

American National Standard

*for Divers –
Commercial Diver Training –
Minimum Standard*



ANSI/ACDE-01-2009

American National Standard
for Divers –
**Commercial Diver Training –
Minimum Standards**

Secretariat

Association of Commercial Diving Educators

Approved April 13, 2009

American National Standards Institute, Inc.

American National Standard

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Foreword (This foreword is not part of American National Standard ANSI/ACDE-01-2009.)

The American National Standards Institute (ANSI) Standard for Commercial Diver Training requires that a diver at work must have received adequate training to undertake the work involved in the diving operation safely. As part of this requirement, each diver must possess a valid certificate of training. This may be:

- a) A certificate of training issued by an Association of Commercial Diving Educators (ACDE) accredited school; or
- b) Commercial diving experience or a combination of both commercial experience and training; or
- c) The equivalent of the training requirements as outlined in this American National Standard.

The Association of Diving Contractors (ADC) hereby recognizes and endorses the standard as one being acceptable for an entry-level commercial diver trainee. Exempted from its application are all those commercial divers who, prior to April 1993, had achieved an equivalent degree of training through a combination of field experience and/or formal classroom instruction. Also exempt from its application are all those entry-level commercial diver trainees who shall have received equivalent classroom instruction and/or additional training as deemed appropriate to the occupational requirements of their employer.

COMPETENCE ASSESSMENT

During 1993, in its endeavor to foster better vocational training and education, the Association of Commercial Diving Educators (ACDE) encouraged the development of standards-based qualifications that focused on essential competence at the workplace and that were assessable, as well as understood, by employers, trainees, and trainers.

With the agreement of the industry, ACDE decided in 1995 that such an approach was appropriate to diver qualification, and that certificates should be issued on the basis of competence rather than merely the completion of a training course. ACDE subsequently developed the competence standard and related assessment requirements as set out in this document.

Competence is determined through written tests, instructor evaluation, log book records, and the trainee's performance, attitude and ability to conduct in-water diving-related work tasks.

In conjunction with a diver training course, divers will be assessed by schools that have been accredited for this purpose. Theoretical competence forms the foundation for the application and is required when practical ability and skills depend on some element of knowledge and understanding. Where both theory and practice is indicated, divers will be assessed both ways. Assessment records on each trainee will be maintained by individual training sites.

Although not spelled out as a specific competence, all divers recommended for a certificate must have achieved specified in water times during training and assessment. Those times for training are set out in the published Commercial Diver Training Minimum Standard; and are further clarified in the standard where needed to avoid ambiguity.

For a certificate of training, a student must achieve a minimum of 625 hours of formal instruction.

COMPETENCE STANDARD

This new standard was derived from the 1998 American National Standard for commercial diver training. This standard is more defined and specifies minimum requirements.

The Competence Standard represents abilities that a diver must demonstrate under testing before he (she) can be issued a Commercial Diving Certificate. This standard pertains whether the Certificate is the result of training or experience or both.

The competence standard is divided into Sections that represent important aspects of a diver's ability and can be identified as such by employers. These include, for example, practical diving - the ability of the diver to leave the surface, remain at the underwater work site until the job is finished or his time is up, and return safely to the surface. Each section is further divided into main and subheadings. The latter provides the essential detail on which the diver will be assessed.

STATEMENT

The aim of the Standard is to:

- Improve the quality of training, both theoretical and practical application, for entrants to commercial diving;
- Reduce the risk of diving accidents attributable to inadequate training;
- Establish consistent minimum training requirements to ensure continuity of training within the ACDE;
- Require that graduates be qualified and competent to dive and perform underwater work assignments before receiving a Certificate.

This standard was developed to establish what is to be taught, the minimum length of training required for each section, the minimum qualifications of instructors, and the minimum facilities and equipment required to support that training as outlined in Section 1. In developing this standard, subject matter that is similar, or closely related, is grouped together. Subject matter has been further subdivided into topics of manageable size for instructional purposes and detailed lesson planning. Such grouping is not intended as a training schedule.

After the effective date of the standard, the Association of Commercial Diving Educators (ACDE) hereby recognizes and endorses this standard as the acceptable minimum training standard for the entry-level commercial diver trainee. All commercial divers who can document an equivalent level of training through a combination of field experience and/or formal diver training prior to the original issue date (1998) are specifically exempt from its application.

ACDE provides accreditation to all of its member schools and ensures that a national system of commercial diver training is maintained. Diver training institutions wishing to become a member of ACDE are inspected and evaluated to ensure the training standards provide training for commercial diving to the level of its standard.

Questions regarding this standard and/or applications for membership in ACDE should be addressed to:

ACDE
721 CLIFF DRIVE
SANTA BARBARA, CA 93109
ATTN: MR. DON BARTHELMESS, TREASURER

Deviation from the standard may be made only to exceed or supplement the required training.

The order of sections presented by ACDE for training requirements is not restricted to the section sequence contained herein. Differences in facilities, equipment, local administrative requirements, state and federal laws, and/or similar conditions may warrant modification of any established sequence. It is the responsibility of each school to provide for the efficient implementation and administration of this standard and to ensure that each topic presented herein is presented in a way that provides a maximum gain in knowledge and skill for each trainee. The minimum standard will be reviewed periodically to reflect changes in technology, techniques and other developments that are likely to occur in the commercial diving industry.

American National Standard for Divers –

Commercial Diver Training – Minimum Standard

1 GENERAL REQUIREMENTS

1.1 Facility

Training facilities shall meet all federal, state, and local requirements and laws. They should possess adequate space, equipment, and safety regulations to offer safe and competent training. Aside from federal, state and local requirements, as a minimum, facilities will include classrooms with adequate lighting, tables, desks, seating, blackboards/whiteboards, audio-visual equipment, technical library, texts, and training materials to support student learning environment. Training facilities shall be available to support practical, in-water training as well as rigging, welding, chamber operations, etc.

1.2 Staff

Each training facility should have adequate support staff to maintain high-quality teaching standards, facility, equipment, records, and emergency procedures. Staff members should be selected for their competency in performing their assigned tasks.

1.3 Instructors

Schools should employ instructors with a minimum of two years full-time working experience in the field of commercial surface-supplied diving, or area of instruction taught, and should meet state educational requirements for vocational instructors. If required, instructors shall meet state and/or city codes. All instructors should have current first aid and CPR certificates and be trained in emergency policies and procedures.

1.4 Equipment

All diving and support equipment shall be properly maintained in accordance with manufacturers' specifications.

Practical training (hands-on) should be conducted with equipment that the trainee will use in the industry. Knowledge of newly developed equipment should be taught. Manufacturers' operational manuals shall be available as well as instruction manuals, equipment, and tools for hands-on helmet and mask repair and maintenance. This shall be in addition to equipment used for working dives.

All commercial diver training facilities shall provide, as a minimum, at least two different types of diving helmet common to the industry, including a "demand" and a "freeflow" type helmet.

Other diving and support equipment that shall be provided on site includes, but is not limited to, the following: diving air compressors (hp and lp), surface-supplied diving systems, bail-out bottles, recompression chambers, air and mixed gas supply manifolds, diver's hot water supply systems, gas racks, welding machines, underwater cutting and welding equipment, hydraulic/pneumatic tools, air lift, water jet, topside and underwater rigging and mechanical projects, equipment for teaching the operation and maintenance of marine engines and compressors, lifting devices and other rigging equipment common to the diving industry, properly constructed umbilicals, and first aid and CPR training equipment.

1.5 Training Aids

Books and training aids should contain current information and be appropriate for individual courses and modules. Up-to-date audiovisual aids should be used with all applicable instruction. Students should be supplied with an ACDE/ADC Commercial Diving Log Book that must be maintained and updated on a regular basis.

1.6 Physical Examinations

Each entrant should pass a medical examination before being accepted into a training program. The medical examination should be current within the last year from the class finish date. Limits and standards for physical condition of the entrant should be spelled out in the medical examination form according to the current Association of Diving Contractors (ADC) medical requirements for commercial divers. The examining physician should be instructed in writing exactly what to look for in a potential entrant and the recommended tests and techniques to be employed should be listed.

1.7 Physical Fitness

The importance of physical fitness shall be emphasized to students throughout the training program.

1.8 Industry Input

Close liaison with the safety, education, and medical committees of the Association of Diving Contractors (ADC) should be maintained to ensure that training meets industry requirements and needs. Contact with commercial diving companies and equipment manufacturers should be maintained to ensure awareness of changes and improvements in equipment, procedures, and safety requirements, etc.

1.9 Employment

Students shall be informed about employers' hiring policies regarding drugs and alcohol. Responsibilities of tenders, tender/divers, and divers shall be included in training. Rules and regulations for the United States Coast Guard, Association of Diving Contractors, (ADC) Consensus Standards, and OSHA shall be an integral part of training.

1.10 Safety

Safety and compliance to federal, state, and ADC standards should be emphasized throughout the training program. Students shall be instructed that the basic responsibility for both personal and operational safety lies with each individual.

1.11 Documentation

Documentation of all training successfully completed shall be available to the student including transcripts, diplomas, and certificates. Students shall be issued and required to maintain an official ADC/ACDE log book. Upon completion of training, an official ACDE certification card will be issued to each graduating student.

1.12 Drug Policy

Safety is of paramount importance. ACDE is committed to maintaining a safe, healthy work and training environment and is dedicated to providing a drug- and alcohol-free workplace.

A substance abuse policy should be strictly enforced. This will provide a means to minimize the use of intoxicants by personnel, staff, employees, and trainees, and will enhance safe conduct of operations.

The goals should be to attain the highest work and training standards possible and to promote a safe work environment, free of drugs and alcohol.

The goals and objectives of maintaining safety in a drug-free work environment are attainable through cooperation at every level and by explicitly and forcefully prohibiting the use, manufacture, distribution, dispensation, and possession of illicit drugs, drug paraphernalia, and alcohol at all training locations and diving operations.

2 PRINCIPLES OF DIVING PHYSICS

Required Hours: 12.5

2.1 Objectives

- a) To provide the trainee with an understanding of the physics of air and water pressure applicable to diving

2.2 Outline of Instruction

- a) Normal air
 - 1) Definition
 - 2) Composition
 - 3) Properties
 - 4) Characteristics
 - 5) Gas laws affecting air
- b) Water
 - 1) Composition, salt and fresh water
 - 2) Characteristics
 - 3) Weight/salt and fresh water
- c) Terminology and values used in pressure (partial, barometric, atmospheric, gauge, and absolute)
 - 1) Mechanical pressure
 - 2) Other ambient pressures related to diving
- d) Buoyancy in water
 - 1) Archimedes' Principle
 - 2) Example and application
- e) Definitions
 - 1) Buoyancy
 - 2) Density
 - 3) Area
 - 4) Volume

- f) Gas Laws
 - 1) Boyle's
 - 2) Charles's
 - 3) Henry's
 - 4) General Gas Law
 - 5) Guy Lussac's
 - 6) Dalton's Law

- g) Summary
 - 1) Characteristics of air and water
 - 2) Laws governing gases
 - 3) Pressure – absolute and relative
 - 4) Computation of pressure at various atmospheres
 - 5) Buoyancy in water
 - 6) Effect of pressure on gas absorption
 - 7) Effect of temperature on pressure

3 FORMULA APPLICATION
Required Hours: 12.5

3.1 Objectives

- a) To familiarize the trainee with diving physics formulas.
- b) To provide practical experience in using diving physics formulas.

3.2 Outline of Instruction

- a) Gauge and absolute pressure at various depths
- 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

4 AIR DECOMPRESSION TABLES AND DECOMPRESSION PROCEDURES
Required Hours: 30

4.1 Objectives

- a) To familiarize the trainee with the various methods of decompression.
- b) To provide the trainee experience in the practical application of decompression tables.

4.2 Outline of Instruction

- a) History of decompression
- b) Decompression
 - 1) Definition
 - 2) Types
- c) US Navy Standard Air Decompression Tables
- d) Surface Decompression Tables (O₂ and Air)
- e) Practical application of decompression tables in theoretical dives
- f) Altitude diving tables and computation
 - 1) Barometric
 - 2) Tables
 - 3) 4% Rule

5 ANATOMY AND PHYSIOLOGY RELATED TO DIVING**Required Hours: 18****5.1 Objectives**

- a) To describe the anatomy and physiology of the circulatory and respiratory systems of the human body.
- b) To educate the trainee on the effects of pressure and changes of pressure on the human body.
- c) To provide the trainee a better understanding of the process and what happens when ambient pressure is increased or decreased.

5.2 Outline of Instruction

- a) Anatomy and physiology: The study of various organs and parts of the body; their functions and activities
 - 1) Anatomy of the circulatory system
 - 2) Physiology of the circulatory system
 - 3) Anatomy of the respiratory system
 - 4) Physiology of the respiratory system
 - 5) Body cavities containing air
- b) Primary effects of pressure
 - 1) Effects of pressure applied equally to the body
 - 2) Effects of pressure applied unequally to the body
- c) Secondary effects of pressure (the disturbances in gas equilibrium; i.e., of gases in the body)
 - 1) Toxic effects of oxygen
 - 2) Narcotic effect of nitrogen
 - 3) Toxic effects of carbon dioxide and carbon monoxide
 - 4) Nitrogen absorption and elimination
 - 5) Effects of pressure in excess of one (1) atmosphere on body tissue
 - 6) Principles involving prevention of decompression sickness

6 DIVING DISEASES, INJURIES AND PSYCHOLOGICAL ASPECTS

Required Hours: 12

6.1 Objectives

a) To familiarize the trainee with the various types of diseases and injuries that occur in diving.

6.2 Outline of Instruction

- a) Anoxia/hypoxia
 - 1) Definition
 - 2) Symptoms
 - 3) Causes
 - 4) Prevention and treatment

- b) Hypercapnia/asphyxia
 - 1) Definition
 - 2) Symptoms
 - 3) Causes
 - 4) Prevention and treatment

- c) Squeeze
 - 1) Definition
 - 2) Symptoms
 - 3) Causes
 - 4) Prevention and treatment

- d) Decompression sickness
 - 1) Definition and types
 - 2) Symptoms
 - 3) Causes
 - 4) Prevention and treatment

- e) Arterial Gas Embolism (AGE)
 - 1) Definition
 - 2) Symptoms
 - 3) Causes
 - 4) Prevention and treatment

- f) High Pressure Nervous Syndrome (HPNS)
 - 1) Definition
 - 2) Symptoms
 - 3) Causes
 - 4) Prevention and treatment

- g) Nitrogen narcosis
 - 1) Definition
 - 2) Symptoms
 - 3) Causes
 - 4) Prevention and treatment

- h) Oxygen toxicity (CNS/pulmonary)
 - 1) Definition
 - 2) Symptoms
 - 3) Causes
 - 4) Prevention and treatment

- i) Pneumothorax
 - 1) Definition
 - 2) Symptoms
 - 3) Causes
 - 4) Prevention and treatment

- j) Mediastinal and subcutaneous emphysema
 - 1) Definition
 - 2) Symptoms
 - 3) Causes
 - 4) Prevention and treatment

- k) Carbon monoxide poisoning
 - 1) Definition
 - 2) Symptoms
 - 3) Causes
 - 4) Prevention and treatment

- l) Drowning (near drowning)
 - 1) Definition
 - 2) Symptoms
 - 3) Causes
 - 4) Prevention and treatment

- m) Lipoid pneumonia
 - 1) Definition
 - 2) Symptoms
 - 3) Causes
 - 4) Prevention and treatment

- n) Bone necrosis
 - 1) Definition
 - 2) Symptoms
 - 3) Causes
 - 4) Prevention and treatment

- o) Psychological aspects of diving
 - 1) Screening for phobias
 - 2) Rationale of physical vs. mental abilities of divers
 - 3) Water skills and their psychological implications
 - 4) Specific adaptations (breathing through the nose, use of mechanical equipment, etc.)
 - 5) Emotional and physical stability
 - 6) Diver stress
 - 7) Effects of stress
 - 8) Comparison of panic and mental controls
 - 9) Diving philosophies
 - 10) Dive planning
 - 11) Breathing and diving (related to stress stimulus)
 - 12) Rules for reacting to all unusual feelings, control of stress, stimulus
 - 13) Green diver syndrome

7 TREATMENT OF DIVER'S ILLNESS AND INJURIES
Required Hours: 30

7.1 Objectives

- a) To educate the trainee in the use of tables for treatment of arterial gas embolism, decompression sickness, and omitted decompression.
- b) To impress upon the trainee the importance of selection of the proper treatment table.
- c) To provide the trainee practical experience in the selection and use of the treatment tables.

7.2 Outline of Instruction

- a) Treatment Table 1A
- b) Treatment Table 2A
- c) Treatment Table 3
- d) Treatment Table 4
- e) Treatment Table 5
- f) Treatment Table 6
- g) Treatment Table 6A
- h) Treatment Table 7
- i) Treatment Table 8
- j) Review case histories with cases that illustrate both proper and improper selection and use of treatment tables
- k) Practical use of tables with hypothetical cases and various symptoms
- l) Examination of injured diver
 - 1) Vital signs
 - 2) Mental condition
 - 3) Cranial nerves
 - 4) Sensory nerves
 - 5) Motor nerves
 - 6) Coordination
 - 7) Reflexes

8 FIRST AID FOR DIVERS & CPR
Required Hours: 16

8.1 Objectives

- a) To provide the trainee with a basic understanding of the first-aid measures appropriate to common diving and industrial accidents/illnesses.
- b) To meet or exceed the minimum standards as set forth by the American Red Cross or equivalent first-aid and CPR training requirements.

8.2 Outline of Instruction

- a) Shock
 - 1) Electric
 - 2) Traumatic
 - 3) Emotional

- b) Artificial respiration (CPR)
 - 1) Drowning
 - 2) CO₂ poisoning
 - 3) CO poisoning
 - 4) Mouth-to-mouth method

- c) Use of mechanical resuscitation

- d) Hemorrhage (bleeding)
 - 1) Venous
 - 2) Arterial
 - 3) Capillary
 - 4) Internal
 - Lungs
 - Stomach

- e) Fracture
 - 1) Simple
 - 2) Compound

- f) Burns
 - 1) Classification
 - 2) Chemical
 - 3) Thermal
 - 4) Treatment

- g) Wounds

- h) Communication with medical personnel (terminology)

- i) Assist in treatment of diving related illness and accidents

- j) Cardiac arrest
 - 1) Definition
 - 2) Symptoms
 - 3) Causes
 - 4) Prevention/treatment

9 NOXIOUS GASES IN ENCLOSED SPACES

Required Hours: 2

9.1 Objectives

- a) To provide the trainee with knowledge of the noxious gases encountered in diving operations.
- b) To introduce the trainee to various instruments used to detect noxious gases.
- c) To familiarize the trainee with precautions necessary to avoid accidents from noxious gases.

9.2 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

10 ENVIRONMENTAL HAZARDS OF DIVING

Required Hours: 12

10.1 Objectives

- a) To provide the trainee a knowledge of the environmental hazards the diver may encounter.

10.2 Outline of Instruction

- a) Marine life
 - 1) Wound-inflicting species
 - 2) Animals that inject venom
 - 3) Treatment of wounds
 - 4) Divers evasive action
- b) Exposure/Weather Patterns
 - 1) Climate
 - Air temperature
 - Water temperature
 - Body protection (Hyperthermia & hypothermia)
 - Exposure suits
 - Underwear
 - Sunburn

- c) Wave motion – seasickness
- d) Surf, surge, currents and tides
- e) Bottom conditions/visibility
- f) Polluted water/hazards
- g) Identification of underwater hazards
- h) Oxygen deficient environments
- i) Underwater explosions
- j) Underwater suction and discharges

11 THE HYPERBARIC CHAMBER AND ASSOCIATED EQUIPMENT

Required Hours: 16

11.1 Objectives

- a) To provide the trainee with a knowledge of the characteristics of the chamber and the procedures for operating the chamber.

11.2 Outline of Instruction

- a) Gas supply for chambers
 - 1) Capacity
 - 2) Ventilation
 - 3) Supply valves
 - 4) Exhaust valves
 - 5) Gauges
 - 6) Relief and gag valve
 - 7) Primary and secondary gas supply
 - 8) Atmosphere sensors (O₂, CO₂, temp)
 - 9) Life support systems, CO₂ scrubbers, heater/chiller
 - 10) Plumbing
 - 11) O₂ System

- b) Precautions in chamber use
 - 1) Lighting
 - 2) Door
 - 3) Seals, openings, and penetrations
 - 4) Oxygen fires
 - 5) Testing and maintenance of chamber
 - 6) Operational considerations
 - Oxygen safety
 - Personal requirements
 - Chamber safety considerations
 - Smoking
 - General fire hazards
 - 7) Equipment
 - 8) Communication system

12 TRAINEE PARTICIPATION IN CHAMBER OPERATIONS

Required Hours: 44

12.1 Objectives

- a) To provide the trainee with practice in the operational procedures of a hyperbaric chamber and simulating the treatment of diving injuries.
- b) To develop trainee skills in the proper decompression and recompression operations.

12.2 Outline of Instruction

- a) Review operating procedures for the chamber
- b) Practice maintaining steady rate of ascent/descent
- c) Conduct simulated treatments
- d) Use of man lock, treatment lock, and the purpose of medical locks
- e) Conduct simulated treatment using oxygen and/or nitrox
- f) Practice maintaining required pressure while ventilating
- g) Safety precautions
- h) Decompression operations
 - 1) Surface decompression using oxygen and/or nitrox
 - 2) Surface decompression using air
- i) Lock-in/lock-out procedures
- j) Pressure test

13 SEAMANSHIP & RIGGING FUNDAMENTALS

Required Hours: 25

13.1 Objectives

- a) To provide the trainee with a knowledge of the construction, use, and care of fiber, synthetic, and wire rope.
- b) To familiarize the trainee with the purpose and use of splices in fiber and wire rope.
- c) To instruct the trainee in the purpose and use of terminal fittings on wire rope.
- d) To introduce the trainee to the applicable sections of the American Petroleum Institute.

13.2 Outline of Instruction

- a) Fiber rope
 - 1) Types
 - 2) Sizes – how measured
 - 3) Care and maintenance
- b) Wire rope
 - 1) Types
 - 2) Sizes – how measured
 - 3) Care and maintenance

- c) Synthetic rope
 - 1) Nylon
 - 2) Polyester (Dacron)
 - 3) Polypropylene
- d) Splices
 - 1) Types
 - 2) Application of various splices
 - 3) Strength of splices
 - 4) Safety factors
- e) Wire rope clips
 - 1) Use
 - 2) Method of application
 - 3) Strength
- f) Terminal fittings
 - 1) Types
 - 2) Strength
 - 3) Methods of application
- g) Blocks and tackles and mechanical advantage
- h) Come-alongs, chain hoists, shackles, and grip hoist
- i) Winches and air tuggers
- j) Hand signals for controlling crane operations
- k) Calculation of problems for safe working load and braking strain for fiber and wire rope
- l) Slings
- m) Performance of underwater projects for practical application of rigging

14 PRACTICAL APPLICATION OF SEAMANSHIP AND RIGGING

Required Hours: 60

14.1 Objectives

- a) To provide the trainee practice in the application of seamanship and rigging.

14.2 Outline of Instruction

- a) Splices, fiber rope
 - 1) Eye
 - 2) Short
 - 3) Long
- b) Splices, wire rope
 - 1) Flemish eye (Molly Hogan)
 - 2) Eye splice, 3 strand line
 - 3) Back splice, 3 strand line
 - 4) Short splice

- c) Knots and hitches
 - 1) Square knot
 - 2) Clove hitch
 - 3) Rolling hitch
 - 4) Timber hitch
 - 5) Telegraph hitch
 - 6) Two half hitches
 - 7) Round turn & two half hitches
 - 8) Fisherman's bend
 - 9) Single sheet bend
 - 10) Double sheet bend
 - 11) Catspaw in center of line
 - 12) Prussic knot
 - 13) Single bowline
 - 14) Running bowline
 - 15) Stopper
 - 16) French bowline
 - 17) Double bowline
 - 18) Baker bowline
 - 19) Girth hitch
 - 20) Double carrick
- d) Practical application in knot tying and splicing
- e) Reeving of block and tackles
- f) Practical underwater projects requiring rigging
- g) Hooks
- h) Mechanical advantage
- i) Chain

15 LIGHTWEIGHT DIVING EQUIPMENT FUNCTION AND NOMENCLATURE

Required Hours: 24

15.1 Objectives

- a) To familiarize the trainee with the nomenclature, function, and operation of lightweight diving equipment, masks, and helmets.
- b) To instruct the trainee in the proper procedures for checking, testing, and maintaining lightweight diving equipment.
- c) To instill in the trainee a sense of confidence and trust in the equipment.
- d) To instruct the trainee in the use of bail-out systems and other safety procedures.

15.2 Outline of Instruction

- a) History and Development
 - 1) Diving equipment
 - 2) Advantages and disadvantages – deep sea gear vs. lightweight gear
- b) Use of lightweight diving equipment

- c) Nomenclature and function
 - 1) Masks and helmets
 - 2) Dress
 - 3) Belt (weight)
 - 4) Air hose
 - 5) Lifeline
 - 6) Communications wire
 - 7) Harness
 - 8) Diver's radio
 - 9) Gas manifolds
- d) Disassemble/assemble mask and helmets
 - 1) Use of drawings/schematics and tech manuals

16 LIGHTWEIGHT DIVING PROCEDURES AND TECHNIQUES
Required Hours: 40

16.1 Objectives

- a) To instruct the trainee in the operational use of lightweight diving equipment, procedures and safety consideration.
- b) To develop the trainee's confidence in lightweight equipment and in lightweight diving.
- c) To develop the trainee's skill in the proper way of entering the water, using hose signals and other means of communication, and accomplishing different tasks, using lightweight diving equipment.
- d) To instruct trainees in the proper use of procedural manuals and emergency procedures.

16.2 Outline of Instruction

- a) Safety precautions
 - 1) Ascending procedures
 - 2) Reasons for not removing lifeline
 - 3) Last resort of ditching mask
- b) Orientation dives using lightweight diving gear, helmets, and weighted belt
 - 1) Instruction before entering water
 - Proper method of dressing
 - Location of air control valve
 - Location of exhaust valve
 - Proper use of weighted belt
 - Proper method of securing lifeline to diver
 - Location and use of EGS valve and bottle
 - 2) Dress diver and commence dive
 - Proper water entry
 - Observe hand signals
 - Proper ditching of weights
 - 3) Water entries
 - 4) Orientation dives
 - 5) Use of a minimum of one demand and one freeflow mask
 - 6) Bailout procedures
- c) Proper tending procedures
- d) Proper use of communication

- e) Time keeping/chart procedures
- f) Use of diver's log book
 - 1) Organization and content
 - 2) Official documentation
 - 3) Recording of dives
- g) Commercial diving standards
- h) Requirements for training
- i) Diver classification, qualifications, and certification
- j) Diving accident reports

17 MAINTENANCE OF DIVER'S UMBILICAL
Required Hours: 12

17.1 Objectives

- a) To instruct the trainee in the proper method for making, maintaining, and testing dive hose.
- b) To provide practice to the trainee in making and testing dive hose

17.2 Outline of Instruction

- a) Lifelines
 - 1) Make-up
 - 2) Maintenance
 - 3) Minimum strength requirement
 - 4) Testing
 - 5) Snap shackle types/sizes
- b) Airhose
 - 1) Make-up
 - 2) Maintenance
 - 3) Testing
 - 4) Marking
- c) Air hose connection
- d) Checking for safety
- e) Communications line: Care and maintenance
- f) Practical application

18 UNDERWATER WORK USING LIGHTWEIGHT DIVING EQUIPMENT
Required Hours: 65

18.1 Objectives

- a) To provide the trainee with practical experience in diving and lightweight equipment.
- b) To provide the trainee experience in some of the more difficult underwater tasks encountered in commercial diving.
- c) To familiarize the trainee with safety issues surrounding using lightweight diving gear, and hazards encountered (i.e., liveboating).

18.2 Outline of Instruction

- a) Safety precautions
- b) Emergency procedures for loss of gas
 - 1) Bail out bottle procedures
 - 2) Pneumo hose procedures
 - 3) Standby diver procedures
- c) Bottom search project (lost object recovery)
- d) Single flange ups
- e) Blank flange removal
- f) Multiple bolts and flange projects
- g) Penetration (outfalls and intakes)
- h) Overhead patches, sea chests
- i) Angle descending line
- j) Hogging line project
- k) Excavating and dredging
 - 1) Air lifts
 - 2) Hand jetting

18.3 Liveboating

- a) Operational considerations
 - 1) Sunset rule
 - 2) Visibility
 - 3) Sea state
 - 4) Vessel
 - 5) Tending considerations
- b) Safety considerations
 - 1) Depth maximum
 - 2) Standby boat
 - 3) Propeller shutdown
 - 4) Propeller guards
 - 5) Standby diver
 - 6) Bailout supply
 - 7) Bottom time limits

19 OPERATIONS PLANNING

Required Hours: 12

19.1 Objectives

- a) To expose the trainee to the successful relationship of diving jobs and operational planning.
- b) To demonstrate to the trainee that while the nature of each operation will determine the scope of the planning effort, certain considerations apply to every operation.
- c) Trainees shall be made aware of the current Association of Diving Contractors Consensus Standard, OSHA and US Coast Guard, diving operational regulations.

19.2 Outline of Instruction

- a) The proper sequence of the planning process is as follows:
 - 1) Define objectives
 - 2) Collect and analyze data (underwater surveys/inspections)
 - 3) Establish operational tasks
 - 4) Select diving technique
 - 5) Select equipment and supplies
 - 6) Select and assemble the diving team
 - 7) Written job description
 - 8) Equipment list
 - 9) Make final preparations; check all safety precautions
 - 10) Start operation
 - 11) Maintain safety requirements/considerations

20 DIVING LOGS, RECORDS, AND STANDARDS FOR COMMERCIAL DIVING OPERATION

Required Hours: 12

20.1 Objectives

- a) To compare and contrast the types and uses of dive logs, records, and reports.
- b) To define the differences in standards for commercial diving operations as set forth by the Association of Diving Contractors Consensus Standards, the US Coast Guard, and OSHA.

20.2 Outline of Instruction

- a) Use of log books.
 - 1) Organization and content
 - 2) Official documentation
 - 3) Recording of dives
- b) Commercial diving standards
- c) Diving accident reports

21 UNDERWATER TOOLS

Required Hours: 24

21.1 Objectives

- a) To provide the trainee with a knowledge of the care and use of tools and equipment used underwater.
- b) To familiarize the trainee with safety precautions required to safely use tools and equipment underwater.

21.2 Outline of Instruction

- a) Nomenclature and use of tools
 - 1) Hand tools
 - 2) Pneumatic & hydraulic tools
 - 3) Special tools
 - 4) Dredges and air lifts
 - 5) Lift bags
- b) Underwater use of tools
- c) Inspection/maintenance of tools
- d) Safety precautions
- e) Practical application in the use of tools

**22 DRAWINGS, BLUEPRINT READING, REPORT WRITING
Required Hours: 8****22.1 Objectives**

- a) To instruct the trainee in how to read and understand blueprints and properly prepare drawings for reporting purposes.
- b) To familiarize the trainee with the preparation of formal reports for submittal to the employer and customer

22.2 Outline of Instruction

- a) Introduction to blueprint reading
- b) Scale drawing and schematics
- c) Report writing

**23 HOT WATER SYSTEMS
Required Hours: 2****23.1 Objectives**

- a) To list the terms associated with diver's hot water systems and the problems associated with the effects of cold.
- b) To provide practical experience in the set up, operation, shut down, and maintenance of diver's hot water systems.

23.2 Outline of Instruction

- a) System description
- b) Operation procedures
- c) Hot water suits and umbilical
- d) Maintenance and troubleshooting
- e) Safety procedures
- f) Practical experience in operation and maintenance of diver's hot water system.

24 INTRODUCTION TO TOPSIDE WELDING

Required Hours: 26

24.1 Objectives

- a) To provide proper training so the student can understand the applications of topside welding, explain the limitations of topside welding in regard to size of project, position, and condition of metals being welded. Students should be able to describe the techniques for topside welding in the flat, vertical, and over-head positions.

24.2 Outline of Instruction

- a) Application of topside welding
- b) Limitations of topside welding
- c) Topside welding techniques

25 TOPSIDE WELDING EQUIPMENT

Required Hours: 12

25.1 Objectives

- a) To assist the student to name and describe the functions of the components of topside welding equipment and to describe the safety precautions prescribed for topside welding.

25.2 Outline of Instruction

- a) Welding machines
- b) Welding cables
- c) Electrode holders
- d) Electrodes
- e) Welding glass and faceplate
- f) Safety precautions

26 OXYGEN-ACETYLENE CUTTING TECHNIQUES

Required Hours: 10

26.1 Objectives

- a) To describe the basic techniques of oxygen-acetylene cutting. At the conclusion, the student will be able to name and describe the function of each component of oxy-acetylene cutting equipment and the necessary safety precautions.

26.2 Outline of Instruction

- a) History of oxy-acetylene cutting
- b) The torch
- c) Oxygen cylinders/care in handling
- d) Gauges for oxygen cylinders/care in handling

- e) Safety precautions in oxy-acetylene cutting
- f) Technique for oxy-acetylene cutting.

27 PRACTICAL APPLICATION OF OXYGEN-ACETYLENE METHOD OF CUTTING
Required Hours: 12

27.1 Objectives

- a) To instruct the student on techniques for cutting various thickness of plate, pipe & structures employing the oxy-acetylene method.

27.2 Outline of Instruction

- a) Construction and nomenclature of cutting equipment
- b) Setting up equipment
- c) Techniques
- d) Accomplish projects
- e) Safety precautions

28 INTRODUCTION TO UNDERWATER CUTTING & WELDING
Required Hours: 24

NOTE: Because of commonalities between topside welding and underwater welding, including basic theory, equipment, and techniques, many hours in the topside welding courses are applicable or supplemental to the Introduction To Underwater Cutting & Welding course.

28.1 Objectives

- a) To list and describe the basic equipment used in oxygen-arc cutting. At the conclusion, the student will be able to name and describe the function of each component of oxy-arc underwater cutting equipment and the necessary safety precautions.
- b) To describe the techniques for oxy-arc underwater cutting using at least two different types of electrodes (Broco, Arcair, thermal, arc lance, or Kerie cable).
- c) To provide a practical introduction to the techniques for cutting various thickness of plate, pipe & structures, underwater, employing the oxy-arc method using at least two different types of electrodes.
- d) To list and describe the function of the components of underwater welding equipment and to describe the necessary safety precautions prescribed for welding underwater.
- e) To provide practical introduction to welding underwater so the student can understand the applications of underwater welding **AND** explain the limitations of underwater welding in regard to size of project, position, and condition of metals being welded. Students should be able to describe the techniques for underwater welding in the flat, vertical, and over-head positions.

28.2 Outline of Instruction

- a) History of oxy-arc underwater cutting
- b) Construction and nomenclature of underwater cutting equipment

- c) The torch holder for electrodes
- d) Electrodes
- e) Welding generators
- f) Welding cables
- g) Safety switch
- h) Oxygen cylinders/care in handling
- i) Oxygen hose/size/care in handling
- j) Gauges for oxygen cylinders/care in handling
- k) Safety precautions in oxy-arc underwater cutting
- l) Technique for oxy-arc underwater cutting
- m) Setting up equipment
- n) Accomplish projects using at least two different manufacturers of oxy-arc cutting rod (would vary on availability of materials)
- o) Techniques
- p) Safety precautions
- q) Welding machines
- r) Welding cables
- s) Electrode holders
- t) Electrodes
- u) Welding glass and faceplate
- v) Waterproofing materials
- w) Application of underwater welding
- x) Limitations of underwater welding
- y) Underwater welding techniques
- z) Safety precautions

29 MIXED GAS DIVING
Required Hours: 30

29.1 Objectives

- a) To provide the student with a basic understanding of mixed-gas diving techniques and procedures.

29.2 Outline of Instruction

- a) History & medical aspects of mixed gas diving
- b) Formulas
- c) Decompression procedures
- d) Diving and emergency procedures
- e) Operator safety considerations
- f) Treatments
- g) Practical applications

30 MARINE ENGINES AND COMPRESSORS
Required Hours: 16

30.1 Objectives

- a) To provide the trainee with fundamental knowledge of the operation, maintenance, and field troubleshooting of diesel engines and low pressure compressors.

30.2 Outline of Instruction

- a) Application of diesel engines in diving
 - 1) Air compressors
 - 2) Generators
 - 3) Cranes
 - 4) Boats
 - 5) Trucks
 - 6) Forklifts
 - 7) Hydraulic power units
 - 8) Etc.
- b) Seven systems common to all diesel engines
 - 1) Fuel system
 - 2) Fuel filters
 - 3) Injectors
 - 4) Lubrication system
 - 5) Cooling system
 - 6) Intake system
 - 7) Exhaust system
- c) Power take offs and clutches
- d) Diesel operation (practical)
- e) Maintenance (practical)
- f) Trouble shooting (practical)

- g) Types of compressors used in diving
- h) Compressor systems
 - 1) Intake
 - 2) Compression stage
 - 3) Intercooler
 - 4) Lubrication System
 - Compressor oil for breathing air compressors
 - 5) Variable Differential Unloader
 - 6) Hydraulic unloader
 - 7) Filters
 - 8) Volume tanks
 - 9) Supply valve/manifold
- i) Compressor calculations
 - 1) Capacity (CFM/SCFM)
 - 2) Depth limit (over bottom pressure)
- j) Set up of compressors used in diving/chamber operations
- k) Compressor operation (practical)
- l) Compressor maintenance (practical)
- m) Troubleshooting (practical)
- n) Air purity testing
- o) Valves and fittings
- p) Air system schematic

31 INDUSTRIAL AND OFFSHORE SAFETY
Required Hours: 6

31.1 Objectives

- a) To familiarize the student with federal, state, and ADC requirements for diving operations
- b) To provide the trainee with instruction in industrial and offshore safety
- c) To provide the student with basic crane safety training

31.2 Outline of Instruction

- a) US Coast Guard Regulations
- b) OSHA Regulations
- c) ADC Standard

- d) 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

- e) Offshore safety
 - 1) H₂S safety
 - 2) Helicopter orientation
 - 3) Personnel safety basket
 - 4) Life jackets
 - 5) Life rafts/boats
 - 6) Visual location aids
 - 7) Audio location aids

- f) Basic crane safety
 - 1) Rules and regulations
 - 2) Slings
 - 3) Rigging hardware
 - 4) Proper rigging techniques
 - 5) Signaling
 - 6) Chain slings
 - 7) Hoists
 - 8) Knots

32 ELECTIVES

32.1 Objectives

- a) To provide the student with additional skills based on individual institution needs. These needs are determined by industry needs, generally defined by demands of geographic location.

32.2 Outline of Instruction

- a) The standards for the courses listed as elective are maintained and monitored by the parent associations of each specific discipline.

- b) The elective coursework is not limited to the list below. The list below is a result of direct industry input.
 - 1) Non-destructive testing
 - 2) Diver medical technician
 - 3) Remotely operated vehicles
 - 4) Hazardous worker (HAZWOPER)
 - 5) Offshore survival & safety
 - 6) Underwater imaging
 - 7) Diving in contaminated environments
 - 8) Noxious gasses in enclosed spaces
 - 9) Dry hyperbaric welding

Total Training Hours: 625 Hours