§ 1910.423, decompression procedure assessment evaluations (§1910.423), and records of hospitalizations (§1910.440) shall be provided in the same manner as employee exposure records or analyses using exposure or medical records. Equipment inspections and testing records which pertain to employees (§1910.430) shall also be provided upon request to employees and their designated representatives.

(3) Records and documents required by this standard shall be retained by the employer for the following period:

(i) Safe practices manual (§1910.420)—current document only;

(ii) Depth-time profile (§1910.422)—until completion of the recording of dive, or until completion of decompression procedure assessment where there has been an incident of decompression sickness;

(iv) Recording of dive (§1910.423)—1 year, except 5 years where there has been an incident of decompression sickness;

(v) Decompression procedure assessment evaluations (§1910.423)—5 years;

(vi) Equipment inspections and testing records (§1910.430)—current entry or tag, or until equipment is withdrawn from service;

(vii) Records of hospitalizations (§1910.440)—5 years.


(5) [Reserved]


APPENDIX A TO SUBPART T TO PART 1910—EXAMPLES OF CONDITIONS WHICH MAY RESTRICT OR LIMIT EXPOSURE TO HYPERBARIC CONDITIONS

The following disorders may restrict or limit occupational exposure to hyperbaric conditions depending on severity, presence of residual effects, response to therapy, number of occurrences, diving mode, or degree and duration of isolation.

History of seizure disorder other than early febrile convulsions.

Malignancies (active) unless treated and without recurrence for 3 yrs.

Chronic inability to equalize sinus and/or middle ear pressure.

Cystic or cavitory disease of the lungs.

Impaired organ function caused by alcohol or drug use.

Conditions requiring continuous medication for control (e.g., antihistamines, steroids, barbiturates, moodaltering drugs, or insulin).

Meniere’s disease.

Hemoglobinopathies.

Obstructive or restrictive lung disease.

Vestibular end organ destruction.

Pneumothorax.

Cardiac abnormalities (e.g., pathological heart block, valvular disease, intraventricular conduction defects other than isolated right bundle branch block, angina pectoris, arrhythmia, coronary artery disease).

Juxta-articular osteonecrosis.

APPENDIX B TO SUBPART T TO PART 1910—GUIDELINES FOR SCIENTIFIC DIVING

This appendix contains guidelines that will be used in conjunction with §1910.401(a)(2)(iv) to determine those scientific diving programs which are exempt from the requirements for commercial diving. The guidelines are as follows:

1. The Diving Control Board consists of a majority of active scientific divers and has autonomous and absolute authority over the scientific diving program’s operations.

2. The purpose of the project using scientific diving is the advancement of science; therefore, information and data resulting from the project are non-proprietary.

3. The tasks of a scientific diver are those of an observer and data gatherer. Construction and trouble-shooting tasks traditionally associated with commercial diving are not included within scientific diving.

4. Scientific divers, based on the nature of their activities, must use scientific expertise in studying the underwater environment and, therefore, are scientists or scientists in training.

[50 FR 1050, Jan. 9, 1985]

APPENDIX C TO SUBPART T TO PART 1910—ALTERNATIVE CONDITIONS UNDER §1910.401(a)(3) FOR RECREATIONAL DIVING INSTRUCTORS AND DIVING GUIDES (MANDATORY)

Paragraph (a)(3) of §1910.401 specifies that an employer of recreational diving instructors and diving guides (hereafter, “divers” or “employees”) who complies with all of the conditions of this appendix need not provide a decompression chamber for these divers as required under §§1910.423(b)(2) or (c)(3) or 1910.426(b)(1).
1. EQUIPMENT REQUIREMENTS FOR
REBREATHERS

(a) The employer must ensure that each
employee operates the rebreather (i.e., semi-
closed-circuit and closed-circuit self-con-
tained underwater breathing apparatuses
(hereafter, “SCUBAs”) according to the re-
breather manufacturer’s instructions.
(b) The employer must ensure that each re-
breather has a counterlung that supplies a
sufficient volume of breathing gas to their
divers to sustain the divers’ respiration
rates, and contains a baffle system and/or
other moisture separating system that keeps
moisture from entering the scrubber.
(c) The employer must place a moisture
trap in the breathing loop of the rebreather,
and ensure that:
(i) The rebreather manufacturer approves
both the moisture trap and its location in
the breathing loop; and
(ii) Each employee uses the moisture trap
according to the rebreather manufacturer’s
instructions.
(d) The employer must ensure that each re-
breather has a continuously functioning
moisture sensor, and that:
(i) The moisture sensor connects to a vis-
ual (e.g., digital, graphic, analog) or auditory
(e.g., voice, pure tone) alarm that is readily
detectable by the diver under the diving con-
ditions in which the diver operates, and
warns the diver of moisture in the breathing
loop in sufficient time to terminate the dive
and return safely to the surface; and
(ii) Each diver uses the moisture sensor ac-
cording to the rebreather manufacturer’s in-
suctions.
(e) The employer must ensure that each re-
breather contains a continuously function-
ing CO₂ sensor in the breathing loop, and that:
(i) The rebreather manufacturer approves
the location of the CO₂ sensor in the breath-
ing loop;
(ii) The CO₂ sensor is integrated with an
alarm that operates in a visual (e.g., digital,
graphic, analog) or auditory (e.g., voice, pure
tone) mode that is readily detectable by each
diver under the diving conditions in which
the diver operates; and
(iii) The CO₂ alarm remains continuously
activated when the inhaled CO₂ level reaches
and exceeds 0.005 atmospheres absolute
(ATA).
(f) Before each day’s diving operations, and
more often when necessary, the employer
must calibrate the CO₂ sensor according to
the sensor manufacturer’s instructions, and
ensure that:
(i) The equipment and procedures used to
perform this calibration are accurate to
within 10% of a CO₂ concentration of 0.005
ATA or less;
(ii) The equipment and procedures main-
tain this accuracy as required by the sensor
manufacturer’s instructions; and
(iii) The calibration of the CO₂ sensor is ac-
curate to within 10% of a CO₂ concentration
of 0.005 ATA or less.
(g) The employer must replace the CO₂ sen-
sor when it fails to meet the accuracy re-
quirements specified in paragraph 1(i)(i) of
this appendix, and ensure that the replace-
ment CO₂ sensor meets the accuracy require-
ments specified in paragraph 1(i)(ii) of this
appendix before placing the rebreather in op-
eration.
(h) As an alternative to using a continuously
functioning CO₂ sensor, the employer
may use a schedule for replacing CO₂-sorbent
material provided by the rebreather manu-
facturer. The employer may use such a
schedule only when the rebreather manufac-
turer has developed it according to the can-
ister-testing protocol specified below in Con-
dition 11, and must use the canister within
the temperature range for which the manu-
ufacturer conducted its scrubber canister
tests following that protocol. Variations
above or below the range are acceptable only
after the manufacturer adds that lower or
higher temperature to the protocol.
(i) When using CO₂-sorbent replacement
schedules, the employer must ensure that each
rebreather uses a manufactured (i.e.,
commercially pre-packed), disposable scrub-
ber cartridge containing a CO₂-sorbent ma-
terial that:
(i) Is approved by the rebreather manu-
facturer;
(ii) Removes CO₂ from the diver’s exhaled
gas; and
(iii) Maintains the CO₂ level in the breath-
able gas (i.e., the gas that a diver inhales di-
rectly from the regulator) below a partial
pressure of 0.01 ATA.
(j) As an alternative to manufactured, dis-
posable scrubber cartridges, the employer
may fill CO₂ scrubber cartridges manually
with CO₂-sorbent material when:
(i) The rebreather manufacturer permits
manual filling of scrubber cartridges;
(ii) The employer fills the scrubber car-
tridges according to the rebreather manufac-
turer’s instructions;
(iii) The employer replaces the CO₂-sorbent
material using a replacement schedule devel-
oped under paragraph 1(h) of this appendix; and
(iv) The employer demonstrates that man-
ual filling meets the requirements specified in
paragraph 1(i) of this appendix.
(k) The employer must ensure that each
rebreather has an information module that
provides:
(i) A visual (e.g., digital, graphic, analog)
or auditory (e.g., voice, pure tone) display
that effectively warns the diver of solenoid
failure (when the rebreather uses solenoids)
2. SPECIAL REQUIREMENTS FOR CLOSED-CIRCUIT REBREATHERS
(a) The employer must ensure that each closed-circuit rebreather uses supply-pressure sensors for the O₂ and diluent (i.e., air or nitrogen) gases and continuously functioning sensors for detecting temperature in the inhalation side of the gas-loop and the ambient water.
(b) The employer must ensure that:
(i) At least two O₂ sensors are located in the inhalation side of the breathing loop; and
(ii) The O₂ sensors are: functioning continuously; temperature compensated; and approved by the rebreather manufacturer.
(c) Before each day’s diving operations, and more often when necessary, the employer must calibrate O₂ sensors as required by the sensor manufacturer’s instructions. In doing so, the employer must:
(i) Ensure that the equipment and procedures used to perform the calibration are accurate to within 1% of the O₂ fraction by volume;
(ii) Maintain this accuracy as required by the manufacturer of the calibration equipment;
(iii) Ensure that the sensors are accurate to within 1% of the O₂ fraction by volume;
(iv) Replace O₂ sensors when they fail to meet the accuracy requirements specified in paragraph 2(c)(iii) of this appendix before placing a rebreather in operation.
(d) The employer must ensure that each closed-circuit rebreather has:
(i) A gas-controller package with electrically operated solenoid O₂-supply valves;
(ii) A pressure-activated regulator with a second-stage diluent-gas addition valve;
(iii) A manually operated gas-supply bypass valve to add O₂ or diluent gas to the breathing loop; and
(iv) Separate O₂ and diluent-gas cylinders to supply the breathing-gas mixture.

3. O₂ CONCENTRATION IN THE BREATHING GAS
The employer must ensure that the fraction of O₂ in the nitrox breathing-gas mixture:
(a) Is greater than the fraction of O₂ in compressed air (i.e., exceeds 22% by volume);
(b) For open-circuit SCUBA, never exceeds a maximum fraction of breathable O₂ of 40% by volume or a maximum O₂ partial pressure of 1.40 ATA, whichever exposes divers to less O₂; and
(c) For a rebreather, never exceeds a maximum O₂ partial pressure of 1.40 ATA.

4. REGULATING O₂ EXPOSURES AND DIVING DEPTH
(a) Regarding O₂ exposure, the employer must:
(i) Ensure that the exposure of each diver to partial pressures of O₂ between 0.60 and 1.40 ATA does not exceed the 24-hour single-exposure time limits specified either by the 2001 National Oceanic and Atmospheric Administration Diving Manual (the “2001 NOAA Diving Manual”), or by the report entitled “Enriched Air Operations and Resource Guide” published in 1995 by the Professional Association of Diving Instructors (known commonly as the “1996 DSAT Oxygen Exposure Table”); and
(ii) Determine a diver’s O₂-exposure duration using the diver’s maximum O₂ exposure (partial pressure of O₂) during the dive and the total dive time (i.e., from the time the diver leaves the surface until the diver returns to the surface).
(b) Regardless of the diving equipment used, the employer must ensure that no diver exceeds a depth of 130 feet of sea water (“fsw”) or a maximum O₂ partial pressure of 1.40 ATA, whichever exposes the diver to less O₂.

5. USE OF NO-DECOMPRESSION LIMITS
(a) For diving conducted while using nitrox breathing-gas mixtures, the employer must ensure that each diver remains within the no-decompression limits specified for single and repetitive air diving and published in the 2001 NOAA Diving Manual or the report entitled “Development and Validation of No-Stop Decompression Procedures for Recreational Diving: The DSAT Recreational Dive Planner,” published in 1994 by Hamilton Research Ltd. (known commonly as the “1994 DSAT No-Decompression Tables”).
(b) An employer may permit a diver to use a dive-decompression computer designed to regulate decompression when the dive-decompression computer uses the no-decompression limits specified in paragraph 5(a) of this appendix, and provides output that reliably represents those limits.

6. MIXING AND ANALYZING THE BREATHING GAS
(a) The employer must ensure that:
(i) Properly trained personnel mix nitrox-breathing gases, and that nitrogen is the only inert gas used in the breathing-gas mixture; and
(ii) When mixing nitrox-breathing gases, they mix the appropriate breathing gas before delivering the mixture to the breathing-gas cylinders, using the continuous-flow or partial-pressure mixing techniques specified in the 2001 NOAA Diving Manual, or using a filter-membrane system.

(b) Before the start of each day’s diving operations, the employer must determine the O₂ fraction of the breathing-gas mixture using an O₂ analyzer. In doing so, the employer must:
(i) Ensure that the O₂ analyzer is accurate to within 1% of the O₂ fraction by volume;
(ii) Maintain this accuracy as required by the manufacturer of the analyzer.

(c) When the breathing gas is a commercially supplied nitrox breathing-gas mixture, the employer must ensure that the O₂ meets the medical USP specifications (Type I, Quality Verification Level A) or aviator’s breathing-oxygen specifications (Type I, Quality Verification Level E) of CGA G-4.3-2000 (“Commodity Specification for Oxygen”). In addition, the commercial supplier must:
(i) Determine the O₂ fraction in the breathing-gas mixture using an analytic method that is accurate to within 1% of the O₂ fraction by volume;
(ii) Make this determination when the mixture is in the charged tank and after disconnecting the charged tank from the charging apparatus;
(iii) Include documentation of the O₂-analysis procedures and the O₂ fraction when delivering the charged tanks to the employer.

(d) Before producing nitrox-breathing-gas mixtures using a compressor in which the gas pressure in any system component exceeds 125 pounds per square inch (psi), the:
(i) Compressor manufacturer must provide the employer with documentation that the compressor is suitable for mixing the high-pressure air with the highest O₂ fraction used in the nitrox breathing-gas mixture when operated according to the manufacturer’s operating and maintenance specifications;
(ii) Compressor manufacturer must provide the employer with documentation that the compressor is suitable for mixing the high-pressure air with the highest O₂ fraction used in the nitrox breathing-gas mixture when operated according to the manufacturer’s operating and maintenance specifications;
(iii) Compressor manufacturer must provide the employer with documentation that the compressor is suitable for mixing the high-pressure air with the highest O₂ fraction used in the nitrox breathing-gas mixture when operated according to the manufacturer’s operating and maintenance specifications;
(iv) The filter-system manufacturer must provide the employer with documentation that the filter system used for this purpose is suitable for producing O₂-compatible air when operated according to the manufacturer’s operating and maintenance specifications; and
(v) Employer must continuously monitor the air downstream from the filter for hydrocarbon contamination.

(f) The employer must ensure that the O₂ fraction the breathing apparatus is suitable for producing O₂-compatible air;
(i) For open-circuit SCUBA, an emergency-egress system as specified in paragraph 7(a) of this appendix, the employer may use:
(ii) For semi-closed-circuit and closed-circuit rebreathers, a system configured so that the second stage of the regulator connects to a separate supply of emergency breathing gas, the emergency breathing gas consists of air or the same nitrox breathing-gas mixture used during the dive.
(b) As an alternative to the “bail-out” system specified in paragraph 7(a) of this appendix, the employer may use:
(i) For open-circuit SCUBA, an emergency-egress system as specified in §1910.424(c)(4); or
(ii) For a semi-closed-circuit and closed-circuit rebreather, a system configured so that the second stage of the regulator connects to a reserve supply of emergency breathing gas.

(c) The employer must obtain from the rebreather manufacturer sufficient information to ensure that the bail-out system performs reliably and has sufficient capacity to enable the diver to terminate the dive and return safely to the surface.

8. TREATING DIVING-RELATED MEDICAL EMERGENCIES

(a) Before each day’s diving operations, the employer must:
(i) Verify that a hospital, qualified healthcare professionals, and the nearest Coast Guard Coordination Center (or an equivalent rescue service operated by a state, county, or municipal agency) are available to treat diving-related medical emergencies;

(ii) Ensure that each dive site has a means to alert these treatment resources in a timely manner when a diving-related medical emergency occurs; and

(iii) Ensure that transportation to a suitable decompression chamber is readily available when no decompression chamber is at the dive site, and that this transportation can deliver the injured diver to the decompression chamber within four (4) hours travel time from the dive site.

(b) The employer must ensure that portable O₂ equipment is available at the dive site to treat injured divers. In doing so, the employer must ensure that:

(i) The equipment delivers medical-grade O₂ that meets the requirements for medical USP oxygen (Type I, Quality Verification Level A) of CGA G-4.3–2000 ("Commodity Specification for Oxygen");

(ii) The equipment delivers this O₂ to a transparent mask that covers the injured diver’s nose and mouth; and

(iii) Sufficient O₂ is available for administration to the injured diver from the time the employer recognizes the symptoms of a diving-related medical emergency until the injured diver reaches a decompression chamber for treatment.

(c) Before each day’s diving operations, the employer must:

(i) Ensure that at least two attendants, either employees or non-employees, qualified in first-aid and administering O₂ treatment, are available at the dive site to treat diving-related medical emergencies; and

(ii) Verify their qualifications for this task.

9. Diving Logs and No-Decompression Tables

(a) Before starting each day’s diving operations, the employer must:

(i) Designate an employee or a non-employee to make entries in a diving log; and

(ii) Verify that this designee understands the diving and medical terminology, and proper procedures, for making correct entries in the diving log.

(b) The employer must:

(i) Ensure that the diving log conforms to the requirements specified by paragraph (d) ("Record of dive") of §1910.423; and

(ii) Maintain a record of the dive according to §1910.440 ("Recordkeeping requirements").

(c) The employer must ensure that a hard-copy of the no-decompression tables used for the dives (as specified in paragraph 6(a) of this appendix) is readily available at the dive site, whether or not the divers use dive-decompression computers.

10. Diver Training

The employer must ensure that each diver receives training that enables the diver to perform work safely and effectively while using open-circuit SCUBAs or rebreathers supplied with nitrox breathing-gas mixtures. Accordingly, each diver must be able to demonstrate the ability to perform critical tasks safely and effectively, including, but not limited to: recognizing the effects of breathing excessive CO₂ and O₂; taking appropriate action after detecting excessive levels of CO₂ and O₂; and properly evaluating, operating, and maintaining their diving equipment under the diving conditions they encounter.

11. Testing Protocol for Determining the CO₂ Limits of Rebreather Canisters

(a) The employer must ensure that the rebreather manufacturer has used the following procedures for determining that the CO₂-sorbent material meets the specifications of the sorbent material’s manufacturer:

(i) The North Atlantic Treating Organization CO₂ absorbent-activity test;

(ii) The RoTap shaker and nested-sieves test;

(iii) The Navy Experimental Diving Unit ("NEDU")-derived Schlegel test; and

(iv) The NEDU Meshfit software.

(b) The employer must ensure that the rebreather manufacturer has applied the following canister-testing materials, methods, procedures, and statistical analyses:

(i) Use of a nitrox breathing-gas mixture that has an O₂ fraction maintained at 0.28 (equivalent to 1.4 ATA of O₂ at 130 fsw, the maximum O₂ concentration permitted at this depth);

(ii) While operating the rebreather at a maximum depth of 130 fsw, use of a breathing machine to continuously ventilate the rebreather with breathing gas that is at 100% humidity and warmed to a temperature of 98.6 degrees F (37 degrees C) in the heating-humidification chamber;

(iii) Measurement of the O₂ concentration of the inhalation breathing gas delivered to the mouthpiece;

(iv) Testing of the canisters using the three ventilation rates listed in Table I below (with the required breathing-machine tidal volumes and frequencies, and CO₂-injection rates, provided for each ventilation rate):
(v) When using a work rate (i.e., breathing-machine tidal volume and frequency) other than the work rates listed in the table above, addition of the appropriate combinations of ventilation rates and CO₂-injection rates;

(vi) Performance of the CO₂ injection at a constant (steady) and continuous rate during each testing trial;

(vii) Determination of canister duration using a minimum of four (4) water temperatures, including 40, 50, 70, and 90 degrees F (4.4, 10.0, 21.1, and 32.2 degrees C, respectively);

(viii) Monitoring of the breathing-gas temperature at the rebreather mouthpiece (at the ‘‘chrome T’’ connector), and ensuring that this temperature conforms to the temperature of a diver’s exhaled breath at the water temperature and ventilation rate used during the testing trial;¹

(ix) Implementation of at least eight (8) testing trials for each combination of temperature and ventilation-CO₂-injection rates (for example, eight testing trials at 40 degrees F using a ventilation rate of 22.5 Lpm at a CO₂-injection rate of 0.90 Lpm);

(x) Allowing the water temperature to vary no more than ±2.0 degrees F (±1.0 degree C) between each of the eight testing trials, and no more than ±1.0 degree F (±0.5 degree C) within each testing trial;

(xi) Use of the average temperature for each set of eight testing trials in the statistical analysis of the testing-trial results, with the testing-trial results being the time taken for the inhaled breathing gas to reach 0.005 ATA of CO₂ (i.e., the canister-duration results);

(xii) Use of the average temperature for each set of eight testing trials in the statistical analysis of the testing-trial results, with the testing-trial results being the time taken for the inhaled breathing gas to reach 0.005 ATA of CO₂ (i.e., the canister-duration results);

(xiii) Specification of the replacement schedule for the CO₂-sorbent materials in terms of the lower prediction line (or limit) of the 95% confidence interval; and

(xiv) Derivation of replacement schedules only by interpolating among, but not by extrapolating beyond, the depth, water temperatures, and exercise levels used during canister testing.

[69 FR 7363, Feb. 17, 2004]

Subparts U–Y [Reserved]

§§ 1910.901–1910.999 [Reserved]