent rights. The user is advised that the determination of patent rights or risk of infringement is entirely their own responsibility.

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1.0 Scope

This standard provides minimum diver training requirements for individuals performing commercial underwater engineering investigations in accordance with "*Underwater Investigations: Standard Practice Manual," ASCE Manuals and Reports on Engineering Practice No. 101*. The standard specifies: (1) prerequisites for diver training course students, (2) minimum qualifications for course instructors, (3) general requirements for course facilities and equipment, and (4) a diver training course syllabus that includes minimum instruction hours.

Persons utilizing this standard may come in contact with hazardous materials, operations and equipment. This standard does not purport to address the safety challenges associated with its application. It is the responsibility of the user of this standard to establish appropriate safety and health practices and to determine the applicability of regulatory and non-regulatory limitations.

English customary units followed by Standard International (SI) units in parentheses shall be used herein.

2.0 Purpose

The purpose of this standard is to improve the level of safety for those individuals engaged in commercial underwater engineering investigations as defined in "*Underwater Investigations: Standard Practice Manual," ASCE Manuals and Reports on Engineering Practice No. 101*. By establishing minimum diver training requirements, this standard is intended to improve both the training and proficiency of divers performing commercial underwater engineering investigations, thereby reducing the risks of diving accidents resulting from inadequate or inappropriate diver training. This standard does NOT address the technical engineering qualifications that are also required to perform underwater investigations as defined by the *Underwater Investigations: Standard Practice Manual*.

Certification of diver training completed in accordance with this standard shall be provided by duly qualified instructors, as specified herein. Any certificates of instruction issued in accordance with this standard shall document successful completion of a diver training course only. Diver training alone in accordance with this standard shall not provide sole certification, license, or approval of an individual to perform underwater engineering investigations. Course training, on-the-job training, experience, and competency assessments in addition to and beyond this minimum diver training standard shall be used to determine appropriate qualifications for individuals performing or involved with commercial underwater engineering investigations.

3.0 Use and applicability

This standard is intended for consumers, producers, and others involved in the solicitation, procurement, and performance of commercial underwater engineering investigations. This standard provides basic diver training requirements and should be considered only applicable for the subjects included. This standard is intended for individuals involved in underwater engineering investigation work limited to:

(A) Diving operations using open circuit self contained underwater breathing apparatus (SCUBA) or lightweight surface supplied air (SSA) diving systems.

(B) The use of compressed air breathing gas only. Nitrox or other mixed gas for life support is specifically excluded.

(C) Planned diving operations within U.S. Navy no-decompression limits.

(D) Diving operations in water depths of less than 100 ft (33 m).

Individuals performing work outside of these limits should have more extensive training than that provided under this standard.

4.0 Applicable documents

American Society of Civil Engineers (ASCE). *Underwater Investigations: Standard Practice Manual. ASCE Manuals and Reports on Engineering Practice No. 101.* Childs, Kenneth M. Jr. ed. ASCE. 2001.

U.S. Department of Labor, Occupational Health and Safety Administration (OSHA). Commercial Diving Operations: Code of Federal Regulations Title 29 Part 1910 Occupational Safety and Health Standards Subpart T. 2006.

5.0 Definitions

The following definitions are provided for uncommon terms or terms that may have more than one common definition. The following terms are used in this standard only as defined.

Air: A gas mixture containing 21% oxygen, 78% nitrogen, and 1% other gases (mainly argon).

Bottom time: The total elapsed time measured in minutes from the time the diver leaves the surface in descent to the time to the next whole minute that the diver begins ascent.

Buoyancy control device (BCD): An inflatable vest worn by the diver that can be manually or orally inflated to help control buoyancy.

Commercial diver: A diver engaged in underwater work for hire, excluding sport, scientific and recreational diving.

Commercial diving operation: All activities in support of a commercial diver.

Commercial SCUBA: SCUBA diving for commercial work that involves more sophisticated diving equipment and more strenuous underwater activities than recreational SCUBA diving. Commercial SCUBA diving requires that divers adhere to stringent safety standards and requirements.

Decompression chamber: A pressure vessel for human occupancy such as a surface decompression chamber especially equipped to recompress, decompress, and treat divers.

Decompression sickness: A condition caused by the formation of gas or gas bubbles in the blood or body tissue as a result of pressure reduction.

Decompression table: A profile or set of profiles of ascent rates and breathing mixtures designed to reduce the pressure on a diver safely to atmospheric pressure after the diver has been exposed to a specific depth and bottom time of the *U.S. Navy Diving Manual* or equivalent limits which the employer can demonstrate to be equally effective.

Depth: The maximum pressure expressed in feet (meters) of seawater attained by a diver and is used to express the depth of a dive.

Engineer-Diver: An engineer engaged in commercial diving who performs underwater inspections and surveys in accordance with *"Underwater Investigations: Standard Practice Manual," ASCE Manuals and Reports on Engineering Practice No. 101*.

Hyperbaric conditions: Pressure conditions in excess of surface atmospheric pressure.

No-decompression limits: The maximum time that can be spent at a given depth that safe ascent can be made directly to the surface at a prescribed travel rate with no decompression stops is the no-decompression limit. No-decompression limits are provided in the *U.S. Navy Diving Manual* or by equivalent limits demonstrated to be equally effective.

Recreational SCUBA: The use of SCUBA equipment primarily for the purpose of leisure and enjoyment.

Reserve breathing gas: A supply of breathing air provided from the dive location or carried by the diver in addition to the primary or secondary breathing air supplied to the diver.

Self contained underwater breathing apparatus (SCUBA): A diving mode independent of surface supply in which the diver is supplied with an open circuit compressed breathing mixture from diver carried equipment.

Surface-supplied air (SSA): A diving mode in which the diver is supplied from the dive location with compressed breathing air.

Treatment table: A depth, time, and breathing gas profile designed to treat a diver for decompression sickness. Tables are provided in the *U.S. Navy Diving Manual* or by equivalent tables demonstrated to be equally effective.

6.0 General requirements

6.1 Diver training facility

Diver training facilities shall meet all federal, state, and local requirements and laws. Diver training facilities shall possess adequate space, equipment, and shall comply with all safety regulations to facilitate safe diver training. Diver training facilities shall be capable of supporting practical, in-water training.

6.2 Instructors

Instructors shall have a minimum of two (2) years full-time working experience in the field of commercial diving or in the subject area for which the instructor shall be responsible for teaching. Instructors shall meet state educational requirements for vocational instructors. Instructors shall meet and comply with all applicable state and city codes.

Instructors providing competency assessment shall impartially and objectively assess the diving knowledge and diving abilities of students. The affiliations and organization of the certificate provider shall be independent of the student's affiliations and organizations. That is, there shall be no financial or other business ties between the certificate provider and the student's organization such that the certificate provider may benefit from the success of the student's organization.

Instructors shall have and maintain current certification in cardiopulmonary resuscitation (CPR), first aid, and oxygen provider. Instructors shall be trained in emergency policies and procedures.

6.3 Equipment

Diving and support equipment used for instruction shall be properly maintained in accordance with manufacturers' specifications and OSHA 29CFR 1910.430.

Diver training shall be conducted with the types of diving equipment that the student will use in industry. Instructors are encouraged to educate participants about newly developed equipment that will likely be used by participants in industry. Manufacturer's operation manuals shall be made available to the student, as well as instruction manuals, equipment, and tools for hands-on diving equipment repair and maintenance.

Other diving and support equipment that shall be provided at the diver training facility includes, but is not limited to, the following: SCUBA and SSA diving systems, high and

low pressure diving air compressors, diver carried reserve air cylinders, air supply manifolds, and properly constructed umbilical hoses.

6.4 Diver training aids

Diver training aids shall contain current information and shall be appropriate for individual courses and modules. Up-to-date audiovisual aids shall be used with all applicable instruction. Students shall be supplied with a commercial diving logbook which shall be maintained and updated by the student on a regular basis.

6.5 Physical examinations

Each student shall pass a medical examination prior to acceptance into a diver training course. The medical examination shall be current within the last year from the course finish date. Limits and standards for physical conditions of the student shall be spelled out in the medical examination form according to the current OSHA and industry requirements for commercial divers. The examining physician shall be provided with written instructions as to the scope of the physical examination and the recommended tests and techniques to be employed shall be listed in the instructions.

6.6 Safety

Safety and compliance to federal and state standards shall be emphasized throughout the diver training program. Students shall be instructed that the basic responsibility for both personal and operational safety lies with each individual. Responsibilities of tenders, tender/divers, and divers shall be included in the student's training. Rules and regulations for working in and around the marine environment, which are enforced by the United States Coast Guard, U.S. Army Corps of Engineers, and OSHA, shall be an integral part of the student's training.

6.7 Diving competency assessment

Students shall demonstrate diving competency in the requirements of this standard. Instructors shall assess a student's diving competency through a combination of written examination and/or individual oral examination, and demonstrated practice of diving skills both in and out of water.

An individual may apply for a diver competency assessment if they have achieved an equivalent level of instruction and/or experience prior to the effective date of this Standard. Basic and/or advanced levels of recreational SCUBA certification alone shall not be considered acceptable previous formal training in commercial diving. Guidance for performing diver competency assessments are provided for each course subject provided in this standard.

6.8 Documentation

Documentation of all diver training successfully completed shall be made available to the student by the instructor, including transcripts, diplomas, and certificates. Students shall maintain an official dive log book.

7.0 Course requirements

The following table provides a summary of training requirements for this Standard, which are described in greater detail in the sections to follow. The hours specified below are minimum levels of instruction only. The instructor(s) alone (not ASCE) shall be responsible for certifying the student's individual level of competency with regards to this standard. Additional hours of instruction may therefore be required to achieve said competency, depending on each individual's abilities and previous training/experience:

Section	Topic	Minimum Hours
7.1	Prerequisites	16**
7.2	Diving Physics	12.5
7.3	Application of Diving Formulas	12.5
7.4	Human Anatomy and Diving Physiology	18
7.5	Diving Illnesses and Injuries	12
7.6	Treatment of Diving Illnesses and Injuries	16
7.7	Non-Decompression Diving And Emergency Decompression Procedures	16
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7.9	Noxious Gases in Enclosed Spaces	2
7.10	Record Keeping and Dive Operations Standards	12
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7.12	Workplace Safety	6
7.13	Diving Equipment	24
7.14	Diving Procedures and Practice	40
	TOTAL	**211**

** Credit for current certifications in CPR, First Aid and Oxygen Provider.

7.1 Prerequisites

Students shall be in possession of and maintain current certification in the following (16 hours minimum):

(A) Cardio-Pulmonary Resuscitation (CPR)

(B) First Aid

(C) Oxygen Provider

Students shall be in possession of at least a basic "Open Water" recreational diving certification, such as that provided by National Association of Underwater Instructors (NAUI), Professional Association of Diving Instructors (PADI), and Scuba Schools International (SSI).

Students shall meet the following minimum education requirements:

(A) Graduation from a 4-year ABET-accredited engineering curriculum or certification as an Engineer-in-Training; or

(B) Successful completion of an industry recognized course of study in engineering investigations, such as a Federal Highway Administration (FHWA) approved comprehensive or underwater bridge inspection training course; or

(C) National Institute for Certification of Engineering Technologies (NICET) certification (Level II, minimum).

7.2 Diving physics

7.2.1 Minimum required hours

A minimum of twelve and one-half (12.5) hours shall be allocated for this section of the course.

7.2.2 Objective(s)

The student shall demonstrate a thorough knowledge of applicable principles of liquid and gas properties, buoyancy, and gas laws related to diving. The student shall demonstrate competence in the practical application and use of the subject theories, principles, and formulas.

7.2.3 Outline of instruction

(A) Composition and characteristics of air, water, and gases

(B) Pressure in diving: Atmospheric, gauge, barometric, and absolute

(C) Gas Laws: Boyle's Law, Charles' Law, Dalton's Law, and Henry's Law

(D) Floatation and buoyancy: Archimedes' Principle

(E) Practical examples and application: Pressures at depth, volume of cylinders, air supply and pressure requirements, and gas law applications

7.3 Application of diving formulas

7.3.1 Minimum required hours

A minimum of twelve and one-half (12.5)hours shall be allocated for this section of the course.

7.3.2 Objective(s)

The student shall demonstrate competence in the practical application and use of the subject theories, principles, and formulas.

7.3.3 Outline of instruction

(A) Pressures at depth

(B) Volume of cylinders

(C) Time duration of air supply from air flasks

(D) Air supplies required by divers

(E) Flow requirements for masks and hats

(F) Required capacity of air compressor

(G) Hose test formula

(H) Application of physics formulas

7.4 Human anatomy and physiology

7.4.1 Minimum required hours

A minimum of eighteen (18) hours shall be allocated for this section of the course.

7.4.2 Objective(s)

The student shall demonstrate familiarity with the muscular/skeletal and nervous systems. The student shall demonstrate an understanding of the circulatory and respiratory systems, ears, sinuses, and vestibular organs. The student shall demonstrate a thorough knowledge of the effects of pressure and how pressure relates to the anatomy and physiology of the human body.

7.4.3 Outline of instruction

(A) Anatomy: Circulatory and respiratory systems

(B) Physiology: Circulatory and respiratory systems

(C) Body cavities containing air

(D) Physiological effects of pressure

(E) Toxic effects of oxygen

(F) Narcotic effects of nitrogen

(G) Toxic effects of carbon dioxide and carbon monoxide

(H) Nitrogen absorption and elimination

(I) Effects of pressure in excess of one (1) atmosphere on body tissue

(J) Principles involving prevention of decompression sickness

7.5 Diving illnesses and injuries

7.5.1 Minimum required hours

A minimum of twelve (12) hours shall be allocated for this section of the course.

7.5.2 Objective(s)

The student shall demonstrate an understanding of the various types, causes, and symptoms for common diving-related injuries and illnesses.

7.5.3 Outline of instruction

(A) Physiological principles of disease and injury prevention

(B) Psychological aspects of diving

(C) Diseases and injuries: Definition, symptoms, causes, prevention, and treatment of the following:
- (1) Anoxia/hypoxia
- (2) Hypercapnia/asphyxia
- (3) Drowning
- (4) Barotrauma (squeeze)
- (5) Decompression sickness
- (6) Pulmonary over-inflation syndrome
- (7) Arterial gas embolism
- (8) High pressure nervous system
- (9) Inert gas narcosis
- (10) Oxygen toxicity: Pulmonary and Central Nervous System (CNS)
- (11) Mediastinal and subcutaneous emphysema
- (12) Carbon dioxide and carbon monoxide poisoning
- (13) Lipoid pneumonia
- (14) Pneumothorax
- (15) Bone necrosis

7.6 Treatment of diving illnesses and injuries

7.6.1 Minimum required hours

A minimum of sixteen (16) hours shall be allocated for this section of the course.

7.6.2 Objective(s)

The student shall demonstrate an understanding of the procedures for assessment and identification of common diving-related injuries and illnesses. The student shall demonstrate practical competence in communicating with medically trained persons in the event of a diving injury or illness. The student shall demonstrate practical competence in the application of appropriate emergency, CPR, first aid, and oxygen provider practices.

7.6.3 Outline of instruction

(A) Routine post dive examinations

(B) Injured diver examinations

- (1) Vital signs
- (2) Mental Condition
- (3) Cranial Nerves
- (4) Sensory Nerves
- (5) Motor Nerves
- (6) Coordination
- (7) Reflexes

(C) Introduction to hyperbaric treatment tables and procedures

(D) Case histories and practical examples

7.7 Non-decompression diving and emergency decompression procedures

7.7.1 Minimum required hours

A minimum of sixteen (16) hours shall be allocated for this section of the course.

7.7.2 Objective(s)

The student shall demonstrate a thorough knowledge of practical competence in the use of non-decompression diving procedures and tables. The student shall demonstrate a thorough understanding of and shall be practically competent in the use of emergency decompression procedures and tables.

7.7.3 Outline of instruction

(A) Breathing air at depth

(B) Standard air non-decompression tables and repetitive dive planning

(C) Emergency decompression definitions, types, and procedures

(D) Standard air decompression tables

(E) Altitude diving computations and tables

(F) Practical application of non-decompression planning and tables

(G) Practical application of emergency decompression procedures and tables

7.8 Environmental hazards of diving

7.8.1 Minimum required hours

A minimum of twelve (12) hours shall be allocated for this section of the course.

7.8.2 Objective(s)

The student shall demonstrate a thorough understanding of the common, realistic potential hazards associated with underwater investigations in typical inland and coastal environments. The student shall acquire a sense of the legality, and actual need for hazard assessment at the beginning (set-up) of the dive day. The student shall demonstrate understanding of common practical methods for avoiding and addressing these hazards.

7.8.3 Outline of instruction

(A) Debris, entanglement and underwater obstructions

(B) Diving in strong currents

(C) Surf, surge, currents and tides

(D) Limited or zero visibility conditions

(E) Diving behind or during contractor diving operations

(F) Vessel traffic and wake conditions

(G) Polluted or contaminated waters

(H) Diving with no direct access to water surface

(I) Penetration of pipelines, culverts, intakes, and outfalls including team size and make up, team experience, necessary extra redundancy

(J) Underwater suctions and discharges

(K) Differential head pressure conditions

(L) Lock-out/tag-out procedures and needs

(M) Sonar and underwater noise conditions

(N) Impressed current cathodic protection

(O) Weather and temperature exposure

(P) Marine life hazards

(Q) Local security requirements: USCG, DOT access, Local/Marine police

7.9 Noxious gases in enclosed spaces

7.9.1 Minimum required hours

A minimum of two (2) hours shall be allocated for this section of the course.

7.9.2 Objective(s)

The student shall demonstrate knowledge of the noxious gases encountered in diving operations. The instruction will also introduce the student to various instruments used to detect noxious gases and familiarize the student with precautions necessary to avoid accidents from noxious gases.

7.9.3 Outline of instruction

(A) Noxious gases

(B) Closed spaces

(C) Carbon Monoxide

(1) Origin, description, and identification

(2) Affinity toward hemoglobin; comparative attraction ratios versus oxygen

(3) Symptoms of carbon monoxide poisoning

(4) Treatment of carbon monoxide poisoning cases

(D) Carbon Dioxide

(1) Sources and description

(2) Effects upon respiration

(3) Symptoms of carbon dioxide poisoning

(4) Treatment of carbon dioxide poisoning cases

(E) Explosive gases

(1) Types

(2) Generation Process

(F) Instruments used in detecting gases

(1) Hydrogen sulfide detector

(2) Carbon monoxide detector

(G) Elimination and prevention of gas hazards

(H) Means of avoiding accidents from gas hazards

(I) Rules for mask or helmet removal

7.10 Record keeping and dive operations standards

7.10.1 Minimum required hours

A minimum of twelve (12) hours shall be allocated for this section of the course.

7.10.2 Objective(s)

The student shall demonstrate an understanding of proper record keeping techniques including individual dive logs, diving and treatment records, accident reports, and current OSHA, U.S. Navy, U.S. Coast Guard and U.S. Army Corps of Engineers commercial diving operations standards. The student shall demonstrate familiarity with relevant legislation, regulations, and standards for commercial diving operations performed within the United States.

7.10.3 Outline of instruction

(A) Individual dive logs

- (1) Organization and content
- (2) Recording of dives
- (3) Diving/treatment records and accident reports
- (4) Required dive profile sheets

(A) Commercial diving operations standards

(B) Training requirements for different diving activities

(C) Diver classification, qualifications, and certification

7.11 Operations planning

7.11.1 Minimum required hours

A minimum of twelve (12) hours shall be allocated for this section of the course.

7.11.2 Objective(s)

The student shall demonstrate an understanding of diving job relationships and operations planning. The student shall understand that although certain considerations apply to every operation, the nature of each operation shall determine the scope of the planning effort. The student shall demonstrate an understanding of the general procedures and methods for planning and executing diving operations.

7.11.3 Outline of instruction

(A) Diving job relationships

(B) Operations planning

- (1) Define objectives
- (2) Collect and analyze data from previous underwater investigations
- (3) Perform a job safety analysis
- (4) Select diving techniques, equipment, and team
- (5) Check equipment, site conditions, and safety precautions

7.12 Workplace Safety

7.12.1 Minimum required hours

A minimum of six (6) hours shall be allocated for this section of the course.

7.12.2 Objective(s)

The student shall demonstrate familiarity with federal and state requirements for commercial diving operations.

7.12.3 Outline of instruction

(A) US Coast Guard Regulations

(B) OSHA Regulations

(C) General Industrial Safety

- (1) Drugs and alcohol
- (2) Hazard identification
- (3) Work zone safety
- (4) Lock-out & Tag-out
- (5) Personal Protective Equipment
- (6) Working in confined spaces
- (7) Hazardous materials
- (8) Fire safety

7.13 Diving equipment

7.13.1 Minimum required hours

A minimum of twenty four (24) hours shall be allocated for this section of the course.

7.13.2 Objective(s)

The student shall demonstrate a thorough knowledge of the function and nomenclature of the diving equipment to be used in the training and working environments. The student shall demonstrate:

(A) Familiarity with the nomenclature, function, and operation of SCUBA and lightweight SSA diving equipment, masks, and helmets.

(B) A thorough knowledge of the proper procedures for checking, testing, and maintaining diving equipment.

(C) An understanding of and a sense of confidence and trust in the equipment.

(D) A thorough knowledge of the use of surface and diver carried reserve breathing gas supply systems and other safety procedures.

7.13.3 Outline of instruction

(A) History, development, and use
- (1) History of diving equipment
- (2) Commercial SCUBA procedures and requirements vs. recreational practices
- (3) Commercial lightweight surface supplied air diving equipment
- (4) Advantages and disadvantages of SCUBA vs. lightweight gear
- (5) Necessity for reserve breathing gas supply (bailout)
- (6) Necessity for adequate High Pressure reserve air

(B) Nomenclature, function, operation, and maintenance
- (1) High pressure and low pressure air compressors
- (2) Compressed air cylinders
- (3) First stage regulators
- (4) Second stage regulators
- (5) High and low pressure hoses
- (6) Gas manifolds/panels
- (7) Filters
- (8) Reserve breathing supplies
- (9) Masks and helmets
- (10) Umbilical hoses
- (11) Air hose
- (12) Lifeline (safety line)
- (13) Communication equipment
- (14) Harness
- (15) Dress (thermal protection)
- (16) Dry suits
- (17) Belts (weights)
- (18) BCD's
- (19) Additional equipment required by penetration, ACOE 385-1-1 etc
- (20) Contaminated diving dress and procedures
- (21) Non return valves, placement, function and testing
- (22) "O" rings purpose and maintenance

(C) Inspection Tools and Test Equipment/Methods
- (1) Underwater cameras and housings
- (2) Ultrasonic thickness testers
- (3) Structure electrolyte potential systems
- (4) Timber coring
- (5) Concrete coring
- (6) Steel coupons
- (7) Measuring devices-rulers, tapes, calipers, paint sticks
- (8) Probes
- (9) Soil samples

7.14 Diving procedures and practice

7.14.1 Minimum required hours

A minimum of forty (40) hours shall be allocated for this section of the course.

7.14.2 Objective(s)

The student shall demonstrate competency as a diver and as a member of a surface team in working and emergency situations through classroom and in-water training activities. Orientation and training dives shall be performed in a controlled diving environment. The student shall demonstrate practical competency in the following:

(A) The use of commercial SCUBA and lightweight SSA diving equipment, procedures, and safety considerations

(B) Dive station set up, safety checks, and operation

(C) Skills in the proper way of entering the water, using umbilical hose signals, and other means of communication

(D) Emergency procedures

(E) Accomplishing basic common working tasks, using SCUBA and lightweight SSA diving equipment

7.14.3 Outline of instruction

(A) Safety precautions
- (1) Pre-dive procedures
- (2) Descending and ascending procedures
- (3) Umbilical and lifeline management
- (4) Regulator, mask, and helmet operation
- (5) Reserve breathing gas supplies
- (6) Post-dive procedures

(B) Proper tending procedures

(C) Basic knots and line securing methods

(D) Orientation dives
- (1) Surface procedures
  - (a) Diver dress
  - (b) Team responsibilities
  - (c) Gas manifold/panel operation
  - (d) Pneumo-fathometer
  - (e) Umbilical
  - (f) Securing the lifeline
  - (g) Checking regulators, masks, helmets, and valves
  - (h) Checking inflation/deflation of BCD
  - (i) Attaching mask/helmet to umbilical
  - (j) Checking diver radio communications
- (2) Diver instruction

(a) Proper method of dressing
(b) Proper use of weighted belt
(c) Air control valve
(d) Exhaust valve
(e) Diver carried emergency gas supply valve and bottle
(f) Proper method of securing lifeline to diver

(3) Orientation diving
(a) Proper water entry and exit
(b) Hand signal procedures
(c) Umbilical signal procedures
(d) Voice radio communications

(4) Emergency procedures
(a) Uncontrolled ascent
(b) Weight belt release
(c) broken mask/helmet/faceplate
(d) trapped/fouled diver
(e) unconscious/injured diver
(f) contaminated air supply
(g) Simulated in-water emergency decompression
(h) Standby diver procedures

(5) Emergency procedures for loss of gas
(a) Surface reserve gas procedures
(b) Diver carried reserve gas procedures
(c) Pneumo-fathometer hose air supply procedures

(E) Practical training dives: Situational practice and training in applicable work procedures utilizing SCUBA and SSA diving equipment. Practical training dives shall include, at a minimum:

(1) One open water planned non-decompression dive to a depth of 60 feet (18 meters) with a minimum bottom time of 20 minutes.

(2) One open water planned non-decompression dive to a depth of 90 feet (27 meters).

(3) Underwater work tasks performed in open water or a controlled diving reservoir including at least one of the following:
a. Visual inspection, survey, and measurement
b. Use of hand tools for cleaning marine growth
c. Navigation
d. Diver search methods
e. Low visibility
f. Non-destructive testing
g. Variable depth diving

8.0 References

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International Diving Schools Association. *International Diver Training Certification: Diver Training Standards*. Rev. 3. Brittany, France. 2005.

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