



2600SEG130 SAFETY STANDARD FOR INDUSTRIAL DIVING

1.0 PURPOSE

To establish minimum safety standards for diving, as well as for training and certification which will allow compatibility between the Panama Canal Authority (ACP) programs and other industrial diving programs operated by outside organizations.

2.0 BACKGROUND

This Standard replaces the safety policy and procedures contained in Appendix H of the former Panama Canal Commission Personnel Manual (PCPM), chapter 790.

3.0 SCOPE

The requirements, standards, and guidance shall apply to all diving sites and to all units and ACP employees, and to non-ACP employees who are involved in underwater activities under the auspices of or in cooperation with the ACP.

4.0 LEGAL FOUNDATION

This Standard is established pursuant to Agreement No. 12 of the Board of Directors of the Panama Canal Authority (ACP), Safety and Health Regulations, Chapter I, Article 8, and Chapter II, Article 16, Paragraph 6.

5.0 DEFINITIONS

5.1 Industrial Diving: All diving carried out by individuals, necessary for and as part of gainful employment.

5.2 ACP Auspices: For the purposes of this Standard, ACP auspices includes any diving operation with which the ACP is involved because the diving site is located within areas under the Authority's control, because the ACP has provided equipment for the operation, or by reason of having a labor or contractual relationship with the organization conducting the diving. This includes all cases involving operations carried out by the ACP, by its contractors, or, at the discretion of the Diving Council (hereinafter "the Council"), by third parties not having a labor or contractual relationship with the ACP who are diving in areas under the Authority's control.

5.3 Diving Foreman: A diver certified by the ACP as having performed 100 recorded industrial dives, 300 recorded hours of work training supervised by other more experienced divers, 100 working days in the field participating in industrial diving operations, plus 100 days as an alternate (foreman) under the direction of a qualified supervisor. Must have completed a safety course approved by the Diving Council, having a minimum duration of 40 hours of theoretical and practical training.

5.4 ACP-designated Authority: The ACP Diving Council.

5.5 Standby Diver: Required to be available and prepared to enter the water when there are one or more divers underwater for the purpose of assisting in case of an emergency.

5.6 pas: A measurement meaning "feet of sea water."

5.7 Designated Head of Unit: The senior person responsible for diving operations within each ACP unit.



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5.8 Diver Tender: A person responsible for assisting with diving operations.

6.0 GENERAL REQUIREMENTS.

6.1 Administrative Structure of the Diving Program.

6.1.1 The industrial diving operations undertaken by the ACP using its own or contracted personnel must be in accordance with a program which shall include as a minimum this Standard and the following:

- a. A Diving Safety Manual (hereinafter "the Diving Manual") containing procedures covering all the specific operations of the Diving Program, emergency procedures, including re-compression, evacuation, and standards for diver training and maintenance of certification.
- b. A Diving Council with authority to approve and implement diving procedures, to review and revise the Diving Manual, certify divers, determine training requirements and monitor compliance with the ACP safety standards. The Council may form *Ad hoc* working groups for special assignments in connection with the Diving Program.

6.2 Diver Qualifications

6.2.1 In accordance with the requirements of this Standard and other requirements established by the Council, all persons involved in ACP or ACP-sponsored diving activities must be in possession of a valid certificate issued by the ACP. Contractors and sub-contractors must be issued with a provisional permit in order to dive for the ACP. If a contractor completes his work and subsequently returns to perform further work, he must obtain a new permit. This permit must be obtained through the Contracting Official. As a minimum, the certification must include:

- Each diver must be in possession of a valid certificate and be trained and qualified for the type of diving undertaken, and each team member must have experience or training in the following:
 1. Use of the appropriate instruments and equipment for the activity to be conducted;
 2. Dive planning and emergency procedures;
 3. Current certification in cardiopulmonary resuscitation (CPR) (one year);
 4. Rescue techniques;
 5. Physics and physiology related to diving, recognition of pressure-related injuries, and correct emergency treatment.

6.2.2 The ACP may recognize a diving certificate issued by another organization, including a medical examination or evaluation, under the following conditions:

a. That the visiting diver presents documentation showing that he is in possession of a valid Diving Certificate issued by the outside organization and a copy of the medical results and tests performed. This document must include the date of the last medical examination and must be signed by the authorized representative of the outside organization.

b. That the visiting diver's organization is in compliance with the minimum standards set out in the attached Diving Manual. That the visiting diver complies, as a minimum, with the ACP Diving Manual. If differences should arise between the requirements of the parent organization and ACP policies and standards, the ACP standards shall apply.

6.3 Emergencies and Deviations from Regulations



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6.3.1 In emergency situations, supervisors are authorized to modify the provisions of this Standard if they consider it necessary to save lives or to prevent serious injury to a diver. Any diver may deviate from the requirements of this Standard to the extent necessary to prevent or minimize a situation certain to cause death, serious physical injury or major environmental damage. A written report of such emergency actions, explaining the circumstances and justifications, must be submitted to the Diving Council or its designee within 48 hours.

6.3.2 Consequences of violation of the Regulations by divers. Non-compliance with Diving Manual Regulations may be cause for revocation or restriction by the Council of an individual's diving certificate.

7.0 RESPONSIBILITIES

7.1 Final Authority

The ACP Administrator has final authority with regard to the Diving Program and its related activities.

7.2 Administration of the Standard

The administration of the Diving Program Standard is the responsibility of the Council which operates under the authority of the Administrator.

7.3 The Diving Council shall:

7.3.1 Review and revise diving operations when it deems appropriate to do so. Certify and revise the depth to which a diver has been trained and review the Diving Supervisor's recommendations with regard to issuing or revoking a diver's certification.

7.3.2 Act as an investigative body to inquire into the nature and cause of all diving accidents and all reports of violation of the provisions of the Diving Manual.

7.3.3 Act as a board of inquiry, when necessary, to analyze problems which arise during diving operations conducted under the Diving Program, its standards and requirements and diving procedures set by the ACP.

7.3.4 Meet monthly, or at other times if so requested by the Administrator or another member of the Diving Council, to review diving activities and to prepare and distribute the minutes of all meetings.

7.3.5 Set training standards for divers and diving foremen.

7.3.6 Set standards for the selection and use of equipment and recommend new equipment or techniques.

7.3.7 Set standards for the inspection and maintenance of diving equipment.

7.4 The Safety and Industrial Hygiene Unit (RSHS) shall:

7.4.1 Advise the different ACP diving units and the Diving Council on occupational safety matters. Monitor compliance with current safety standards and operating procedures to be observed by ACP personnel and contractors.



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- 7.4.2 Recommend the suspension of work, projects, or diver certifications due to unsafe practices.
- 7.4.3 Review investigation reports of accidents and near-accidents.
- 7.4.4 Review divers' activities at least annually and submit reports to the Diving Council.
- 7.4.5 Monitor ACP stations handling air or mixed gases to verify compliance with established safety and breathable air quality standards.
- 7.4.6 Approve contractors' diving plans.
- 7.5 Health, Wellness and Labor Welfare Unit (RHSS) shall:
 - 7.5.1 Set medical standards for qualifying divers.
 - 7.5.2 Provide health services to diving units including divers' annual examinations. Advise the units in writing and keep medical records.
 - 7.5.3 Establish and review emergency medical procedures including supervision of hyperbaric treatments.
 - 7.5.4 Provide advice and training in occupational health matters.
- 7.6 Each unit or contractor/sub-contractor must:
 - 7.6.1 Retain the records and documents required by this Standard for the period set by the ACP.
 - 7.6.2 Investigate and submit Accident and Incident Reports to the Diving Council.
 - 7.6.3 Comply with all the requirements of this Standard.

8.0 INQUIRIES

Any information or clarification of the content or application of this Standard must be requested in writing to the Safety and Industrial Hygiene Unit (RHSH).

9.0 EXCEPTIONS

Departures or temporary exceptions from compliance with this Standard must be requested in writing to the Diving Council through the Safety and Industrial Hygiene Unit, with the exception of the circumstances covered under Clause 6.3 of this Standard.

10.0 TERM

This Standard shall remain in force until amended or revised.

11.0 REFERENCES

11.1 ADC Industrial Diving Manual



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11.2 Medical Protocol for ACP Divers

11.3 U.S. Navy Diving Manual



Panama Canal Authority

Diving Safety Manual

November 29, 2005

Section 1 General

1.0 THIS DIVING SAFETY MANUAL.

Has as its objective:

1.0.1 To reflect on the potential dangers and inherent risks involved in this activity and endeavor to have all diving undertaken under ACP auspices conducted in such a manner as to promote the protection of divers against accidental injuries and/or illnesses, and to set standards for training and certification which will allow compatibility between the ACP and other commercial diving programs.

1.0.2 To ensure that the ACP Industrial or Commercial Diving Program remains in compliance with the regulations applicable to commercial diving standards pursuant to OSHA 29CFR 1910, Subpart T, and the ADC, the ANSI ACDE-01-1993 standard for training commercial divers, and any other applicable standard.

1.0.3 To ensure that the Council has, as a minimum, the necessary authority to fulfill its specific obligations under the standards set out in this Manual.

1.0.4 To ensure that divers and their supervisors comply with diving procedures.

1.0.5 To set out minimum standards for Diving Programs, their organization, and the basic standards and regulations and safety procedures in industrial diving operations. It further establishes a frame of reference for reciprocity between organizations which follow these minimum standards for joint diving projects.

1.1 Policy

All diving operations conducted under the auspices of the ACP must be carried out safely and in compliance with the prevailing applicable standards and accepted practices for safe commercial diving. Diver certification, the ACP procedures and criteria, and all safety standards shall comply in all respects with the guidance and regulations set out in this Manual.

1.2 Scope

The requirements, standards, and guidance shall be applied to all diving sites and to all ACP organizations and workers, and non-ACP workers taking part in underwater activities under the auspices of or in cooperation with the ACP. ACP employees must have diving specified as part of their official job description.

1.3 Authority

Authority over the Diving Program rests with the Administrator in consultation with the Diving Council.

1.4 Definitions

1.4.1 Industrial Diving: All diving carried out by individuals, necessary for and as part of gainful employment.

1.4.2 ACP Auspices: For the purposes of this Manual, ACP auspices and those of its organizational units includes any diving operation with which the ACP is connected by reason of its being

the owner of any equipment used, site selection, or due to a relationship with the individual(s) involved. This includes all cases involving operations carried out by ACP personnel or contractors' personnel, in which said personnel are acting pursuant to their employment; and in ACP operations.

1.5 Types of Certification:

The ACP requires that all persons involved in diving activities under their auspices shall be in possession of a valid and recognized certificate issued by the ACP, in accordance with the provisions of this Manual. Contractors and sub-contractors shall obtain a temporary permit to dive with the ACP. If a contractor completes his work and subsequently returns to perform further work, he must obtain a new permit. This permit must be obtained through the Contracting Official.

1.6 Equipment:

All diving equipment used by divers and trainee divers, irrespective of ownership, shall comply with the standards set out in this Manual.

1.7 Sites:

The regulations set out herein are to be observed at all ACP diving sites.

1.8 Reciprocity:

The ACP may recognize a diving certificate from another organization, including a medical examination or evaluation, under the following conditions:

1.8.1 The visiting diver shall submit a card or letter indicating that he is in possession of a valid Diving Certificate issued by his organization. This document must include the date of the last medical examination and must be signed by his organization's authorized representative.

1.8.2 That the organization is in compliance with the minimum standards set out in this Manual. That the visiting diver complies, as a minimum, with the ACP Diving Safety Manual. If differences should arise between the requirements of the parent organization and ACP policies and standards, the ACP standards shall apply.

1.9 Waiver of Requirements:

Following consultation with the Council, the ACP may, if it deems necessary, waive the requirements for training, examinations, depth certification, and minimum activity necessary to maintain certification. In emergency situations, supervisors may modify the provisions of this Manual if they consider it necessary to save a life or prevent serious injury to a diver.

1.10 Program Authorities and Responsibilities

1.10.1 Final Authority: The ACP Administrator has final authority over the Diving Program and its related activities.

1.10.2 Policy Administration: Policy administration for the Diving Program rests with the Council who operates under the authority of the Administrator.

1.10.3 The Diving Council consists of seven members, namely:

- a. The Manager of Fleet and Equipment Maintenance Division (OPM) or their designee
- b. The Manager of the Locks and Facilities Maintenance Division (OPE) or their designee
- c. The Manager of the Human Resources Division or their designee
- d. The Manager of Health, Wellness and Labor Welfare Unit (RHSS) or their designee

- e. The Safety and Industrial Hygiene Unit's Diving Safety Specialist.
- f. The Diving General Foreman and Diving School Supervisor of the Fleet and Equipment Maintenance Division (OPM) or their designee
- g. A Diving Supervisor from the Locks and Facilities Maintenance Division (OPE) or their designee
- h. A Union representative from the Non-professional Workers Negotiating Unit.

1.10.4 Responsibilities:

- a. The Council is responsible for setting policy, and this work includes, but is not limited to:
 1. Reviewing and revising diving operations, when deemed necessary.
 2. Ensuring strict compliance with the ACP Diving Manual.
 3. Certifying and reviewing the depth to which a diver has been trained and reviewing the Diving Supervisor's recommendations with regard to granting or revoking the diver's certification;
 4. Recommending disciplinary measures for unsafe diving practices, including the suspension of work, projects, or diver certifications.
 5. Ensuring compliance with the Standards set out in this Manual.
 6. Acting as a board of inquiry to investigate the nature and cause of all diving accidents and all reports of violation of the provisions of this Manual.
 7. Acting as an investigative body, when necessary, to consider diver-related problems encountered during diving operations under, or in compliance with, the Diving Program, its policies or standards and the requirements of this Manual.
 8. Reviewing divers' activities at least annually and filing reports with the Administrator or his designee.
 9. Meeting at least monthly and, if requested by the Administrator, preparing and distributing the minutes of all meetings;
 10. Setting standards for the selection and use of equipment and recommending new equipment or techniques.
 11. Setting standards for the inspection and maintenance of diving equipment.
 12. Ensuring that the quality of ACP stations handling air or mixed gases meets the standards set out in this Manual.

1.10.5 Operating Responsibilities:

- a. Locks Division diving supervisors are responsible for diving operations in their respective areas, including those carried out by other divisions or contractors within the OPE.
- i. b. Managers of the Diving School and the Diving Rescue Unit are responsible for all diving operations conducted by the Fleet and Equipment Maintenance Division (OPM) and for the operation of the ACP Diving School, and similarly, for contractors' diving operations outside the locks.
- c. The Safety and Industrial Hygiene Unit (RHSH) is responsible for providing advice to the different ACP diving units and the Diving Council on occupational safety matters and for ensuring compliance with the current safety standards applicable to ACP employees and contractors.
- d. The Health, Wellness and Labor Welfare Unit (RHSS) is responsible for the provision of health services to the diving units, including divers' annual examinations, supervision of hyperbaric treatments and advice and training in occupational health matters.

1.10.6 The Diving Supervisor

- a. The Diving Supervisor shall be responsible for all operational matters related to diving and safety in the field.
- b. Responsibilities
 1. Responsible to the ACP for conducting dives.
 2. Prepares diving and operational plans and keeps records.
 3. Ensures that diving activities conducted in his division or work area follow the safety standards set out in this Manual.

4. Authorized to unilaterally suspend diving operations or divers whose activities are considered unsafe or unwise, and must immediately report such action to his Unit Supervisor.

c. Responsible for documenting equipment maintenance.

1.10.7 Divers' individual responsibilities

- a. Each diver is personally responsible for:
 1. Taking the regular divers' medical examination as required by the ACP.
 2. Maintain in good physical condition and high level of diving expertise, depending on the frequency, scope, and type of diving he undertakes.
 3. Refusing to dive if:
 - a) In his opinion, the conditions are unsafe or unfavorable for the type of operations being planned.
 - b) For any reason he believes that his participation in diving operations could put human life in danger.
 - c) He is not in suitable physical or mental condition.
 - d) He believes that the equipment being used is not in suitable condition.
 4. Maintaining a valid cardio-pulmonary resuscitation (CPR) certification.
 5. Assuming responsibility for his personal safety and for compliance with the ACP Diving (Safety) Manual.
 6. Checking his equipment (See Section 4.12.5).

Section 2 Training Requirements

2.0 GENERAL INFORMATION

The purpose of this Section is to set out the minimum training requirements for divers working for the Panama Canal Authority. These training standards should not be regarded in any way as total or complete, but rather as entry level requirements for industrial or commercial diving. Training may be expanded to include more specialized activities to complement the initial basic training. The curriculum must be in accordance with the most recent version of the ANSI *Commercial Diver Training Minimum Standard* No. ANSI/ACDE-01 (for unrestricted divers only).

2.1 Initial Candidate Evaluation

2.1.1 Medical Examinations

The trainee diver candidate must be examined by a physician approved by the Panama Canal Authority, in accordance with the medical examination described in Section 3 of this Manual, before proceeding with the training described in this Section.

2.1.2 Swimming Evaluation

- a. The candidate must complete the following tests, or their equivalent, satisfactorily with two (2) minute rest between tests in the presence of an ACP-approved instructor or examiner (with dive fins, masks, snorkel);
- b. Swim under water without swimming aids a distance of 25 meters without coming to the surface;
- c. Swim 400 meters without swimming aids in under 10 minutes;
- d. Remain afloat without swimming aids for 30 minutes by using the hands, plus two more minutes unaided without using the hands;
- e. Swim 200 meters in open water, with swimming aids.

2.1.3 Bench-press 100 pounds while lying down. (6X)

2.1.4 Oxygen tolerance test. (60, 20 minutes, 100%)

2.1.5 Do 20 push-ups.

2.1.6 Sitting pull-downs, 100 pounds (6X). 6 lb suspension.

2.2 Basic Training

2.2.1 Practical SCUBA diver training

On completion of training, the candidate must demonstrate to the instructor's satisfaction, in a swimming pool or in confined waters, as a minimum, the ability to:

- a. Enter the water with complete SCUBA gear.
- b. Clear a diving face mask;
- c. Demonstrate the technique of buddy-breathing a regulator as both donor and recipient with and without a diving face mask;
- d. Demonstrate the ability to breathe alternately through a regulator and a breathing tube (snorkel), while swimming;
- e. Understand underwater hand signals;
- f. Demonstrate mouth-to-mouth resuscitation (rescue breathing) in the water;
- g. As a diver, rescue and transport a simulated passive victim;
- h. Demonstrate the ability to remove and replace the SCUBA unit under water (ditch and don).
- i. Demonstrate a level of competence satisfactory to the instructor;
- j. Transport a person of the same size 25 meters in the water without swimming aids.

2.2.2 Practical training with non self-contained equipment (surface supplied).

On completion of training, the candidate must demonstrate to the instructor's satisfaction, in a swimming pool or in confined waters, as a minimum, his ability to:

- a. Put on his equipment;
- b. Locate and operate the control valve;
- c. Locate the exhaust valve;
- d. Use the weight belt;
- e. Secure a life-line to a diver;
- f. Use different methods of entering the water;
- g. Use at least one type of demand system.
- h. Maintenance to the divers umbilical.
- i. Exercise safety precautions;
- j. Follow procedures in emergencies, including loss of air supply;
- k. Follow work procedures;
- l. Plan operations;
- m. Fill out diving logs and forms;
- n. Demonstrate the proper use of the pneumofathometer hose.

2.2.3 Written Examination:

Before completing diver training, the candidate must pass a written diving examination. The minimum passing mark is 80% for the part supervised by the Occupational Health Division (HRH) Manager or his designee, and 75% for the part supervised by the Industrial Shipyard Division (SII) Manager or designee, and must demonstrate knowledge in at least the following areas:

For the Health, Welfare and Occupational Health Section (RHSS) Manager or his designee:

- a. Physics and physiology of diving;
- b. Dangers of apnea diving and ascents;
- c. Causes, symptoms, treatment and prevention of the following:
 1. drowning,
 2. aero-embolism,
 3. carbon dioxide intoxication (Hypercapnia),
 4. barotraumas,
 5. oxygen intoxication,
 6. nitrogen narcosis,
 7. exhaustion and panic,
 8. respiratory fatigue,
 9. seasickness,
 10. decompression illness.
 11. hypothermia and hypoxia / anoxia.
 12. carbon monoxide poisoning.
- d. Introduction to the operation of hyperbaric chambers;

a. For the Maintenance of Floating Equipments Division (OPM) Diving Foreman and Diving School Supervisor.

- a. Operation, care, use, and maintenance of SCUBA and non self-contained diving equipment, including regulators, umbilicals, helmets, and complete face masks;
- b. Violations of regulations concerning speed of ascents and their consequences;
- c. Diving regulations and precautions;
- d. ACP Diving Safety Manual;
- e. Coastal currents and waves;
- f. Hazardous marine life;
- g. Emergency procedures, including controlled ascents and sharing of regulator (buddy-breathing).

- h. Currently accepted procedures for non-decompression diving, non-decompression repetitions, decompression procedures and dive tables;
- i. Underwater communications;
- j. Considerations for diving in lakes and at high altitudes;
- k. Planning and supervision of diving operations;
- l. Diving hazards;
- m. Diving in contaminated waters;
- n. Operation of air compressors and systems;
- o. Survival at sea;
- p. Preparation, putting on equipment;
- q. Marine life;
- r. Welding and oxy-arc cutting;
- s. Welding safety.
- d. Introduction to the operation of hyperbaric chambers.

2.2.4 Certification in Cardiopulmonary Resuscitation (CPR) and Oxygen Administration (annually).

The candidate must submit proof of training in CPR and oxygen administration during the past year in case of diving accidents.

2.2.5 Assessment in Open Water

The candidate must demonstrate to the satisfaction of an ACP-approved instructor, his ability to apply the following techniques in open water:

- a. Descend from the surface to a depth of 10 feet, in open water, without SCUBA gear;
- b. Demonstrate ability to share the regulator (buddy-breath) both as donor and recipient;
- c. Enter the water, dive, and leave the water from a beach, platform or boat, using complete SCUBA gear and non self-contained equipment (surface-supplied).
- d. Swim 300 meters on the surface wearing SCUBA gear, without breathing from the regulator (snorkel only).
- e. Demonstrate appropriate judgment for safe diving;
- f. Demonstrate the ability to handle situations correctly in the environment, on the surface, and underwater;
- g. Complete a controlled simulated emergency ascent from at least 20 feet;
- h. Demonstrate the ability to clear a flooded face mask and diving regulator underwater;
- i. Demonstrate the ability to achieve and maintain neutral buoyancy while submerged;
- j. Demonstrate the ability to ascend at a speed not exceeding 30 feet per minute with self-contained and non self-contained equipment;
- k. Demonstrate self-rescue techniques and those for rescuing a buddy-diver;
- l. Navigate underwater;
- m. Plan and carry out a dive with self-contained and non self-contained equipment;
- n. Use of non self-contained equipment (helmets and masks);
- o. Operation of the diving communication system;
- p. Operation of the umbilical;
- q. Equipment maintenance and repair. ALREADY COVERED in 2.2.3
- r. Cutting and welding;
- s. Use of hand tools underwater;
- t. Use of dry suits;
- u. Operation of hyperbaric chambers;
- v. Other techniques considered important by the Agency ;
- w. Successful completion of fifteen (15) dives in open water for a total of 7.5 hours of which a total of two hours must be on the bottom with SCUBA gear and a maximum of three (3) dives per day.

2.2.6 Industrial Diver's Permit

This permit means that the diver has completed a minimum of 400 hours of training and a minimum of 15 open water dives and holds a certificate recognized by the ACP which is the minimum qualification required to work as a diver for the ACP.

2.2.7 Maintenance of Certification

a. Divers and Diver Tenders must undergo an annual re-certification process to ensure that they are maintaining themselves in suitable condition to dive. During this re-certification process, divers will reinforce their knowledge and skills in areas deemed necessary by the ACP Diving Council. An updated diving re-certification course will be given. The following physical tests must be passed, as a minimum, during the re-certification process:

1. Swim 300 meters in 10 minutes or less, without swimming aids, 10 minutes rest;
2. Float 30 minutes, 2 minutes rest;
3. Swim 15 meters underwater, without swimming aids, 2 minutes rest;
4. Do 20 push-ups; 2 minutes rest.
5. Press 100 pounds (6X), 2 minutes rest.
6. Sitting pull-down 100 pounds (6X).

b. The following areas of knowledge, as a minimum, must be covered each year as part of diver training:

1. Cardiopulmonary resuscitation (CPR) complete course;
2. First Aid (every 3 years);
3. Emergency diving procedures (self-contained and non self-contained equipment).

2.2.8 Instructors

The instructors who conduct the ACP diving courses shall be qualified and must have practical experience in the material taught. Instructors' qualifications shall be approved by the Diving Council.

2.2.9 If a diver fails the written examination, he is given two weeks to take it again. If he fails, it will be recommended to him that he should take the re-certification course again. A diver who fails the examination may participate in the next group; he does not have to await the next re-certification.

Section 3: Diving Equipment

3.0 GENERAL POLICY

All equipment, in order to be used, must comply with the minimum standards demanded by the regulations applicable to commercial diving standards pursuant to Title 29, Subpart T, of the Code of Federal Regulations of the Occupational Safety and Health Administration of the United States (OSHA 29CFR 1910, Subpart T) and the Association of Industrial Diving Contractors (ADC), the ANSI ACDE-01-1993 standard for training commercial divers and any other relevant standard. The equipment must also comply with the requirements set out in this Section and any others considered by the ACP to be applicable. Any equipment subjected to extreme usage and adverse conditions, shall require more frequent maintenance and testing than that indicated in this Section.

3.1. Equipment required to be carried by all divers:

3.1.1 For SCUBA diving

- a. Face mask and flippers.
- b. SCUBA diving regulator.
- c. Air cylinder with valve.
- d. Instrument for measuring time underwater.
- e. Depth indicator.
- f. Submersible pressure gauge
- g. Buoyancy compensator, except in confined spaces. The buoyancy compensators should be of the type designed for self-contained diving and must be fitted with a low-pressure inflator.
- h. Diver's knife. The knife must be sharp enough to cut through fishing nets.
- i. Quick-release weight belt.
- j. Dry suit when required by the nature of the operation. This suit may not be used without a buoyancy compensator.
- k. Appropriate thermal protection.
- l. Communications equipment, unless the diver is accompanied by a similarly-equipped fellow diver or is able to communicate with an assistant at the surface by means of signals on a safety line.
- m. Flashlight of suitable design
- n. Compass

3.1.2 Non self-contained diving with air supplied from the surface:

- a. Helmet or mask equipped with an air supply suitable for the working depth.
- b. Quick-release weight belt. Unless the conditions dictate changes for the diver's safety.
- c. Safety harness with quick-release buckles. The harness must be capable of distributing the diver's weight and preventing anything from falling back on the diver's helmet or mask upon pulling the umbilical. The harness must be positioned below the rest of the equipment, unless very heavy equipment is being used.
- d. A self-contained air reserve separated from the main system, unless the physical space available does not permit. The reserve should be connected to a system which prevents (check valve) the flow of air on or toward the surface through the umbilical.

e. Instruments for measuring working depth and time worked. A control system at the surface may substitute for these instruments. If this method is used, there must be a diver-to-surface communication system in place whereby an assistant can advise the diver of his decompression status at any given moment.

f. Suitable thermal protection.

3.2 Records

An official diving record of the equipment used is to be set up and maintained. Equipment must be identified so that it may be located in the records. Any modification, repair, testing, calibration, or maintenance service shall be registered in the records, and shall include the date and description of the work, serial number of the equipment, and the name of the person who worked on the following equipment:

- 3.2.1. Regulators and alternate sources of air.
- 3.2.2. Submersible pressure gauges.
- 3.2.3. Depth gauges.
- 3.2.4. Buoyancy compensators.
- 3.2.5. Air cylinders.
- 3.2.6. Air cylinder valves.
- 3.2.7. Diving helmets.
- 3.2.8. Full-face dive masks.
- 3.2.9. Compressors.
- 3.2.10. Gas control panels.
- 3.2.11. Storage cylinders.
- 3.2.12. Filtration systems.
- 3.2.13. Analytical instruments.
- 3.2.14. Diving computers.
- 3.2.15. Time-measuring instruments.
- 3.2.16. Ascent monitors.

3.3. Personnel responsible for repair and maintenance of equipment shall be trained and knowledgeable in the types of equipment being used.

3.4. General Requirements:

3.4.1. Suits:

- Suits used by divers must be of a suitable type for the work environment, considering biological, radiological, chemical, and thermal risk factors.

3.4.2. Dry Suits:

- a. Must have a system to prevent over-inflation.
- b. Must be manufactured of a material resistant to the working environment.
- c. Must protect the diver from environmental contamination.

3.4.3. Harnesses:

a. Must be manufactured of a material capable of supporting the weight of a diver plus the equipment being used.

- b. Must have a quick-release mechanism for the umbilical.
- c. Must be so manufactured that an unconscious diver could not fall out while being

pulled.

- d. Should not be used as a weight belt.

3.4.4. Weight Belts:

- a. Must not be used to fasten the umbilical.
- b. Must be equipped with quick-release buckles or mechanisms.
- c. Must be secured to the diver so as to prevent inadvertent release.

3.4.5. Emergency Air Supply Systems:

- a. Must include a pressurized cylinder which meets the requirements of Clause 3.4.8.
- b. Must include a regulator which permits a supply of breathable gas to the diver, at a suitable pressure.
- c. Must have an appropriate method of fastening the supply line to the diver's helmet or mask.
- d. Must be connected to a system of one-way valves to prevent flow from the reserve cylinder to the surface.

3.4.6 Regulators and Alternative Air Sources:

- a. Only those models specifically approved by the ACP for each type of operation may be used.
- b. Regulators used for self-contained diving must be inspected in accordance with the manufacturer's specifications before use and annually thereafter.

3.4.7. Breathing Helmets and Masks:

- a. Must be of a suitable type and material for the nature of the work to be performed. All breathing helmets and masks must have:
 1. A one-way valve at the point of connection between the helmet and the hose, which shall close readily and positively.
 2. An air supply, capable of maintaining the diver at the diving depth, of at least 1.5 cubic feet per minute and at the manufacturer's recommended pressure.
 3. A two-way communication system.
 4. Spring-loaded one-way valves whose opening pressure does not exceed 3 psi.
- b. Breathing helmets and masks must be inspected in accordance with the manufacturer's specifications.

3.4.8 Diving Cylinders:

- a. Cylinders for self-contained diving must be designed, manufactured and maintained in accordance with the specifications of the Unfired Pressure Vessel Safety Orders issued by the U.S. Department of Transport (D.O.T.) or by the American Society of Mechanical Engineers (A.S.M.E.).
- b. Testing of cylinders and valves:
 1. Diving cylinders must be hydrostatically tested every five years pursuant to the current U.S. Department of Transport standards.
 2. Diving cylinders must be visually inspected by a qualified technician at intervals not to exceed 12 months.
 3. Diving valves must be tested at intervals not to exceed 12 months.

3.4.9. Umbilicals:

- a. General
 1. The umbilical shall consist of an assembly formed by the breathable gas hose, the communications cable, a method of determining the diver's depth, and a strengthening member.
 2. The umbilical shall be formed by an assembly of members manufactured with materials which will not be affected by prolonged immersion in water.
 3. The umbilical must have a minimum breaking strength of 1000 lb. including the terminals.
 4. Umbilical hoses, useful life 5 years.
 5. Umbilicals shall be marked at 10 ft. intervals, starting from the diver, for the first 100 ft., and thereafter at 50 ft. intervals, in accordance with the following table:

Color-coding for Umbilicals	
10 feet	green
20 feet	white
30 feet	blue
40 feet	yellow
50 feet	red
60 feet	red with green
70 feet	red with white
80 feet	red with blue
90 feet	red with yellow
100 feet	red with red
150 feet	red with red with red

6. Must have identification marks and undergo periodic maintenance.
 7. Hoses must have a pressure at rupture equal to four (4) times the maximum working pressure.
 8. Hoses must have connectors with a working pressure equal to or greater than that of the hose they are attached to.
 9. Connectors must be corrosion-resistant and must not become disconnected accidentally.
 10. Hoses must be made of a material that does not bend or twist.
 11. Hoses used in hot water systems must be manufactured to withstand the working temperatures.
 12. All hoses must be visually examined annually and tested at a pressure of 1.5 times working pressure for 10 minutes without loss of pressure (corrected for temperature).
 13. Hoses must be examined and pressure-tested, as specified in 12. above, each time they are repaired or modified.
- b. Breathable Gas Hoses.
1. Hoses used to transport gases for breathing must meet the requirements of sub-section 3.4.9a.7 above.
 2. Hoses shall be suitable for the gas to be used.
 3. Breathable gas hoses shall be designed to withstand a pressure equal or greater than that of the maximum working depth plus 150 psi.
 4. Hoses must be hydrostatically tested at a pressure equal to 1.5 times working pressure. This test must be performed for 10 minutes without loss of pressure. The connectors must withstand an axial load of 200 lb. each.
 5. Hoses must be designed so as not to collapse if the external pressure exceeds the internal pressure.
- c. Oxygen Hoses.
1. Oxygen hoses must meet the requirements of sub-sections 3.4.9a.7 and 8 above.
 2. Hoses used for mixtures of gases with an oxygen contents greater than 40% shall be compatible and cleaned for oxygen service.
 3. Hoses used for oxygen service must be identified by a consistent color or be marked for this application.

4. Lubricants used with oxygen service hoses shall be compatible with oxygen.

3.4.10 Auxiliary Equipment:

- a. Control system for non self-contained diving (DCS):
 1. Must be of an approved type and used for all non self-contained diving operations and must be capable of controlling the pressure of the air supplied to the diver and measuring depth.
 2. The control system shall be inspected and maintained in accordance with the manufacturer's instructions and shall be used in compliance with the standards set out by the manufacturer. A record shall be kept of inspections, tests and repairs.
- b. Rigging:
 1. Shall be maintained in accordance with the manufacturer's instructions and shall be used in compliance with the standards set out by the manufacturer. A record shall be kept of inspections, tests and repairs.
 2. Rigging for cylinders and weight systems shall be regularly inspected by the person using them.
- c. Gauges.

Gauges shall be inspected and tested before use and every 12 months thereafter. Inaccurate gauges may not be used. A record shall be kept of inspections, tests, and repairs.
- d. Diving Computers.

Only ACP-approved models may be used. Diving computers shall be inspected and maintained in accordance with the manufacturer's instructions and shall be used in compliance with the standards set out by the manufacturer. A record shall be kept of inspections, tests and, repairs.
- e. Buckles.

The rigging for cylinders and weight systems shall be equipped with quick-release mechanisms which allow the entire assembly to be readily discarded. The quick-release mechanism must be easily operated with a single movement of either hand.
- f. Personal Flotation Systems.

Buoyancy compensators, dry suits, or other variable-volume buoyancy compensation devices shall be equipped with an relief valve. These devices shall be inspected and tested, at least annually, by the divers using them.
- g. Oxygen Equipment and First-Aid Materials.

A First-Aid kit and an oxygen unit with a demand valve must be available in the diving area at all times. When used in a hyperbaric chamber or diving bell, the First-aid kit shall be suitable for use under hyperbaric conditions.
- h. Submersible Power Tools.
 1. Electrical tools and equipment used underwater shall be approved for that application. Electrical tools and equipment powered from the surface shall be discharged before entering and leaving the water. Portable power tools shall only be activated at the request of the diver.
 2. All power tools must be inspected every 12 months.
- i. Compressor and Breathable Air Systems: Air for breathing in diving equipment must meet the following standards:
 1. Minimum oxygen: atmospheric.
 2. Oxygen content: The special mixtures must be specified by a competent authority.
 3. Maximum carbon monoxide content: 0.001% (10ppm)
 4. Maximum carbon dioxide: 0.10% (1000ppm)
 5. Dust and water and oil drops: absent
 6. Total hydrocarbon content (e.g. methane): 25ppm

7. Odors and fumes: absent.
- j. Compressor Systems:
 1. Low-pressure compressors used to supply air to divers must be equipped with a reservoir cylinder provided with a one-way valve at the intake, a pressure gauge, a pressure-relief valve, and a drain valve.
 2. Air systems pressurized in excess of 500 psi must be provided with slow-opening valves.
 3. All compressor air intakes must be located away from areas containing exhaust gases or other contaminants.
 4. All compressors must be operated and maintained in accordance with the manufacturer's specifications.
- k. Compressor Operation and Air Testing Records.
 1. Air quality and gas analysis tests must be performed on all compressors at intervals not exceeding 100 hours of operation or six months.
 2. A record must be kept showing operations, repairs, rebuilds, filter maintenance, and temperature adjustments.
- l. Oxygen Safety:
 1. Equipment used with oxygen or mixtures of oxygen containing a proportion of oxygen in excess of forty per cent (40%) shall be designed, used and maintained for oxygen service in accordance with the current standards for this application.
 2. Those components (with the exception of umbilical hoses) exposed to oxygen or to mixtures of oxygen having an oxygen content in excess of forty per cent (40%) oxygen by volume, shall be cleaned of inflammable material prior to use.
 3. Those oxygen systems pressurized above 125 psi must have slow-opening and closing valves.
- m. Pressurized Gas Storage Cylinders:
 1. Gas storage cylinders must meet the requirements of the American Society of Mechanical Engineers (ASME) or the U.S. Department of Transportation (DOT) in the case of mobile systems.
 2. Storage cylinders must be equipped with:
 - a) Pressure gauges.
 - b) One-way inlet valves s, in accordance with the manufacturer's specifications..
 - c) Pressure-relief valve
 - d) A drain valve at the lowest point (ASME only)
 - e) Slow-closing valves when pressure exceeds 500 psi.
- n. Tests and Inspections

Cylinders must be inspected visually once yearly and tested hydrostatically every five (5) years, as specified by the manufacturer.

3.4.11 Hyperbaric Chambers:

- a. Hyperbaric chambers for treatment must:
 1. Meet ASME standards.
 2. Be of the multilock-multiplace type.
 3. Be of sufficient size to accommodate one person lying in a horizontal position and another person at his side, attending to him.
 4. Allow personnel to enter and leave while the chamber is pressurized.
 5. Allow all the hatches to operate from both sides. The hatches must have suitable closing mechanisms for the working pressure.

6. Have interior illumination sufficient to operate the controls and observe and treat the patient.
7. Be equipped with small windows to observe the interior.
8. Have the capability to be pressurized to a minimum of six (6) absolute atmospheres (165 feet of salt water) or to the maximum diving depth for immersions at depths greater than 10 absolute atmospheres (300 feet of salt water).
9. Be capable of depressurization at a rate of one atmosphere per minute.
10. Be capable of pressurization at a rate of one atmosphere per minute.
11. Be equipped with a method of keeping the proportion of oxygen below 25% oxygen by volume.
12. Be equipped with a method of keeping the proportion of carbon dioxide below 2% by volume.
13. Be equipped with outlet silencers for pressurized gases.
14. Be equipped with suction-proof covers over pressurized lines in each compartment.
15. Have all the pipelines arranged so as to allow appropriate circulation inside and outside the chamber.
16. Have all hoses inspected in accordance with the procedure described in paragraph 3.4.9 of this Section.
17. Have all openings into the chamber marked and labelled as to their purpose.
18. Have all the pipelines constructed in accordance with ANSI code B31.1 or ASME/PVHO 1990 or the code used to construct the chamber. (PVHO = Pressure vessels for human occupancy.)
19. Be equipped with a pressure gauge in each compartment.
20. Have pressure gauges calibrated annually. The calibrations must be noted in an official diving record.
21. Be equipped with a pressure-relief valve that meets code ASME/PVHO-1 or the code under which the chamber was constructed.
22. Be equipped with a breathing system installed with a minimum of one mask per occupant per compartment.
23. Have the capability to supply breathable gas at 4.5 cubic feet per minute per occupant.
24. Be equipped with one-way valves in any opening in the chamber which supplies breathable gas to a breathing system.
25. Be equipped with a two-way communication system between the operator and the occupants in each compartment of the chamber.
26. Be equipped with a functioning fire extinguishing system.
27. Be equipped with electrical systems suitable for class A, division 1, environments.
28. Be equipped with speech decoders when mixed gases are used.

b. Hyperbaric Stretchers for Emergency Transfer and Evacuation must:

1. Meet the ASME PVHO-1 standards, the safety certification requirements for hyperbaric systems operated by the U.S. Navy for diving purposes and Lloyds' Rules and Regulations for Submersibles and Diving Systems (American Society of Mechanical Engineers PVHO-1 & Code Case 6 (2002); U.S. Navy Diving & Manned Hyperbaric Systems Safety Certification Requirements, Lloyds' Rules & Regulations for Submersibles & Diving Systems).
2. Be of the single compartment (monoplaza) type.
3. Be of a sufficient size to accommodate a person lying horizontally, at least 2,245 millimeters long and 595 millimeters in diameter.
4. Be equipped with two acrylic hatches at least 25 millimeters thick which allow good internal illumination and visual observation of the patient by the operator. The hatches must be equipped with closing mechanisms compatible with the working pressure.
5. Be equipped with sufficient interior illumination to permit operation of the controls and observation and treatment of the patient.

6. Have a working capacity to be pressurized to two (2) absolute atmospheres (66 feet of salt water).
7. Be capable of pressurization and depressurization at a rate of one (1) atmosphere per minute.
8. Be equipped with a method of keeping the proportion of carbon dioxide below 2% by volume.
9. Have all the pipelines arranged so as to allow appropriate circulation inside and outside the chamber.
10. Have all hoses inspected in accordance with the procedure described in paragraph 3.4.9 of this Section.
11. Have all openings into the chamber marked and labeled as to their purpose.
12. Have all the pipelines constructed in accordance with ANSI code B31.1 or ASME/PVHO 1990 or the code used to construct the chamber.
13. Be equipped with a pressure gauge for the compartment.
14. Have pressure gauges calibrated annually. The calibrations must be registered in an official diving record.
15. Be equipped with a pressure-relief valve that meets code ASME/PVHO-1 or the code under which the chamber was constructed.
16. Have the capability of supplying breathable gas to the occupant at the rate of 4.5 cubic feet per minute.
17. Be equipped with electrical systems suitable for Class A, Division 1, environments.
18. Shall be capable of withstanding six times its working pressure.

Section 4: Operating Requirements

4.0 GENERAL POLICY

All diving carried out by ACP personnel and contractors must be performed according to the standards and regulations set out in this Manual.

4.1 Diving Procedures:

All diving activities conducted under ACP auspices shall be planned and carried out in such a manner as to ensure that each diver maintains constant and effective communication with the surface, or in the case of self-contained diving, with at least another diver, similarly equipped and certified, or by means of a safety line to the surface. This buddy system is based on mutual assistance, especially in emergencies. Dives must be planned taking into account the competence level of the least-experienced diver. If effective communication between co-workers and the surface is lost, all divers must come to the surface and re-establish contact.

4.2 Emergency Procedures:

Procedures shall be put in place for the evacuation of diver(s) to a hyperbaric chamber or to a medical facility authorized by Health, Welfare and Occupational Health Section (RHSS) which allow for any hazardous conditions, such as: equipment failure, fire, extreme environmental conditions, illness or injury. These procedures have been approved by an authority designated by the ACP.

4.3 Closed or Confined Spaces:

Where a closed or confined space is not large enough for two divers, one of the workers shall position him at the entry point, and a guide-line shall be used.

4.4 Diving Flags:

Diving flags (code Alfa) shall be prominently displayed where diving is being carried out. During night operations, a rigid replica of the code Alfa flag shall be displayed with a rotating red light on its upper part.

4.5 Diving Tables:

A suitable set of diving tables, approved by the Council, shall be available at the site, even though other methods may be used to calculate decompression. These tables shall be *Spencer Huggins* tables. In special circumstances, U.S. Navy tables may be used.

4.6 Equipment Required at Different Depths:

Depth limits for diving operations and minimum equipment requirements are set out in the following table:

Depth (Down to)	Limit for
100' (30 mts.)	SCUBA diving, normal activity, single tank, 80 cfm.
100' (30 mts.)	Masks with SCUBA supply, single tank, 80 cfm
130' (39.6 mts.)	Open circuit, SCUBA, maximum limit in emergencies with permission from the General Foreman, Diving, Salvage and Recovery, double tank, 80 cfm
130' (39.6 mts.)	Diving without recompression chambers on site
190' (57.9 mts.)	Diving with masks and helmets on demand, maximum working limit using air and recompression chambers.

4.7 Refusal to Dive:

4.7.1 The decision to dive is exclusive to each diver. A diver may refuse to dive without fear of retaliation or discipline when he believes it would be unsafe to do so. The final responsibility for the diver's safety rests with each individual. It is the duty and responsibility of the diver to refuse to dive, if, in his judgment, the conditions are unsafe or unfavorable, or if he/she would be violating the principles of his/her training or the standards set out in this Manual.

4.7.2 No team member shall be obliged to expose himself to hyperbaric conditions against his will, except when necessary to prevent or treat a pressure-related injury.

4.8 Suspension from Diving:

4.8.1 It is the diver's responsibility to suspend diving operations, when he believes it is unsafe to continue, unless this would compromise the safety of another diver already in the water.

4.8.2 Diving must be suspended while there is still sufficient air pressure in the cylinder (in the case of SCUBA diving) to allow the diver to return safely to the surface, including safety or decompression stops, or to permit access to another air resource at a decompression station.

4.8.3. No team member shall be permitted to dive while conditions are known to exist which might adversely affect the safety and health of a diver or other diving team members.

4.9 Closed or Semi-closed Circuit Systems:

Closed or semi-closed circuit SCUBA systems must meet the following requirements:

4.9.1 The partial pressure of oxygen (ppO₂) must not exceed 1.5 atmospheres at depths below 25 feet (7.6 meters of sea water);

4.9.2 Chemicals used to absorb carbon dioxide must be stored in sealed containers in a cool, dry place until required;

4.9.3 The person designated as being in charge, must satisfy himself that the container of carbon dioxide absorbent is used as instructed by the manufacturer.

4.9.4 The closed and semi-closed circuit equipment must not be used at depths lower than that recommended as a limit by the equipment manufacturer, and must be operated and maintained in accordance with the manufacturer's specifications and requirements.

4.10 Non Self-contained Diving (SSA-Surface Supplied Air)

4.10.1 Divers whose air is supplied from the surface must comply with all applicable procedures in this Manual. Non self-contained divers may not exceed a depth of 190 feet (58 meters) of sea water.

4.10.2 Divers using the non self-contained system must be equipped with an independent emergency air supply for breathing.

4.10.3 The hose for each non self-contained diving operation must be attended by a team member (or *tender*), assigned especially, whenever a diver is underwater.

4.10.4 Divers using the non self-contained system must maintain two-way verbal communication with the *tender* on the surface.

4.10.5 The surface air supply must be sufficient to maintain all divers supplied from surface throughout the planned diving time, including stops for decompression.

4.11 Standby Diver

4.11.1 During diving operations, whenever there are divers underwater, there must be a Standby Diver at the diving site, ready to assist them. The Standby Diver must be well rested and be capable of carrying out rescue operations. The Standby Diver must be sufficiently free of residual nitrogen to allow him 25 minutes of bottom time at the operation's working depth without exceeding the no-decompression limits.

4.11.2 For non self-contained diving operations, the Standby Diver must have the same abilities and equipment as the chief diver and be prepared:

- a. with the safety ring attached to the diving suit (*Superlite*),
- b. with the umbilical connected to the harness (KMB=Kirby Morgan Band).

4.11.3 During SCUBA diving operations, a standby diver shall wear full diving equipment, checked by the supervisor, after which he may remove the cylinder, the mask, and the fins.

4.11.4 The Standby Diver may join the operations as a diver under the following conditions:

- a. Non self-contained diving without decompression up to 60; fsw
- b. Maintenance, construction ,or light salvage work (*shiphusbandry*);
- c. The same location and with visual contact;
- d. Current less than one knot.

4.12 Rules for Diving Operations:

4.12.1 Diving Unit Supervisor or Foreman

- a. In each diving operation, the unit may designate one person to be in charge.
- b. The person in charge must remain at the diving site throughout the entire diving operation.

c. The person in charge shall be responsible for the coordination of the diving operation. Diving must be coordinated with other known activities being carried out in the area which might interfere with diving operations.

- d. Team members must be informed with regard to:
1. objectives of the diving operations;
 2. dangers or environmental conditions which may affect the safety of the diving operation.
 3. changes to diving plans or possible emergencies in a specific operation.

4. How to report any adverse physical problem or physiological effects, including symptoms of illness related to pressure changes.

4.12.2 Planning of Diving Operations. The planning of a diving operation should consider the safety and health aspects of:

- a. Type of diving.
- b. Surface and underwater conditions and hazards.
- c. Thermal protection.
- d. Diving equipment.
- e. Assignment of diving teams.
- f. Residual nitrogen in team members.
- g. Decompression profiles and altitude corrections.
- h. Emergency procedures.
- i. Job Safety Analysis

4.12.3 Diving and Evacuation Plans

Prior to conducting any diving operation under ACP auspices, the unit Diving Foreman must submit a Diving Plan to the designated unit authority for review and approval, which includes:

- a. The scope of the operation and the resources to be used.
- b. Personnel involved in the diving operation.
- c. Location of the scheduled dives.
- d. Anticipated bottom depths and times.
- e. Team padlocks and labels.
- f. Any anticipated hazardous condition.
- g. Emergency Plan, location of the nearest hyperbaric chamber, method of transport to be used, and emergency telephone numbers.

4.12.4 Diving Teams

The number of divers assigned to an operation depends on the type of operation. The following table sets out the required minimum values for different types of diving;

(Following page)

Minimum Personnel Required for Different Types of Diving							
	Depth and Condition	Divers Under-water	Diver Tender	Standby Diver	Person In Charge of DCS	2 nd DCS Operator	Total
Surface-supplied Air	<60' depth	1	1	1	1	-	4
	>10' visibility	2	1	-	1	-	4
	Current <1 knot	3	3	-	1	-	7
	Non-penetration Diving	4	4	1	1	1	11
	60' < 190' Non-penetration Diving	1	2	1	1	-	5
		1	2	1	1	1	6
	60' Penetration Diving	3	3	-	1	-	7
		4	5	1	1	1	12
	60' < 190' Non-penetration Diving	2	3	1	1	-	7
		3	3	-	1	-	7
4		5	1	1	1	12	
SCUBA	<60' Depth	2	-	-	1	-	3
	60' <130' Depth	2	-	1	1	-	4
	Visibility Less Than 10'	Diving operations prohibited					
	Current in Excess of 1 Knot	Diving operations prohibited					

Warning:

THESE ARE THE MINIMUM PERSONNEL LEVELS REQUIRED FOR DIVING OPERATIONS: DIVING OPERATIONS WILL NOT BE PERMITTED AT PERSONNEL LEVELS BELOW THOSE SET OUT IN THIS TABLE. THERE MAY BE CIRCUMSTANCES WHICH WILL REQUIRE THESE LEVELS TO BE INCREASED IN ORDER TO CARRY OUT DIVING OPERATIONS SAFELY.

4.12.5 Safety Revision Prior to Diving:

- a. Each diver must perform a functional revision of his diving equipment in the presence of another diver or the diver tender;
- b. The diver must assure himself that he has sufficient air in his cylinder (in the case of SCUBA diving) to permit him to carry out his work and return to the surface safely including decompression. Each diver must perform a revision of his submersible pressure gauge, time meter, depth indicator, and/or dive computer;
- c. If mixed gases are being moved for breathing, the person in charge of the diving operations must verify that he has the correct tables for the particular mixtures.

4.12.6 Post-diving Safety Review:

- a. Following conclusion of diving operations, divers must report any physical difficulties, symptoms of illness due to decompression or malfunctioning equipment.

b. When diving operations take place beyond no-decompression limits, divers must remain awake for at least one hour after diving and in the company of a team member who is ready to transport him/her to a hyperbaric chamber, if necessary.

4.12.7 Emergencies and Deviations from Regulations

Any diver may deviate from the requirements of this Manual to the extent necessary to prevent or minimize a situation certain to cause death, physical damage or major environmental damage. The foreman shall prepare a report explaining the circumstances and justifications, and shall transmit it through the Safety and Industrial Hygiene Unit to the Diving Council.

4.12.8 Consequences of Violation of Regulations by Divers

Failure by a diver to comply with Safety Manual regulations may be cause the revocation or restriction of the individual's certification by a decision of the Diving Council.

4.12.9 Records and Requirements

Official diving record

a. For each diving operation, divers must complete an individual report and submit it to the foreman after each operation, with a copy for the diver's permanent file. The report shall include, at a minimum, the following:

1. Date;
2. Name of diver tender;
3. Location;
4. Maximum depth;
5. Type of diving (SCUBA or with surface-supplied air);
6. Time, repetitive group, and intervals at surface;
7. Any safety or decompression stoppage;
8. Signatures of the diver and the person in charge of diving operations;
9. Decompression table used;
10. Other comments and exceptions, such as whether diving computers were used, environmental conditions or notes on the equipment, hazardous diving operations.

b. If any potentially dangerous injury is suspected, caused by pressure changes, or if there are symptoms evident, after attending to the same, the Diving Foreman shall investigate and prepare a report and shall submit it to the Diving Council along with the official diving record.

1. A complete record of the incident.
2. A description of the symptoms, including the depth, time of appearance and results of treatment.

Section 5: Medical Requirements

5.1 General

Due to the inherent exceptional physical demands placed on persons engaged in diving operations or otherwise exposed to hyperbaric conditions, all ACP or contracted employees performing diving operations in Canal waters must undergo a physical examination, in accordance with the following protocol, to ensure that the employee is physically fit to perform the particular duties of his position without sickness or risk of injury.

5.2 Medical Requirements for Diving Personnel

The Health, Welfare and Occupational Health Section (RHSS) must ensure that all divers exposed to hyperbaric conditions have passed a recent medical assessment and have been declared fit to engage in diving activities within the limitations imposed by the medical assessment report. All medical assessments required by this Manual must be performed by an ACP physician or by a certified physician approved by the ACP, preferably one trained in diving-related medicine. Outside physicians shall sign a medical certification form and attach a copy of the results and the tests performed for verification and approval by the ACP physicians responsible for certifications. A diver should not exhibit chronic or acute incapacitating conditions, nor illnesses and/or conditions which would restrict him from diving.

5.3 Physical Examination

5.3.1 The medical assessment for divers and tenders shall consist of an initial complete evaluation, followed by a complete annual physical examination, including auxiliary diagnostic tests, as described by this Manual.

5.3.2 The periodic (annual) health assessments shall be performed to ascertain whether a diver or tender is fit to perform diving operations.

5.3.3 Only those divers who have undergone the examinations and tests deemed necessary to determine the presence of any disqualifying condition as listed in this Protocol shall be permitted to engage in diving operations.

5.3.4 If, during a twelve-month period, an employee has undergone a medical examination, which, in the opinion of the Health, Welfare and Occupational Health Section (RHSS), is comparable to the initial examination specified in this Protocol, and if the results of this examination do not indicate the presence of significant irregularities which could affect the general health of the employee during diving operations, the said examination shall be considered to have satisfied the requirements of the divers' periodic health examination.

5.4 Physical Examination Following Illness or Injury

5.4.1 Any person employed as a diver or otherwise exposed to hyperbaric conditions shall undergo a medical examination following an illness or injury (whether diving-related or not) which has caused:

- a. Restriction to his quarters or hospitalization for 72 hours or more.
- b. Decompression illness with audiovestibular or central nervous system dysfunction.

5.4.2 The employee's unit shall refer him for a medical examination prior to returning to work, in order to assess his physical aptitude or fitness to perform work involving hyperbaric exposure.

5.4.3 The examining physician shall decide on the scope of the examination, according to the nature of the illness.

5.5 Permanent and Temporary Disqualifying Conditions:

5.5.1 A diver who exhibits any of the following conditions, as determined by his medical history and medical examination, shall be **permanently** disqualified from engaging in diving or other hyperbaric activities:

- a. Cranial deformities or loss of cranial bone matter.
- b. Significant auditory damage, irreparable damage to the eardrum, chronic sinusitis, Menière's disease, prior middle ear surgery with recent vestibular dysfunction and/or chronic inability to equalize intrasinusoidal or middle ear pressure.
- c. Cystic or cavitory lung disease, obstruction or significant recurring disease of the lungs or pneumothorax.
- d. A history of convulsive illness, whether or not under control, which has not been related to fever convulsions during childhood or a history of repeated syncopes.
- e. Central or peripheral disease damage to the nervous system.
- f. Cardiac abnormalities (valvular heart disease, congenital heart disease, dilated or hypertrophic cardiomyopathy, atrioseptal defects, cardiac arrhythmias).
- g. Chronic alcohol or illicit substances abuse; history of psychosis.
- h. Hemoglobinopathy (hemoglobin S or C disease).
- i. History of dysbaric osteonecrosis.
- j. Chronic or poorly controlled medical conditions (arterial hypertension, diabetes mellitus, fatty liver disease) that require medication.
- k. Any other disease or physical condition causing chronic or recurrent impediment, which in the medical examiner's opinion, significantly increases the risk associated with diving.

5.5.2. A diver who exhibits any of the following conditions, as determined by his medical history and medical examination, shall be **temporarily** disqualified from engaging in diving or other hyperbaric activities:

- a. Perforated eardrum, untreated acute sinusitis.
- b. Acute uncontrolled medical conditions (arterial hypertension, hyperglycemia) not requiring medication.
- c. Pregnancy.
- d. Moderate or morbid obesity.
- e. Unrepaired abdominal wall hernias.

5.6 Diver Physical Examination:

5.6.1 Divers must appear annually at the Physical Examination Center for examination by a physician. The physical examination will place special emphasis on the head, face, scalp, neck, ears, nose, throat, Eustachian tubes, mouth, lungs and thorax, cardiovascular system, abdomen and pelvis, and a neurological examination.

5.6.2 The diver must meet the standards for weight and Body Mass Index (see Tables 1--4). A variation is acceptable if the diver exceeds the standards and the physician believes that the excess is due to his muscular build and physical condition. If an individual meets the standards but exhibits an excess of adipose tissue (= fat) above that indicated by the Body Mass Index tables, he shall be temporarily disqualified until his condition has been corrected.

5.6.3 Arterial pressure at rest shall not exceed 140/90 mmHg. In cases of apparent hypertension, the necessary number of repeated determinations of the tensional values shall be made before a final decision is reached.

5.6.4 Check for cranial deformities such as depressions, exostosis or any loss or absence of cranial bone matter which would prevent the individual from using the required equipment.

5.6.5 The nose / ears / throat should be examined for acute disease, chronic serous otitis or otitis media, perforation of the eardrum, any significant nasal or pharyngeal obstruction or respiratory obstruction or hypertrophy (polyps, tonsils, adenoids), chronic sinusitis not readily controlled, speech impediments due to organic defects, and inability to equalize pressure changes for any reason.

5.6.6 Mouth: A complete dental examination of candidates by a dentist is recommended to ensure a high level of oral hygiene. Whenever a dentist is unavailable, the examination should include an inspection of any process of acute infection of the soft tissue of the oral cavity, advanced oral disease and generally unserviceable teeth and of any dental abnormality, severely imperfect occlusion or malformation of the jaw which hinders the ability to effectively secure and retain any mouthpiece or standard diving equipment.

5.6.7 The neck should be examined for congenital cysts originating from the branchial cleft, or those arising from vestiges of the thyroglossal duct, with or without fistular tracts, as well as any chronically draining fistula of any type.

5.6.8 Lungs: Evaluate any type of chronic or restrictive obstructive pulmonary disease, congenital or acquired defects which may restrict pulmonary function and cause pulmonary hyperinflation or affect the ventilation-perfusion balance.

5.6.9 Cardiovascular System: Any abnormality such as disturbances in the heart rate (persistent tachycardia and other arrhythmias) with the exception of the sinus type, arteriosclerosis (documented after a detailed ophthalmologic examination of the retina), varicose veins, and hemorrhoids should be completely investigated.

5.6.10 Hematology: Any history of significant hemolytic disease or anemia should be evaluated. Diver candidates should be examined for falciform anemia; the minimum requirement for this test is the dithionite solubility test, for which the hemoglobin electrophoresis test may be substituted. Candidates having variable hemoglobin conditions should be disqualified. Candidates with seric levels which are very low or deficient in glucose-6-phosphate dehydrogenase (G6PD), a first phase catalyst in the pentose phosphate pathway to the glucose metabolism, should be disqualified, since their deficiency may lead to various levels of hemolytic crises in affected individuals.

5.6.11 Gastrointestinal and Abdominal: Active peptic ulceration shall be cause for disqualification unless it has healed and the diver has had no symptoms for at least three (3) months without medication. Any abdominal herniation shall be cause for rejection until it has been satisfactorily repaired.

5.6.12 Genitourinary and Reproductive: Pregnancy at any stage shall be cause for temporary disqualification. Any menstrual disorder characterized by abnormal or prolonged bleeding, accompanied by excessive pain, shall also be cause for disqualification.

5.6.13 Any impediment in skeletal muscle function or defect in the skeletal structure that might interfere with the performance of an individual as a diver should be carefully assessed based on the general requirements.

5.6.14 Neurological Examination: A complete examination of the central and peripheral nervous system should show normal functioning. Local anesthetized areas will be permitted provided that disease of the nervous system has been excluded. Any history of convulsions (unrelated to fever convulsions during childhood), intracranial surgery, loss of consciousness, or cranial trauma with after-effects that have caused more than one episode of momentary loss of consciousness or confusion shall be cause for

disqualification. If there is doubt as to the severity of the injury, an evaluation and special studies should be considered.

5.6.15 Psychiatric: In view of the special nature of underwater work, a careful evaluation is required of the individual's emotional and temperamental capacity. Personality disorders, neuroses, psychoses, immaturity, instability, and anti-social characteristics will lead to disqualification, as well as any evidence of mental illness, past or present. Stuttering or stammering is cause for disqualification.

5.6.16. Ancillary Diagnostic Tests: These tests are performed as part of every physical examination:

- a. A complete hemogram with platelet count: Any significant anemia or history of hemolytic disease should be evaluated.
- b. Fasting Blood chemistry : Rule out hyperglycemia, hyperlipidemia, creatinemia or elevated levels of transaminases in the liver.
- c. Hemoglobin Electrophoresis (only on initial examination): Rule out the presence of Type S or C hemoglobin.
- d. Glucose-6-phosphate Dehydrogenase (only on initial examination): Quantitative analysis to rule out any deficiency.
- e. Pulmonary Function Tests: Results > 75% in the pulmonary function test to determine the Forced Expiratory Volume in one second (FEV1) over the Forced Vital Capacity (FVC). If it is less, other additional specialized pulmonary function tests may be required to show suitability. Forced Expiratory Flow (FEF) values should be between 25% and 75% for a normal FEV1.

5.6.17 Roentgenography

- a. Thorax (14 x 17) PA, during inhalation and exhalation in order to rule out the presence and determine the size of lung granulomas (initial examination and every four years thereafter or as indicated by a physician).
- b. Long bones, if it is expected to carry out saturation diving, there should be a re-assessment every three years.

5.6.18 A derived 12-lead resting electrocardiogram.

5.6.19 Pure Tone Audiogram: Deafness in either ear above 35 dB at frequencies up to 3000 Hz, or over 50 dB in frequencies above 3000 Hz up to 6000 Hz is cause for referral to the candidate or diver's primary care physician, likewise in the case of any doubt as to the functioning of the inner ear.

5.6.20 Visual Acuity: Correctible to 20/20, J-1 in one eye, and 20/40, J-4 in the worst eye.

5.6.21 Aerobic Capacity Test: Measures the combined efficiency of the respiratory, cardiovascular and skeletal muscular systems in obtaining sufficient oxygen for the muscles and putting them to work. This oxygen capture, expressed in milliliters of oxygen per kilogram of body weight per minute (ml / kg / min) or in multiples of oxygen capture (METS / metabolic equivalents / measurement in exercise training), varies among individuals. The higher the rate of oxygen capture, the higher will be an individual's functional capacity. The value of METS indicates how many times an individual is capable of increasing his resting rate of oxygen capture. Candidates or divers must demonstrate a minimum aerobic capacity equivalent to 35 ml / kg / min (10 METS) during the exertion test.

Table 1. Maximum Male Weight per Height According to Years of Age.

Height		17 - 20		21 - 27		28 - 39		> 40	
in.	(cm)	Lb.	Kg.	Lb.	Kg.	Lb.	Kg.	Lb.	Kg.
60	(152.4)	139	63.2	141	64.1	143	65.0	146	66.4
61	(154.9)	144	65.5	146	66.4	148	67.3	151	68.6
62	(157.4)	148	67.3	150	68.2	153	69.5	156	70.9
63	(160.0)	153	69.5	155	70.5	158	71.8	161	73.2
64	(162.5)	158	71.8	160	72.7	163	74.1	166	75.5
65	(165.1)	163	74.1	165	75.0	168	76.4	171	77.7
66	(167.6)	168	76.4	170	77.3	173	78.6	177	80.5
67	(170.1)	174	79.1	176	80.0	179	81.4	182	82.7
68	(172.7)	179	81.4	181	82.3	184	83.6	187	85.0
69	(175.2)	184	83.6	186	84.5	189	85.9	193	87.7
70	(177.8)	189	85.9	192	87.3	195	88.6	199	90.5
71	(180.3)	194	88.2	197	89.5	201	91.4	204	92.7
72	(182.8)	200	90.9	203	92.3	206	93.6	210	95.5
73	(185.4)	205	93.2	208	94.5	212	96.4	216	98.2
74	(187.9)	211	95.9	214	97.3	218	99.1	222	100.9
75	(190.5)	217	98.6	220	100.0	224	101.8	228	103.6
76	(193.0)	223	101.4	226	102.7	230	104.5	234	106.4
77	(195.6)	229	104.1	232	105.5	236	107.3	240	109.1
78	(198.1)	235	106.8	238	108.2	242	110.0	247	112.3
79	(200.6)	241	109.5	244	110.9	248	112.7	253	115.0
80	(203.2)	247	112.3	250	113.6	255	115.9	259	117.7

Table 2. Maximum Female Weight per Height According to Years of Age.

Height		17 - 20		21 - 27		28 - 39		> 40	
In.	(cm)	Lb.	Kg.	Lb.	Kg.	Lb.	Kg.	Lb.	Kg.
58	(147.3)	112	50.9	115	52.3	119	54.1	122	55.5
59	(149.5)	116	52.7	119	54.1	123	55.9	126	57.3
60	(152.4)	120	54.5	123	55.9	127	57.7	130	59.1
61	(154.9)	124	56.4	127	57.7	131	59.5	135	61.4
62	(157.4)	129	58.6	132	60.0	137	62.3	139	63.2
63	(160.0)	133	60.5	137	62.3	141	64.1	144	65.5
64	(162.5)	137	62.3	141	64.1	145	65.9	148	67.3
65	(165.1)	141	64.1	145	65.9	149	67.7	153	69.5
66	(167.6)	146	66.4	150	68.2	154	70.0	158	71.8
67	(170.1)	149	67.7	154	70.0	159	72.3	162	73.6
68	(172.7)	154	70.0	159	72.3	164	74.5	167	75.9
69	(175.2)	158	71.8	164	74.5	168	76.4	172	78.2
70	(177.8)	163	74.1	168	76.4	173	78.6	177	80.5
71	(180.3)	167	75.9	173	78.6	177	80.5	182	82.7
72	(182.8)	172	78.2	177	80.5	183	83.2	188	85.5
73	(185.4)	177	80.5	183	83.2	188	85.5	193	87.7
74	(187.9)	183	83.2	188	85.5	194	88.2	198	90.0
75	(190.5)	188	85.5	194	88.2	200	90.9	204	92.7
76	(193.0)	194	88.2	200	90.9	206	93.6	209	95.0
77	(195.6)	199	90.5	205	93.2	211	95.9	215	97.7
78	(198.1)	204	92.7	210	95.5	216	98.2	220	100.0
79	(200.6)	209	95.0	215	97.7	222	100.9	226	102.7
80	(203.2)	214	97.3	220	100.0	227	103.2	232	105.5

Table 3. Maximum Male Body Mass Index per Height (kg/m²)

Height		BMI	Height		BMI	Height		BMI
In.	(cm)		In.	(cm)		In.	(cm)	
64	(162.5)	28.2	70	(177.8)	27.9	76	(193.0)	28.1
65	(165.1)	28.0	71	(180.3)	27.8	77	(195.6)	28.0
66	(167.6)	28.1	72	(182.8)	27.9	78	(198.1)	28.0
67	(170.1)	28.1	73	(185.4)	27.9	79	(200.6)	28.0
68	(172.7)	28.0	74	(187.9)	28.0	80	(203.2)	28.0
69	(175.2)	28.0	75	(190.5)	28.1			

Table 4. Maximum Female Body Mass Index per Height (kg/m²)

Height		BMI	Height		BMI	Height		BMI
In.	(cm)		In.	(cm)		In.	(cm)	
64	(162.5)	26.8	70	(177.8)	25.4	76	(193.0)	25.0
65	(165.1)	26.7	71	(180.3)	25.3	77	(195.6)	25.1
66	(167.6)	26.4	72	(182.8)	25.1	78	(198.1)	25.0
67	(170.1)	26.2	73	(185.4)	25.0	79	(200.6)	25.1
68	(172.7)	25.9	74	(187.9)	25.0	80	(203.2)	25.0
69	(175.2)	25.7	75	(190.5)	25.0			

5.6.22 Ergometric Testing: It is necessary to ensure that a commercial diver's ability to dive is not hindered by a subnormal working capability. A person's physical working capacity is limited by his maximum rate of oxygen capture (VO₂ MAX). All divers who have demonstrated an aerobic capacity of less than 10 METS during the aerobic capacity test must undergo an ergometric test and demonstrate a rate of oxygen capture of not less than 3.0 lts/min.

5.7 Physical Examination for Diver Tenders (Initial and Annual Examination).

5.7.1 Diver Tenders must appear at the Physical Examination Center every two years until age 50, and annually thereafter.

5.7.2 General medical history should emphasize cardiovascular disease, hypertension, breathing difficulty, diabetes *mellitus*, vertigo or fainting spells, medication(s) which affect alertness, convulsions, nervous attacks, skeletal muscle problems, and dependence on or abuse of illicit substances or alcohol.

5.7.3 The physical examination shall include vital signs; visual acuity; hearing; cardiopulmonary evaluation; range of joint movement, especially shoulders, elbows, knees and back; physical ability to lift 100 lb.; an examination of the lumbar spine; and a neurological examination.

5.7.4 Auxiliary Diagnostic Tests:

- a. A complete hemogram with platelet count: Any type of chronic anemia.
 1. Blood chemistry while fasting: Rule out hyperglycemia, hyperlipidemia, creatinamia or elevated levels of transaminases in the liver.
 2. X-rays of the thorax (14 x 17) PA, during inhalation and exhalation to rule out the presence and determine the size of lung granulomas.
 3. A derived 12-lead resting electrocardiogram if clinically indicated.
 4. Pure tone audiogram: Deafness in either ear above 35 dB at frequencies up to 3000 Hz, or over 50 dB in frequencies above 3000 Hz up to 6000 Hz is cause for referral to the candidate or diver's (or tender's) primary care physician, likewise if there is any doubt as to the functioning of the inner ear.
 5. Visual acuity: Correctible to 20/20, J-1 in one eye, and 20/40, J-4 in the worst eye.



RECORD OF REVISIONS

This clause was moved to a Word document which includes only the changes to be published, not the many internal revisions.

This table is only retained here for information and as a reference for when the Word document LIST OF REVISIONS is updated.

Revision No.	Date of Revision	Reason for the Revision	Revision Made by:
Original	Nov 05	General	Diving Council