

Correction of Publication

■ Accordingly, the publication of the temporary regulations (TD 9101), that were the subject of FR Doc. 03-31361, is corrected as follows:

- 1. On page 75119, column 3, in the heading, the language, is corrected to read “26 CFR Parts 1 and 602”.
- 2. On page 75122, column 1, in the preamble, the “List of Subjects” is corrected to read as follows:

List of Subjects

26 CFR Part 1

Income taxes, Reporting and recordkeeping requirements.

26 CFR Part 602

Reporting and recordkeeping requirements.

PART 1—[AMENDED]

- 3. On page 75122, column 2, in the words of issuance, the language, “Accordingly, 26 CFR part 1 is amended” is corrected to read “Accordingly, 26 CFR parts 1 and 602 are amended”.

§ 1.6045-3T [Corrected]

- 4. On page 75125, column 3, § 1.6045-3T(e), lines 1 and 2, the language, “(e) Furnishing of forms to actual owners. The Form 1099-B prepared for” is corrected to read “(e) Furnishing of forms to customers. The Form 1099-B prepared for”.
- 5. On page 75126, column 1, the heading for Part 602 and amendments 4. and 5. are added following § 1.6045-3T to read as follows:

PART 602—OMB CONTROL NUMBERS UNDER THE PAPERWORK REDUCTION ACT

■ **Par. 4.** The authority citation for part 602 continues to read in part as follows:

Authority: 26 U.S.C. 7805 * * *

■ **Par. 5.** In § 602.101, paragraph (b) is amended by removing the following entries in the table as follows:

§ 602.101 OMB Control numbers

* * * * *

(b) * * *

CFR part or section where identified and described	Current OMB control No.
1.6043-4T	1545-1812
1.6045-3T	1545-1812

CFR part or section where identified and described	Current OMB control No.
* * * * *	

Cynthia E. Grigsby,
Acting Chief, Publications and Regulations Branch, Legal Processing Division, Associate Chief Counsel (Procedure and Administration).
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DEPARTMENT OF LABOR

Occupational Safety and Health Administration

29 CFR Part 1910

[Docket No. S-550]
 RIN 1218-AB97

Commercial Diving Operations

AGENCY: Occupational Safety and Health Administration (OSHA), Department of Labor.

ACTION: Final rule.

SUMMARY: OSHA is issuing this final rule to amend its Commercial Diving Operations (CDO) standards. This final rule allows employers of recreational diving instructors and diving guides to comply with an alternative set of requirements instead of the decompression-chamber requirements in the current CDO standards. The final rule applies only when these employees engage in recreational diving instruction and diving-guide duties; use an open-circuit, a semi-closed-circuit, or a closed-circuit self-contained underwater-breathing apparatus supplied with a breathing gas that has a high percentage of oxygen mixed with nitrogen; dive to a maximum depth of 130 feet of sea water; and remain within the no-decompression limits specified for the partial pressure of nitrogen in the breathing-gas mixture. These alternate requirements essentially are the same as the terms of a variance granted by OSHA to Dixie Divers, Inc. in 1999.

DATES: This final rule becomes effective on March 18, 2004.

ADDRESSES: In compliance with 28 U.S.C. 2112(a), OSHA designates the Associate Solicitor of Labor for Occupational Safety and Health as the recipient of petitions for review of this final rule. Submit petitions of review to the Associate Solicitor at: Office of the Solicitor of Labor, Room S-4004, U.S. Department of Labor, 200 Constitution Avenue, NW., Washington, DC 20210.

FOR FURTHER INFORMATION CONTACT: For general information and press inquiries, contact Mr. George Shaw, Office of Communications, Room N-3647, OSHA, U.S. Department of Labor, 200 Constitution Avenue, NW., Washington, DC 20210; telephone (202) 693-1999. For technical inquiries, contact Mr. Robert Bell, Directorate of Standards and Guidance, Room N-3609, OSHA, U.S. Department of Labor, 200 Constitution Avenue, NW., Washington, DC 20210; telephone (202) 693-2053 or fax (202) 693-1663.

Copies of this **Federal Register** notice are available from the OSHA Office of Publications, Room N-3101, U.S. Department of Labor, 200 Constitution Avenue, NW., Washington DC 20210; telephone (202) 693-1888. For an electronic copy of this notice, go to OSHA's Web site (<http://www.osha.gov>), and select “**Federal Register**,” “Date of Publication,” and then “2003.”

SUPPLEMENTARY INFORMATION:

Table of Contents

The following Table of Contents identifies the major sections under **SUPPLEMENTARY INFORMATION**, including a detailed summary and explanation of the final rule.

- I. Background
- II. Summary and Explanation of the Rule
 - A. Final §§ 1910.401(a)(3) and 1910.402 (“Definitions”)
 - B. Conditions Specified in Final Appendix C
- III. Legal Considerations
- IV. Final Economic Analysis and Regulatory Flexibility Certification
- V. Paperwork Reduction Act
- VI. Federalism
- VII. State Plans
- VIII. Unfunded Mandates
- IX. Applicability of Existing Consensus Standards
 - List of Subjects in 29 CFR Part 1910
- X. Authority and Signature

I. Background

In 1999, acting under section 6(d) of the Occupational Safety and Health Act of 1970 (“OSH Act” 29 U.S.C. 655), the Occupational Safety and Health Administration (“OSHA” or “the Agency”) published an order granting a permanent variance to Dixie Divers, Inc. (“Dixie Divers”) (Ex. 2-11). The permanent variance exempted Dixie Divers from OSHA's decompression-chamber requirements specified at § 1910.423(b)(2) and (c)(3)(iii), and § 1910.426(b)(1), when its recreational diving instructors and diving guides (hereafter, “divers”) engage in underwater instructional and guiding operations.

The purpose of having a decompression chamber available and

ready for use at a dive site is to treat decompression sickness (DCS) and arterial gas embolism (AGE). DCS may occur from breathing air or mixed gases at diving depths and durations that require decompression, while AGE may result from over-pressurizing the lungs, usually following a rapid ascent to the surface during a dive without proper exhalation.

The Dixie Diver variance from the decompression-chamber requirements applied only to mixed-gas diving operations at a maximum depth of 130 feet of sea water ("fsw") performed within no-decompression limits. During these diving operations, divers use a breathing-gas mixture consisting of a high percentage of O₂ mixed with nitrogen (*i.e.*, a nitrox breathing-gas mixture) supplied by an open-circuit, semi-closed-circuit or closed-circuit self-contained underwater breathing apparatus (SCUBA). In issuing the permanent variance, the Agency noted that compliance would provide divers with a level of protection that met or exceeded the level of protection they would receive if they had access to a decompression chamber at the dive site as required by §§ 1910.423(b)(2) and (c)(3)(iii), and 1910.426(b)(1).

On January 10, 2003, OSHA proposed to amend its Commercial Diving Operations ("CDO") standards to incorporate the terms and conditions of the Dixie Divers variance as an appendix to the CDO standards (68 FR 1399). The Agency now is issuing the final rule to amend the CDO standards based on this proposal. OSHA believes that this amendment enables recreational diving instructors and diving guides to extend their diving operations while minimizing their risk of DCS and AGE. The Agency concludes that the recreational diving instructors and diving guides covered by this amendment will receive a level of safety and health protection that is equivalent to recreational diving instructors and diving guides who have a decompression chamber located at the dive site during mixed-gas diving operations regulated under the CDO standards. Therefore, a decompression chamber near the dive site is unnecessary for the divers covered by this final rule.

II. Summary and Explanation of the Final Rule

OSHA received no requests for a hearing on the proposed amendment, thereby enabling it to proceed directly to this final rule after considering the comments submitted by the public in response to the proposal. In this regard, the Agency received 13 public

comments on the proposal. However, two commenters each submitted a duplicate set of responses (Exs. 6–6 and 6–7, and 6–8 and 6–9); one set of duplicate responses (Exs. 6–6 and 6–7) was received from a commercial diver that involved an issue unrelated to this rulemaking. We address the remaining comments in sections A and B below, which discuss the conditions adopted in the final rule.

When the discussion regarding a condition does not cite a comment, then the public did not comment on that condition. In such cases, we have assumed that the regulated community found the proposed condition to be appropriate and necessary for diver safety based on OSHA's stated rationale in the proposed rule, and we have retained it in the final rule without further explanation (see 68 FR 1399, pages 1400–1409).

A. Final §§ 1910.401(a)(3) and 1910.402 ("Definitions")

Proposed § 1910.401(a)(3) specified that this amendment would apply only to recreational diving instructors and diving guides who are engaged solely in recreational diving instruction and dive-guiding operations. Accordingly, OSHA also proposed to add the following definitions for "recreational diving instruction" and "dive-guiding operations" to § 1910.402 of the CDO standards:

"Recreational diving instruction" means the training of diving students in the use of recreational diving procedures and the safe operation of diving equipment, including open-circuit, semi-closed-circuit, or closed-circuit SCUBA during dives.

"Dive-guiding operations" means the leading of groups of trained sports divers, who use open-circuit, semi-closed-circuit, or closed-circuit SCUBA, to local undersea diving locations for recreational purposes.

To further limit application of the amendment, proposed § 1910.401(a)(3) required employers to ensure that the instructors and guides conduct these dives within the no-decompression limits, and that they use a nitrox breathing-gas mixture consisting of a high percentage of O₂ (more than 22% by volume) mixed with nitrogen and supplied by an open-circuit, semi-closed-circuit, or closed-circuit SCUBA. Under this proposed requirement, employers also would have to comply with the requirements specified in new Appendix C of subpart T.

Based on its analysis of the record, OSHA is adopting proposed §§ 1910.401(a)(3) and 1910.402 in the final rule. Recreational diving instructors and diving guides who use a nitrox breathing-gas mixture supplied

by an open-circuit, semi-closed-circuit, or closed-circuit SCUBA under no-decompression diving limits will receive a level of safety and health protection equivalent to the recreational diving instructors and diving guides who have a decompression chamber located at the dive site during mixed-gas diving operations regulated under the CDO standards.

B. Conditions Specified in Final Appendix C

OSHA proposed to add a new appendix to the CDO standards to specify the conditions under which employers may use this alternative to decompression chambers. Accordingly, the Agency is adopting new Appendix C in the final rule after revising the proposal based on comments submitted to the record. The following discussion addresses the comments received on the proposed conditions, and what OSHA is including in the final rule.

1. Equipment Requirements for Rebreathers

(a) *Manufacturer's instructions.* As proposed, this condition required employers to ensure that their recreational diving instructors and diving guides use rebreathers (*i.e.*, semi-closed circuit and closed-circuit SCUBA) according to the rebreather manufacturer's instructions. OSHA is retaining this condition in the final rule. As noted in the proposal, the Agency believes that SCUBA manufacturers are best qualified to identify and specify the components, configuration, and operation of their products.

(b) *Counterlungs.* This proposed condition required employers to ensure that each rebreather has a counterlung (also referred to as an "inhalation bag" or "breathing bag") that both contains a baffle system that prevents moisture from entering the scrubber or breathing hoses and supplies a sufficient volume of breathing gas to the divers to sustain their respiration rate during diving operations. The National Oceanic and Atmospheric Administration (NOAA) considers counterlungs a necessity for rebreather diving (see Ex. 3–12, p. 14–3). OSHA expects rebreather manufacturers to provide the purchaser or user with information regarding this displacement as part of their usual and customary practice. In addition, by keeping moisture from entering the scrubber, baffle systems prevent rapid deterioration of the CO₂-sorbent material housed in the scrubber and decrease the risk of CO₂ toxicity (see Ex. 3–12, p. 14–8).

The Agency received one comment (Ex. 5–2–1) regarding the proposed

baffle-system requirement. This commenter recommended revising the condition to read that the counterlung must contain "a baffle system and/or other moisture separating system that keeps moisture from entering the scrubber." In justifying this revision, the commenter stated: "While all manufactured units have some sort of system to accomplish this function, all do not call it a 'baffle' system. Additionally, use of the specific term may * * * create problems for future technological developments, which may address the problem in different ways." OSHA agrees with this commenter that the proposed wording was too specific, and might hinder future efforts to develop new technologies to prevent moisture from entering the scrubber. Therefore, the final rule adopts the language of the proposed condition except for the part addressing baffle systems; for this part, the Agency is adopting the language recommended by this commenter.

(c) *Moisture traps.* Under this proposed condition, employers need to place a moisture trap in the breathing loop of each rebreather. The employer also must ensure that the rebreather manufacturer approves both the moisture trap and its location in the breathing loop, and that their divers use the moisture trap according to the rebreather manufacturer's instructions. The Agency is retaining this condition in the final rule as proposed because it believes that moisture traps, when approved by the rebreather manufacturer and located and used according to the manufacturer's instructions, prevent water from entering the CO₂-absorbing canisters. By preventing such water leakage, moisture traps preserve the CO₂-absorbing properties of the sorbent material inside the canister.

(d) *Moisture sensors.* Under this proposed condition, employers must ensure that each rebreather has a continuously functioning moisture sensor that connects to a visual (*e.g.*, digital, graphic, or analog) or auditory (*e.g.*, voice, pure tone) alarm. This alarm must be readily detectable by divers under the diving conditions in which they operate and warn them of moisture in the breathing loop in sufficient time for them to terminate the dive and return safely to the surface. Additionally, the proposed condition required employers to ensure that their divers use the moisture sensors according to the rebreather manufacturer's instructions. By warning divers of hazardous water leakage into the canister, moisture sensors allow divers to return to the surface before

CO₂ in the recycled breathing gas reaches dangerous levels. Therefore, the final rule includes these requirements as proposed.

(e) *CO₂ sensors.* An important component in controlling excessive CO₂ is the CO₂ sensor. In the proposal, this condition required employers to ensure that each rebreather contains a continuously functioning CO₂ sensor in the breathing loop. It also specified that the rebreather manufacturer must approve the CO₂ sensor and its location in the breathing loop. In addition, employers must ensure that the CO₂ sensor is integrated with an alarm that operates in a visual (*e.g.*, digital, graphic, or analog) or auditory (*e.g.*, voice, pure tone) mode readily detectable by divers under the diving conditions in which they operate. This alarm would remain continuously activated when the inhaled CO₂ level reaches and exceeds 0.005 atmospheres absolute ("ATA").¹ In the final rule, OSHA is retaining the condition as proposed.

(f) *Calibrating CO₂ sensors.* This proposed condition stated that employers must, before each day's diving operations (and more often when necessary), calibrate each CO₂ sensor according to the sensor manufacturer's instructions. Additionally, employers must maintain the accuracy of the equipment and procedures used to perform the calibration to within 10% of a CO₂ concentration of 0.005 ATA or less according to the sensor manufacturer's instructions. Using this equipment, they would calibrate the CO₂ sensor to within 10% of a CO₂ concentration of 0.005 ATA or less. The Agency is including this condition in the final rule because it concludes that this calibration requirement is necessary to identify improperly functioning CO₂ sensors.

(g) *Faulty CO₂ sensors.* In the proposal, this condition specified that employers must replace CO₂ sensors that fail the accuracy requirements delineated above in Condition 1(f)(iii) with a sensor that meets these requirements. Eliminating sensors that are unreliable or that cannot function under rugged diving conditions is necessary to provide divers with safe breathing gas. OSHA is retaining this requirement in the final rule.

(h) *CO₂-sorbent materials.* As an alternative to using continuously functioning CO₂ sensors, the proposed

condition allowed an employer to implement a rebreather manufacturer's schedule for replacing the CO₂-sorbent material in the canister of a rebreather. However, the manufacturer would have to develop the schedule according to the canister-testing protocol specified in Condition 11 of Appendix C ("Testing Protocol for Determining the CO₂ Limits of Rebreather Canisters"). Additionally, the employer may use the rebreather at a water temperature that is lower than the minimum, or higher than the maximum, water temperature used in the testing protocol specified in Condition 11, but only when the rebreather manufacturer adds that lower or higher temperature to the testing protocol.

A commenter (Ex. 5-2-1) stated that the proposed language regarding the minimum and maximum water-temperature requirement was confusing, and recommended that the requirement read as follows: "A rebreather within the temperature range for which the manufacturer conducted its scrubber canister tests following the protocol specified in Condition 11. Variations above or below the range are acceptable only after the manufacturer adds that lower or higher temperature to the protocol." OSHA agrees that the commenter's revision expresses more clearly than the proposal the meaning of this provision, and has revised this language in the final rule accordingly. The Agency believes that the canister-replacement schedule provides a reliable estimate of canister duration that incorporates an assessment of the physical properties of the CO₂-sorbent material and an evaluation of the canister's effectiveness.

(i) *Commercially pre-packed cartridges.* This proposed condition required employers who use a CO₂-sorbent replacement schedule specified in Condition 1(h) to ensure that each rebreather uses a manufactured (*i.e.*, commercially pre-packed), disposable scrubber cartridge. This cartridge would have to contain a CO₂-sorbent material that is approved by the rebreather manufacturer and is capable of removing CO₂ from the divers' exhaled gas. In this regard, the canister would maintain the CO₂ level in the breathable gas (*i.e.*, the gas a diver is inhaling directly from the regulator) below a partial pressure of 0.01 ATA.

OSHA is including this condition in the final rule as proposed. These requirements ensure proper compression and uniform distribution of the sorbent material in the cartridge, thereby minimizing "channeling" in the

¹ ATA is the partial pressure of a constituent gas in the total pressure of a breathing gas. When the percentage of the constituent gas in the breathing gas remains constant throughout a dive, its partial pressure, or ATA, increases in direct proportion to increases in diving depth.

material² and lowering the diver's risk of rebreathing exhaled breathing gas that is high in CO₂.

(j) *Alternative to commercially pre-packed cartridges.* This proposed condition permitted employers to fill CO₂ scrubber cartridges manually instead of using commercially pre-packed cartridges. This practice is acceptable when the rebreather manufacturer designs the scrubber cartridge to be filled manually, the employer implements the alternative method according to the rebreather manufacturer's instructions, and the employer can demonstrate that the alternative method meets the performance requirements for commercially pre-packed cartridges specified by Conditions 1(h) and 1(i). OSHA is adopting this condition in the final rule as proposed because manually filled cartridges that meet the performance requirements for commercially pre-packed cartridges will remove CO₂ effectively from the breathing loop.

(k) *Information module.* In the proposal, this condition required employers to ensure that their divers use an information module that provides them with critical information regarding rebreather operation. For all rebreathers, the module needed to contain visual or auditory warning devices that would alert the diver to electrical weaknesses or failures (e.g., solenoid failure, low battery levels). In addition, modules used in semi-closed circuit rebreathers needed to contain visual displays for the partial pressure of CO₂, or deviations above and below a preset CO₂ partial pressure of 0.005 ATA. For closed-circuit rebreathers, the module also would have visual displays for the partial pressures of O₂ and CO₂, or deviations above and below a preset CO₂ partial pressure of 0.005 ATA and a preset O₂ partial pressure of 1.40 ATA. The module also needed to have a visual display for both gas temperature in the breathing loop and water temperature.

OSHA is including these requirements in the final rule as proposed because warning divers of electrical weaknesses and failures informs them not to rely on their electrically operated equipment and to take protective actions. Providing

information about O₂ and CO₂ partial pressures alerts divers to rising and potentially toxic levels of these gases in time for them to prevent extended exposure. Additionally, information regarding water temperature warns divers of the risk of hypothermia, while gas-temperature information allows divers to estimate the duration of their CO₂-sorber material.

(l) *Checking electrical power and circuits.* Under this proposed condition, employers would ensure that the electrical power supplies and electrical and electronic circuits in each rebreather are operating according to the rebreather manufacturer's instructions. Employers must check for proper operation prior to beginning diving operations each day, and more often when necessary. The Agency is adopting this condition as proposed because partial or total electronic failures could interfere with rebreather sensor and control systems.

2. Special Requirements for Closed-Circuit Rebreathers

(a) *Supply-pressure and temperature sensors.* This proposed condition stated that employers are responsible for ensuring that closed-circuit rebreathers use supply-pressure sensors for the O₂ and diluent gases (i.e., air or nitrogen), as well as continuously functioning sensors for detecting temperature in the inhalation side of the breathing loop and in the ambient water. OSHA is including it in the final rule as proposed. In this regard, supply-pressure sensors inform divers of the remaining supply of breathing-gas ingredients (i.e., O₂ and air or nitrogen), thereby enabling them to monitor their breathing-gas consumption during a dive. Low gas supplies alert divers to an unusually high consumption of breathing gas, indicating a possible problem with the rebreather. An unexpected gas loss also may increase the need for a diver to make a rapid (i.e., emergency) ascent to the surface during a dive, which could result in over-pressurization of the lungs associated with AGE. In addition, OSHA believes that temperature sensors increase diver safety because the sensors alert divers to the possibility of hypothermia. Temperature reductions in breathing gas also inform divers that the efficiency of the CO₂-sorber material is likely to deteriorate (Ex. 3-11).

(b) *O₂ sensors.* As proposed, this condition required employers to ensure that at least two O₂ sensors are located in the inhalation side of the breathing loop. These O₂ sensors must function continuously, compensate for variations in temperature, and be approved by the

rebreather manufacturer. The Agency is including the condition in the final rule as proposed because the sensors provide divers with critical information regarding O₂ levels in the breathing gas. Accurate information about O₂ levels enables divers to maintain appropriate amounts of O₂ in the breathing gas, thereby minimizing the need for emergency escape.

(c) *Calibrating O₂ sensors.* This proposed condition specified that employers must calibrate O₂ sensors as required by the sensor manufacturer's instructions before the start of each day's diving operations and more often when necessary. In performing this requirement, employers would: (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 the accuracy of the calibration equipment as required by the manufacturer of the 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 specified accuracy requirements; and (v) ensure that the replacement O₂ sensors meet these accuracy requirements.

OSHA believes that the levels of accuracy specified under this condition provide an adequate safety margin for the divers to detect anomalous O₂ concentrations, to identify the cause of the anomaly and adjust breathing-system controls accordingly, and to ascend to the surface when necessary. Additionally, proper and timely calibration of O₂ sensors, as well as accurate information regarding the level of O₂ in the breathing loop, provides divers with an opportunity to take corrective action should the O₂ level exceed the specified parameters. Maintaining proper O₂ levels will prevent the central nervous system and pulmonary effects of O₂ toxicity, and will protect divers from death and injury. Accordingly, the Agency is including these O₂-sensor requirements in the final rule as proposed.

(d) *Controlling O₂ delivery.* This proposed condition stated that employers are to ensure that closed-circuit rebreathers have: (i) A gas-controller package with solenoid O₂-supply valves that are operated electronically; (ii) a pressure-activated regulator with a second-stage diluent-gas addition valve; (iii) a manually-operated gas-supply bypass valve to add O₂ and diluent gas to the breathing loop; and (iv) separate O₂ and diluent-gas cylinders to supply the breathing-gas mixture. Accordingly, closed-circuit rebreathers would automatically inject

² "Channeling" describes open spaces (or channels) that form in the sorber material, and that permit exhaled breathing gas to pass through that part of the material to the inhalation side of the breathing apparatus with little or no absorption of the CO₂ contained in the exhaled breathing gas. Channeling can be prevented by compressing the sorber material uniformly in the canister (e.g., by shaking the canister vigorously).

O₂ into the breathing loop to maintain the pre-established O₂ partial pressure in the breathable gas, and automatically add diluent gas (*i.e.*, nitrogen or air) through the regulator to compensate for decreases in gas volume during descent. The diver also must be able to control these functions manually using gas-supply bypass valves provided on the equipment. Separate cylinders would provide the O₂ and diluent gas used in the breathing-gas mixture.

OSHA is adopting the condition as proposed because these equipment requirements maintain O₂ levels in the breathing gas within a specified range of partial pressures. This condition provides assurance that a sufficient and reliable breathing-gas pressure is available to deliver breathable gas to the diver without adversely affecting breathing effort. Maintaining a comfortable breathing effort reduces CO₂ accumulation caused by an increased rate of breathing and, in turn, lowers the risk of CO₂ toxicity. Additionally, by maintaining O₂ in the breathing loop at specified levels, the condition ensures that divers remain within pre-established O₂ exposure limits. Finally, the condition allows divers to manually add O₂ or diluent gas from separate cylinders, enabling them to adjust the components of the breathing-gas mixture should the gas-controller package and pressure-activated regulator fail.

3. O₂ Concentration in the Breathing Gas

Under this proposed condition, employers would be responsible for ensuring that the fraction of O₂ in the nitrox breathing-gas mixture exceeds 22% by volume.³ For rebreathers, the fraction of O₂ would never exceed an O₂ partial pressure of 1.40 ATA, while for open-circuit SCUBA, the O₂ fraction would never exceed 40% by volume or an O₂ partial pressure of 1.40 ATA, whichever exposed divers to less O₂.

One commenter (Ex. 6-2) responded to this proposed condition by stating, "The concept that diving with a higher concentration of [O₂] than compressed air removes the risk of DCS is ludicrous. Any level of nitrogen predisposes individuals to the likelihood of DCS. * * *" The following comment submitted by Dr. Larry Raymond (Ex. 5-1), an occupational-health physician with experience in treating diving-related injuries, addressed this issue:

Oxygen-rich mixtures of nitrogen and oxygen ("Nitrox") have indeed been shown

to be advantageous[] with regard to decompression sickness (DCS). Nitrox allows longer dives at a given depth (vs. air dives). Nitrox is [] safe, as long as meticulous care is given to gas mixing, lubrication of oxygen-exposed surfaces (avoid fire), and compliance with depth limits and decompression schedules.

Although the Agency believes that increased O₂ levels can reduce the risk of DCS by displacing nitrogen in the nitrox breathing-gas mixture, it notes that the major purpose of this condition is to prevent O₂ toxicity or hypoxia, not to remove the risk of DCS. Another commenter (Ex. 6-1), who had three years of experience with nitrox breathing-gas mixtures as a recovery diver and diving instructor, recommended that "any diver who is engaged in recreational diving with open-circuit [SCUBA], be supplied with a breathing gas consisting of a high percentage of oxygen mixed with nitrogen." This recommendation attests to the health and safety benefits of nitrox breathing-gas mixtures, as incorporated in the final rule.

OSHA is including this condition in the final rule as proposed because it finds that the minimal level of 22% is consistent with the minimal level required for nitrox breathing-gas mixtures.⁴ Additionally, the Agency is including in the final rule the upper limits designated for the O₂ component in the nitrox breathing-gas mixture as proposed (*i.e.*, 40% by volume and 1.40 ATA). The 40% limit specifies the level above which equipment exposed to O₂ (*e.g.*, SCUBA cylinders, valves, first-stage regulators, high-pressure hoses) must be rated for O₂ service because of the increased risk of an O₂-accelerated explosion (Ex. 3-12, p. 15-18), while the 1.40-ATA limit represents the maximum level of O₂ exposure that effectively will prevent O₂ toxicity among divers (see Ex. 3-4, pp. 3-5 through 3-15 and P-37 through P-45, and Ex. 3-10).

4. Regulating O₂ Exposures and Diving Depth

(a) *Limiting O₂ partial pressure.* This proposed condition identified procedures for preventing O₂ toxicity. Employers would have to: (i) Determine a diver's O₂ exposure duration using the maximum partial-pressure O₂ exposure 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); and (ii) using the diver's exposure duration, ensure that a diver

exposed to partial pressures of O₂ between 0.60 and 1.40 ATA does not exceed the 24-hour single-exposure O₂ limits specified by the 2001 NOAA Diving Manual (Ex. 3-12, p. 3-23) or by the 1995 Diving Science and Technology Corporation (DSAT) report contained in the publication entitled "Enriched Air Operations and Resource Guide" (Ex. 3-13, p. 34).

Under this condition, paragraph (i) reduces the risk of developing O₂ toxicity by regulating O₂ exposures according to increases in O₂ partial pressure (*i.e.*, dive depth) and dive duration. Paragraph (ii) controls O₂ exposures by requiring that diving operations conform to the 24-hour single-exposure O₂ limits specified in the 2001 NOAA Diving Manual and the 1995 DSAT report contained in the publication entitled "Enriched Air Operations and Resource Guide." In the single comment received on this proposed condition (Ex. 5-1), Dr. Raymond expressed concern about the deleterious effects of breathing O₂ at 1.40 ATA, stating, "The risk of oxygen toxicity from Nitrox diving is a * * * very real concern. Oxygen-induced seizures usually abate when the high-oxygen gas * * * is replaced by air, but any seizure which occurs in the water is a potential disaster, placing the diver at risk for AGE, drowning and death." (Emphasis in original.)

As noted in the proposal, OSHA agrees that O₂ toxicity is a substantial hazard to divers breathing nitrox breathing-gas mixtures. The Agency is retaining this condition in the final rule as proposed because the NOAA and DSAT procedures are designed to protect divers by effectively regulating their exposure to O₂. Both NOAA and DSAT developed their O₂-exposure limits using models and theories extensively tested in the field for safety and efficacy. The recreational diving industry recognizes and uses both of these procedures and, as OSHA concluded in granting the Dixie Diver variance, both of these procedures afford divers adequate protection against O₂ toxicity. Moreover, restricting diving operations to 130 fsw (see Condition 4(b) below) will provide divers with added protection from O₂ toxicity.

(b) *Limiting diving depth.* Under this proposed condition, employers would have to limit divers covered by the amendment to a maximum depth of 130 fsw or to a maximum O₂ partial pressure of 1.40 ATA, whichever exposes them to less O₂. OSHA is adopting the requirements specified by this proposed condition in the final rule because it finds that the condition limits divers'

³ Although low O₂ levels are rare under nitrox breathing conditions, the sensors also would detect levels of O₂ less than 22% by volume (see Condition 3 of Appendix C below).

⁴ By definition, a nitrox breathing-gas mixture must contain a higher percentage of oxygen than is found in normal air (*i.e.*, 21%), usually 32% and 36% oxygen (Ex. 3-12).

overall exposure to O₂. In addition, as noted in the discussion of Condition 3 above, limiting the depth of diving operations also will restrict the partial pressure of oxygen in the nitrox breathing-gas mixture, thereby lowering the incidence of O₂ toxicity.

5. Use of No-Decompression Limits

(a) *No-decompression procedures.* In the proposal, this condition specified that employers must ensure that divers using nitrox breathing-gas mixtures remain within the no-decompression limits specified for single and repetitive air diving. These limits are available in the 2001 NOAA Diving Manual (Ex. 3–12) or the 1994 DSAT report entitled “Development and Validation of No-Stop Decompression Procedures for Recreational Diving: The DSAT Recreational Dive Planner” (Ex. 3–14). In determining the no-decompression limits for nitrox breathing-gas mixtures in its 2001 Diving Manual, NOAA applies the equivalent-air-depth (“EAD”) formula.

Divers using nitrox breathing-gas mixtures can use the EAD formula to determine accurately the no-decompression limits for different nitrogen partial pressures. According to NOAA, EAD “is the depth based on the partial pressure of nitrogen in the gas mixture to be breathed, rather than the actual depth of the dive” (Ex. 3–12, p. 15–7).

NOAA applies its EAD formula in determining what equivalent air-decompression limits to use with nitrox breathing-gas mixtures. The formula assumes that equivalent nitrogen partial pressures and dive durations will result in similar DCS risk to dives performed with air. OSHA believes that the NOAA EAD formula can accurately estimate the DCS risk associated with nitrox breathing-gas mixtures based on equivalent nitrogen partial pressures and dive durations used in air diving. In the proposal, OSHA cited comments regarding the efficacy of the EAD formula submitted to the record by Dr. Edward D. Thalmann (Ex. 2–7), a world-renowned expert in treating diving-related medical emergencies among recreational divers. In these comments, Dr. Thalmann asserts that research data show that the EAD approach is valid for computing no-decompression limits for O₂ partial pressures as high as 1.5 ATA. He also stated that DCS associated with breathing a nitrox gas mixture “should not be substantially different in incidence and severity compared to diving on air[,] provided the Nitrox no-decompression times are computed from accepted air no-decompression limits using the [NOAA] EAD

[formula].” Dr. Thalmann concluded that, within these constraints, “there is no rationale for having different requirements for * * * air and Nitrox no-decompression diving.”

OSHA received two comments on the proposed condition. The first commenter (Ex. 6–4) stated:

Nitrox may reduce [DCS] only if you do not allow for more uptake[;] by staying longer you have just negated this aspect. [DCS] is not merely a subject of “coming up too fast,[]” but rather [is caused by] “inadequate decompression.” There is no miracle table/schedule and [DCS] can and will manifest regardless of the table, mix or schedule utilized[.]. Current proven tables/schedules have risk, but are by no means 100%[.]

Similarly, the second commenter (Ex. 6–8) claimed that “the risk of [DCS] can be lessened, but only if you use air diving decompression procedures while diving on nitrox,” and “the use of nitrox or any other mixed gas will not reduce the need for recompression chambers if the divers do not utilize air diving procedures while diving on oxygen enriched gas.”

The Agency agrees with the first commenter that nitrox may reduce DCS. This reduction occurs in part because O₂ displaces nitrogen in the volume of breathing gas available for use. Additionally, Condition 5(a) imposes no-decompression limits on diving operations, thereby further reducing the uptake of nitrogen and the risk of DCS.

OSHA concurs with both commenters that no diving table or schedule, or breathing high levels O₂ instead of compressed air, will prevent DCS completely. Accordingly, the purpose of this provision is to reduce DCS as a significant risk for the divers covered by this final rule.

The statements made by the second commenter imply that only air-diving procedures will result in a low level of DCS risk. However, DSAT’s published research reports (see the proposed rule at 68 FR 1406) clearly demonstrate that DSAT adopted its tables of no-decompression limits only after extensive laboratory and field testing showed that these tables are safe and reliable. Additionally, for its part, NOAA did base its no-decompression tables on equivalent air-decompression limits, consistent with the recommendations of this commenter. Therefore, based on this evidence, the Agency is retaining this condition in the final rule as proposed.⁵

⁵ Note that the final rule reverses the designations of proposed Conditions 5 and 6 to Conditions 6 and 5, respectively. Redesignating proposed Condition 6 as Condition 5 groups it with the other conditions (i.e., 3 and 4) that address procedures for protecting divers from O₂ toxicity and DCS.

(b) *Dive-decompression computers.* Under this proposed condition, employers could use dive-decompression computers designed to regulate decompression when the computers use the NOAA or DSAT no-decompression limits specified above in Condition 5(a) and provide output that reliably represents these limits. OSHA is including the condition in the final rule as proposed because the condition provides employers with the flexibility to use either manual calculations or dive-decompression computers to determine no-decompression limits. The Agency also finds that restricting the no-decompression limits programmed into the computers to those limits published by the 2001 NOAA Diving Manual and the 1994 DSAT report will ensure that divers use only those no-decompression limits approved under this rulemaking.

6. Mixing and Analyzing the Breathing Gas

(a) *Mixing of breathing gas by the employer.* When employers prepare the breathing-gas mixture, this proposed condition stated that they must: (i) Ensure that properly trained personnel mix nitrox breathing gases, and that nitrogen is the only inert gas used in the breathing-gas mixture; and (ii) mix the appropriate breathing-gas mixture before delivering it to the breathing-gas cylinders, using the continuous-flow or partial-pressure mixing techniques specified in the 2001 NOAA Diving Manual (Ex. 3–12), or using a filter-membrane system. The Agency is adopting this condition as proposed because these requirements provide quality control over the processes and techniques commonly used and accepted by the diving industry to mix nitrox breathing-gas mixtures.

(b) *Analyzing O₂.* This proposed condition would require employers, before the start of each day’s diving operations, to determine the O₂ fraction of the breathing-gas mixture using an O₂ analyzer. In doing so, they must: (i) Ensure that the O₂ analyzer is accurate to within 1% of the O₂ fraction by volume; and (ii) maintain this accuracy as required by the manufacturer of the analyzer. OSHA is including this condition in the final rule as proposed. This condition will enable employers to accurately assess the proportions of O₂ and diluent gas in nitrox breathing-gas mixtures, thereby ensuring that divers maintain the O₂ levels necessary to comply with the 24-hour single-exposure O₂ limits described under Condition 4 above. The accuracy requirements specified by these provisions are consistent with the accuracy requirements for O₂ found in

other provisions of the final rule, and serve the same purpose described for these requirements (see the discussion for proposed Condition 2(c) above).

(c) *Commercially supplied breathing gas.* This proposed condition stated that when the breathing gas is a commercially supplied nitrox breathing-gas mixture, employers must ensure that the O₂ is Grade A (also known as “aviator’s oxygen”) or Grade B (referred to as “medical-industrial oxygen”). Also, the O₂ would have to meet the specifications, including the purity requirements, found in the ANSI-Compressed Gas Association Commodity Specification for Air, G-7.1-1997 (ANSI-CGA G7.1-1997). In addition, the employer must ensure that the commercial supplier: (i) Determines 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) makes this determination when the mixture is in the charged tank and after disconnecting the charged tank from the charging apparatus; (iii) documents the O₂ fraction in the mixture; and (iv) provides the employer with a written certification of the O₂ analysis.

OSHA determined after publication of the proposed rule in the **Federal Register** that it inadvertently misidentified the standard for aviator’s oxygen and medical-industrial oxygen. In this regard, the ANSI-CGA G7.1-1997 does not provide specifications for aviator’s oxygen, and it lists requirements for medical-grade air, but not for medical-grade oxygen. The correct standard for aviator’s oxygen and medical-grade oxygen is CGA G-4.3-2000 (“Commodity Specification for Oxygen”).⁶ The Agency considers this misidentification a technical error and is correcting the reference to CGA G-4.3-2000 in the final rule. Selecting O₂ that meets these specifications ensures that divers use the highest quality O₂ in their nitrox breathing-gas mixtures, thereby preventing them from inhaling contaminants. In addition, they require the O₂ to have a moisture content that helps to maintain normal pulmonary function.

The Agency revised the proposed condition to indicate that the requirements specified in paragraphs (i) through (iv) are the responsibility of the supplier, not the employer. The Agency also combined proposed paragraphs (iii) and (iv) in the final rule to simplify the requirements. These paragraphs still

specify that the accuracy of the method used to analyze O₂ must conform to the tolerance limits specified under condition (b) above. Additionally, employers must ensure that commercial suppliers analyze the breathing-gas mixture actually contained in the SCUBA cylinders to determine the fraction of that the divers will breathe, unaffected by O₂ in the storage banks used to fill the SCUBA cylinders. Also, the supplier must provide documentation to the employer specifying the analytic procedures used in making the O₂ determination and the O₂ fraction in the charged tanks delivered to the employer. OSHA is including these requirements in the final standard to provide assurance that the nitrox breathing-gas mixtures supplied to divers contain the correct levels of O₂, as required by Condition 4 above.

(d) *Using a compressor.* This proposed condition specified that when employers produce nitrox breathing-gas mixtures, and before using a compressor in which the gas pressure in any system component exceeds 125 psi, they must ensure that: (i) Compressor manufacturers certify in writing that the compressor is suitable for mixing high-pressure air with the highest O₂ fraction used in the nitrox breathing-gas mixture; (ii) compressors are oil-less or oil-free and rated for O₂ service, unless the employer complies with the requirements of condition (e) below; and (iii) compressors meet the requirements specified in paragraphs (i)(1) and (i)(2) of § 1910.430 whenever the highest O₂ fraction used in the mixing process exceeds 40% by volume. In the proposal, OSHA stated that the purpose of these proposed requirements was to prevent O₂-accelerated explosions during the mixing process, the risk of which increases when gas pressure in a system component exceeds 125 psi.

OSHA revised paragraph (i) of this condition to indicate that the requirement specified in this paragraph is the responsibility of the compressor manufacturer, not the employer, but is adopting paragraph (ii) in the final rule as proposed. These provisions will provide assurance that a compressor’s components cannot serve as an ignition source for an O₂-accelerated explosion.

Paragraph (iii) of this condition addresses cascading processes in which an employer takes O₂ from storage banks that contain O₂ concentrations higher than 40% by volume, and mixes it with diluent gas from separate cylinder banks. The mixed product is a final breathing-gas mixture that does not exceed 40% by volume as required

above by Condition 3. Equipment used for this purpose must comply with paragraphs (i)(1) and (i)(2) of § 1910.430 (“Oxygen safety”). These paragraphs require employers to use equipment designed for O₂ service, and to clean the equipment of flammable materials before such use. The Agency finds that these equipment requirements, along with the other provisions of this condition, will reduce the risk of an O₂-accelerated explosion. Therefore, OSHA is adopting these requirements in the final rule.

(e) *Oil-lubricated compressors.* Before the employer produces nitrox breathing-gas mixtures using an oil-lubricated compressor to mix high-pressure air with O₂, and regardless of the gas pressure in any system component, this proposed condition would require employers to: (i) Use only uncontaminated air (*i.e.*, air containing no hydrocarbon particulates) for the nitrox breathing-gas mixture; (ii) have the compressor manufacturer certify in writing that the compressor is suitable for mixing the high-pressure air with the highest O₂ fraction used in the nitrox breathing-gas mixture; (iii) filter the high-pressure air to produce O₂-compatible air; (iv) have the filter-system manufacturer certify in writing that the filter system used for this purpose is suitable for producing O₂-compatible air; and (v) continuously monitor the air downstream from the filter for hydrocarbon contamination.

Two commenters responded to this proposed condition. The first commenter (Ex. 6-5) made the following statement:

[R]estricting compressor usage based on the [u]nlikely event that there would be a fire is preposterous, particularly in the area of restricting oil compressors. We know of [no] incidents * * * where there was a problem using oil compressors and membrane systems. Most membrane systems [never] allow an oxygen content over 40%. In our case we keep our mixture around 32-33%, and it is not possible that this mixture would [cause] a fire. Our air is double filtered and our hydrocarbon content is quite low.

Unfortunately, this commenter did not identify the provisions of the proposed condition considered to be “restricting.” The commenter stated that he already filters the high-pressure air as required under this condition by proposed paragraph (iii). The product-certification requirements under proposed paragraphs (ii) and (iv) placed the major responsibility on the compressor and filter manufacturers. The remaining requirements under this condition are the uncontaminated-air and continuous-monitoring requirements of proposed paragraphs (i)

⁶ The aviator’s oxygen specification is Type I, Quality Verification Level E (Aviator’s Breathing Oxygen), while the specification for medical-grade oxygen is Type I, Quality Verification Level A (Medical USP); see Ex. 3-15, p. 2.

and (v). By maintaining the concentrations of O₂ in the mixing process at 40% or less, which the commenter already is doing, he avoids the additional requirements of paragraphs (i)(1) and (i)(2) of § 1910.430 specified above under Condition 6(d)(iii).

As OSHA noted in the proposal, oil-based lubricants used in compressors contain hydrocarbons that can ignite in the presence of an enriched O₂ environment during the mixing process; such ignition may cause an explosion that injures and kills employees. To prevent the injuries and death that could result from such explosions, the proposed requirements were designed to ensure that the high-pressure O₂ being pumped through the compressor is free of combustible hydrocarbons. Therefore, paragraph (i) of the proposed condition specified a requirement that employers use hydrocarbon-free air when mixing nitrox breathing gases. By obtaining the manufacturer's written certification that the compressor is suitable for this purpose, as required by paragraph (ii), the employer knows that system components exposed to high O₂ will be safe for mixing high-pressure air with the highest O₂ fraction used in the nitrox breathing-gas mixture. OSHA revised this provision slightly to indicate that providing documentation of a compressor's suitability is the responsibility of the manufacturer, not the employer.

The paragraph (iii) requirement to filter the high-pressure air when producing O₂-compatible breathing gases, and the filter system-certification requirement specified by paragraph (iv), also ensure that the breathing gas is free of hydrocarbons. In the final rule, OSHA revised paragraph (iv) to indicate that providing documentation that the filter system is suitable for producing O₂-compatible air is the responsibility of the manufacturer, not the employer. Additionally, the monitoring requirement under paragraph (v) would indicate when high-pressure O₂ contains hydrocarbons, thereby alerting the employer of the need to take emergency action (*i.e.*, shut off O₂ flow to the compressor and then purge the compressor with an inert gas). Paragraph (v) of this condition would impose a basic requirement to assure that the final nitrox mixture is free of hydrocarbon particulates. OSHA believes the elements of the proposed condition are necessary to protect divers, and is retaining these conditions in the final standard.

The president of Machine Design & Fabrication, Inc., Mr. Tom Grubb, submitted comments regarding

compressors that use synthetic lubricants (Ex. 5–3). After noting that most compressors used for mixing breathing gases use synthetic lubricants (usually diester or triester based), Mr. Grubb argued that the final rule should treat these compressors in the same fashion as oil-less or oil-free compressors. In doing so, he asserted that compressors that use synthetic lubricants have flashpoints and autoignition temperatures that are higher than the operating temperatures of the compressors, thereby eliminating the risk of hydrocarbon contamination of the breathing gas. He concludes that these compressors are as safe as oil-less and oil-free compressors when operated according to the manufacturers' specifications regarding maximum temperature, cooling, ventilation, and maintenance.

Mr. Grubb raises an issue regarding the safety of synthetic lubricants that OSHA did not address in the proposal. As the regulated community has not had an opportunity to comment on this issue, the Agency is not in a position at this time to act on Mr. Grubb's recommendations. Therefore, for the purposes of the alternative procedures permitted by this final rule, employers who operate compressors that use synthetic lubricants are to treat these compressors in the same fashion as oil-lubricated compressors.

In addition, Mr. Grubb noted the importance of using compressor systems according to the manufacturers' specifications. Under the certification requirements in proposed conditions (d)(ii), (e)(ii), and (e)(iv), manufacturers are responsible for providing the user with information on how to use their equipment safely and appropriately. Therefore, the Agency is adding the phrase "when operated in accordance with the manufacturer's operating and maintenance specifications" to these provisions.

(f) *Compliance with other OSHA standards.* Under this proposed condition, employers must ensure that SCUBA equipment in which either nitrox breathing-gas mixtures or pure O₂ is under high pressure (*i.e.*, exceeding 125 psi) complies with the requirements of paragraphs (i)(1) and (i)(2) of § 1910.430. OSHA is including this condition in the final standard as proposed because it ensures that this equipment is free of ignition sources that could cause an O₂-accelerated explosion. As noted above in the discussion of Condition 3(d)(iii), the Agency believes that paragraphs (i)(1) and (i)(2) of § 1910.430 reduce this risk by requiring employers to use diving equipment designed for O₂ service and

to clean the equipment of flammable materials before such use.⁷

7. Emergency Egress

(a) *Bail-out system.* The proposed condition would require employers to equip their divers with a reliable emergency-egress system (*i.e.*, a "bail-out system") for emergencies involving SCUBA malfunctions that endanger diver health and safety (*e.g.*, high CO₂ levels). The bail-out system must contain a separate supply of breathing gas, which may include air, and provide the breathing gas to the second stage of the SCUBA regulator. OSHA is including this condition in the final standard as proposed because the bail-out system enables divers to shift to a known, safe, and immediately available breathing gas, and to terminate the dive safely whenever a CO₂-related problem or other emergency occurs.

(b) *Alternative systems.* In the proposal, this condition allowed for alternatives to bail-out systems for use with open-circuit SCUBA and semi-closed-circuit or closed-circuit rebreathers. Such an alternative system would provide the diver with a reserve supply of breathing air or gas mixture. When a diver uses open-circuit SCUBA with a nitrox breathing-gas mixture, the alternative system permits employers to use the emergency-egress procedure (*i.e.*, reserve breathing-gas supplies) specified for open-circuit SCUBA by paragraph (c)(4) of § 1910.424 instead of a separate bail-out breathing-gas system.⁸ For semi-closed-circuit and closed-circuit rebreathers, such an alternative system would be configured so that the second stage of the regulator connects to a reserve supply of emergency breathing gas.

The Agency is adopting the condition in the final rule as proposed. In this regard, paragraph (c)(4) of § 1910.424 already recognizes the safety afforded to divers by the alternative system used for air-supplied open-circuit SCUBA diving operations. Therefore, OSHA concludes that this alternative system will provide a similar level of protection to divers who use open-circuit SCUBA supplied with nitrox breathing-gas mixtures. In

⁷ In addition, employers already are required to comply with other OSHA standards that provide for accurate mixing and decontamination (especially hydrocarbon removal) of breathing gases, and they must assure that employees are properly protected during these activities. These standards include the appropriate provisions of §§ 1910.101 ("Compressed gases (general requirements)"), 1910.169 ("Air receivers"), and 1910.134 ("Respiratory protection").

⁸ Paragraph (c)(4) of § 1910.424 is an emergency-escape provision in OSHA's existing CDO standards that applies to divers using air-supplied open-circuit SCUBA.

extending this alternative system to semi-closed-circuit and closed-circuit rebreathers, OSHA believes that any bail-out system that allows divers to access a secondary source of sufficient quantities of emergency breathing gas will provide them with the requisite level of protection during emergency escape. Examples of a secondary source of emergency breathing gas include an inflator-regulator system or a manual reserve activated by a valve maintained in the closed position until needed (as permitted for air-supplied open-circuit SCUBA under § 1910.424(c)(4)(i) and (c)(5)).

(c) *Safety requirements.* This proposed condition provided that employers rely on rebreather manufacturers to specify the necessary capacity for a bail-out system because these manufacturers are in the best position to make this determination. A rebreather manufacturer can determine this capacity based on critical diving parameters (e.g., depth of dive and breathing rate) provided by the employer.

The Agency is including this condition in the final rule as proposed because it ensures that the bail-out system used by divers, whether it is a separate bail-out system or an alternative bail-out system built into the breathing equipment, will function appropriately when needed by the diver for emergency egress. A properly functioning bail-out system will enable the diver to terminate the dive and make a safe and controlled ascent to the surface under emergency conditions, thereby preventing over-pressurization of the lungs associated with AGE.

8. Treating Diving-Related Medical Emergencies

(a) *Availability of medical resources.* As proposed, this condition would require employers, prior to beginning diving operations each day, to ensure that: (i) A hospital, qualified health-care professionals, and the nearest Coast Guard Coordination Center (or an equivalent rescue service operated by a state, county, or municipal agency) are available for diving-related medical emergencies; (ii) each dive site has a means to alert these treatment resources in a timely manner when a diving-related medical emergency occurs; and (iii) 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 two hours travel time from the dive site. These requirements would avoid unnecessary delay in treating

diving-related injuries by confirming that resources are on call and available to render appropriate treatment, by alerting the treatment facility to the occurrence of a diving-related medical injury so it can initiate treatment action, and by providing timely transportation for the injured diver to the treatment facility.

The Agency received no comments on paragraphs (i) and (ii) of this condition. OSHA is adopting these paragraphs as proposed because it believes that these provisions will ensure that medical treatment for DCS and other diving-related injuries is readily available, thereby improving the likelihood that affected divers will recuperate fully from these injuries.

Regarding the two-hour travel-time requirement proposed by paragraph (iii) of this condition, the Professional Association of Diving Instructors (PADI) recommended that the Agency remove this paragraph entirely from the final rule (Exs. 5–2 and 5–2–1). PADI justified this recommendation in the following statement:

The experience of the dive industry since the 1999 Dixie Divers variance went into effect has been that while the practice of no-decompression enriched air diving has expanded significantly, [DCS] injuries to professionals at work as a result of the variance have not occurred. In fact, PADI's incident reporting system, which requires PADI professionals to report any incident of injury that they may suffer or witness, has recorded no [DCS] (or other) injuries to dive professionals as a result of the variance. PADI records show that during this period of time, PADI Instructors have certified in excess of 30,000 divers during Enriched Air Certification courses, plus had many thousands of exposures using enriched air while acting as dive guides.

PADI also noted that in the preamble to the Dixie Diver variance, OSHA “quoted Dr. Edward D. Thalmann * * *, who clearly stated, ‘there is no rationale for having different requirements for recompression chamber availability for air and (n)itrox no-decompression diving.’” In conclusion, PADI commented:

Based upon Dr. Thalmann's previously stated position, and upon the experience of PADI Instructors in the field and PADI's incident report records, PADI recommends that the proposed condition for recompression chamber access as [it] relates to defining a specific maximum transport time is unnecessary, and the issue should be treated as it is for recreational diving using air, i.e., no special condition regarding maximum transport time should be required.

As OSHA noted in the proposal, Dr. Thalmann first discussed the four-hour travel-time requirement in the context of pain-only DCS and DCS with severe

neurological symptoms that occur among recreational divers during no-decompression dives (Ex. 2–7). In this discussion, Dr. Thalmann noted that a treatment delay of four hours can occur without diminishing treatment success (i.e., complete relief of symptoms). Dr. Thalmann stated further that “[t]here is no significant body of evidence to suggest that, so long as one is diving within accepted no-decompression limits breathing air or Nitrox, having access to a recompression facility within 4 hours is inadequate” (Ex. 2–7).

Secondly, Dr. Thalmann concluded that travel time and decompression-chamber availability are irrelevant with regard to AGE because the incidence of AGE is extremely low among recreational divers breathing air supplied by an open-circuit SCUBA. After reviewing available research studies and data from the Diver Alert Network (“DAN”), Dr. Thalmann concluded that “[AGE] is a rare occurrence and can be avoided with proper training and experience,” that it “is essentially independent of the time spent at depth,” and that “there is no evidence * * * [to] suggest that the occurrence and outcome of [AGE] would be any different breathing a [n]itrox mixture [other] than air.” However, Dr. Larry Raymond stated that “[t]he treatment for [AGE] * * * is immediate pressurization in a recompression chamber. Delay compromises the diver's chances of a good outcome” (Ex. 5–1).⁹

In reviewing the AGE-related comments submitted by Drs. Thalmann and Raymond, OSHA finds that Dr. Thalmann's comments regarding AGE apply directly to recreational-diving operations, while Dr. Raymond did not describe the type of diving operations underlying his opinion. In addition, Dr. Thalmann based his comments on an extensive analysis of recreational divers, while Dr. Raymond did not indicate the specific basis for his opinions.

After carefully reviewing the available information, OSHA is revising the two-hour travel-time requirement proposed under paragraph (iii) of this condition to four hours in the final rule. The Agency is basing this decision on: Dr. Thalmann's comments showing that a four-hour travel delay is unlikely to impair treatment outcomes for DCS, and that AGE is rare among recreational

⁹Dr. Raymond made these comments in reference to an OSHA news release (dated January 10, 2003) that stated erroneously that nitrox breathing-gas mixtures prevented AGE. Dr. Raymond did indicate correctly that nitrox breathing-gas mixtures do *not*, in fact, prevent AGE. OSHA subsequently corrected this news release (with the same issue date of January 10, 2003).

divers and can be prevented with proper training and experience; PADI's observations regarding the protection afforded to divers by the Dixie Diver variance; and the equipment and procedural conditions specified in this final rule that are designed to significantly reduce the incidence of DCS and AGE.

(b) *O₂ treatment.* Oxygen treatment is the preferred means of initially treating AGE and DCS (Ex. 3–12, pp. 3–19 and 3–28). Accordingly, this proposed condition would require employers to ensure that portable O₂ equipment is available at the dive site to treat an injured diver. This equipment would have to deliver medical-grade O₂ (*i.e.*, Type I, Quality Verification Level A (medical USP) of CGA G–4.3–2000 (“Commodity Specification for Oxygen”)) (Ex. 3–15, p. 2) to a transparent mask that covers the injured diver's nose and mouth. Additionally, the equipment must be available for this purpose from the time the employer recognizes the symptoms of a diving-related medical emergency until the injured diver reaches a decompression chamber for treatment.

OSHA is including this condition in the final rule as proposed because it will provide injured divers with the maximum dose of O₂ possible to enhance treatment effectiveness. Medical-grade O₂ contains minimal contaminants (especially hydrocarbons) and adequate moisture to prevent drying of the employee's breathing passages and lungs. Also, the transparent mask covering the diver's nose and mouth allows attendants to monitor the diver's breathing and provides the means to check for an effective seal against O₂ loss.

(c) *Treatment personnel.* This proposed condition specifies that the employer, before starting each day's diving operations, must 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 must verify their qualifications before designating them for this purpose. The Agency is including this condition in the final standard as proposed because personnel qualified in first aid and O₂ treatment will stabilize the injured diver as rapidly as possible, thereby improving the effectiveness of subsequent treatment regimens. Regarding the use of non-employees, the Agency notes that the main purpose of this provision is to ensure that properly qualified personnel are available for initial treatment, regardless of their employment status. However,

recognizing that employers may not be familiar with the qualifications of non-employees involved in this procedure, this provision requires employers to verify their qualifications prior to designating them for this purpose.

9. Diving Logs and Decompression Tables

(a) *Diving log.* This proposed condition required the employer, before beginning diving operations, to (i) designate an employee or non-employee to make entries in a diving log, and (ii) verify that this designee understands diving and medical terminology and the proper procedures for making such entries. Recognizing that many employers of recreational divers and diving guides are small businesses that may not have an employee available to make entries in the diving log, OSHA also proposed under this condition to allow non-employees to make entries in the log. The Agency is including this provision in the final rule as proposed because it believes that any properly qualified individual can make such entries, provided that, as noted earlier, the employer verifies their qualifications before designating them for this purpose.

(b) *Diving log requirements.* Under this proposed condition, employers would have to: (i) ensure that diving logs meet the information requirements specified by § 1910.423(d), including the requirement for DCS information when appropriate; and (ii) maintain diving logs according to the provisions of § 1910.440, including the requirements for record availability, access to records by employees and OSHA, and retention of records. The Agency is retaining this condition in the final standard as proposed. Diving logs enable the employer to assess the safety of each dive and determine which diving parameters are especially hazardous. Should an injury occur during a dive, the log allows the employer to inform medical personnel about the parameters of the dive that may assist them in making an accurate diagnosis of the injury and prescribing an effective treatment. In addition, employers covered by this condition must continue to collect dive records as required by § 1910.423(d) and meet the other recordkeeping provisions of § 1910.440 because their employees breathe a mixed gas (*i.e.*, nitrox) during diving operations.

(c) *Availability of decompression tables.* As proposed, employers must have a hard copy of the no-decompression tables used for the dives (see Condition 5(a) above) readily available at the dive site, whether or not

the divers use dive-decompression computers. OSHA is maintaining the requirement in the final rule as proposed because it ensures that the parameters of the no-decompression limits are readily available and accessible as a reference source. In addition, a hard-copy of the decompression tables serves both as a reference source should decompression become necessary, and as a back-up resource to divers with dive-decompression computers (see Condition 5(b) above).

10. Diver Training

Under this condition as proposed, employers would have to ensure that their divers receive training that enables them to perform their work safely and effectively while using open-circuit SCUBAs or rebreathers supplied with nitrox breathing-gas mixtures. At a minimum, the divers must be trained to: recognize the effects of breathing excessive CO₂ and O₂; take appropriate action after detecting the effects of breathing excessive CO₂ and O₂; and properly evaluate, operate, and maintain their diving equipment under the diving conditions they encounter.

This performance-based condition provides assurance that divers are trained to perform safely and effectively while using open-circuit SCUBAs or rebreathers supplied with nitrox breathing-gas mixtures. Although the Agency believes that employers are in the best position to determine when the training their divers receive is adequate for this purpose, the provision nevertheless specifies several critical tasks, as noted above, that divers must perform safely and effectively.

The Agency is including the condition in the final standard as proposed because divers must be able to recognize the life-threatening effects of CO₂ and O₂ toxicity, including convulsions and loss of consciousness, and be capable of taking remedial actions to prevent and properly respond to them. In addition, OSHA believes that if divers know how to evaluate, operate, and maintain their open-circuit SCUBAs and rebreathers under the diving conditions they encounter, they will be less likely to experience equipment failure, thereby reducing the incidence of AGE that may result during rapid emergency egress.

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

The proposed condition specified the requirements employers must follow when they use a schedule to replace depleted CO₂-sorber material instead of using CO₂ sensors to detect when the

material is no longer absorbing CO₂ effectively (see Condition 1(h) above). Employers may use a canister-replacement schedule developed by a rebreather manufacturer only when the manufacturer has tested the schedule according to the protocol specified under this condition.

The Agency adapted the U.S. Navy Experimental Diving Unit's (NEDU) canister-testing protocol (Ex. 3-11) and statistical procedures (Ex. 3-9) for this rulemaking; the NEDU is the lead Federal agency for testing CO₂-sorber replacement schedules. OSHA believes that the NEDU protocol provides valid and reliable data for determining CO₂-sorber replacement schedules because NEDU carefully executed and controlled significant variables that deplete CO₂-sorber materials, such as breathing rate (by using breathing machines) and ambient temperature. In addition, NEDU conducts extensive research and development programs involving canister-duration testing (Ex. 3-4, pp. 3-5, 5-12, 9-7 through 9-10, P-34 through P-36, and P-69 through P-75).

(a) *Testing the physical properties of the CO₂-sorber material.* Under this proposed condition, employers would have to ensure that the rebreather manufacturer has used the required procedures to determine that the CO₂-sorber material has several necessary physical properties. These procedures include: (i) The North Atlantic Treaty Organization CO₂ absorbent-activity test to assess the capacity of the material to absorb CO₂; (ii) the RoTap shaker and nested-sieves test to determine granule-size distribution; (iii) the NEDU-derived Schlegel test to assess the friability of the CO₂-sorber material; and (iv) the NEDU's MeshFit software to evaluate mesh size conformance to specifications.

The Agency is including the condition in the final standard as proposed because it believes that these procedures assure the quality of the CO₂-sorber material. They also indicate whether the CO₂-sorber material meets the specifications provided by the material's manufacturer. In developing the canister-replacement schedule using the protocol specified under this condition, rebreather manufacturers must approve for use only CO₂-sorber materials that meet these specifications. Carefully controlling the conditions used to develop a canister-replacement schedule, including the quality of the CO₂-sorber material, will ensure that the schedule is reliable. Therefore, an employer who has this information will be able to replace a diver's canister before the CO₂-sorber material fails

(i.e., before CO₂ increases to dangerous levels).

(b) *Testing canister function.* This proposed condition would require employers to ensure that the rebreather manufacturer has used the specified canister-testing protocol. The canister-testing protocol measures the effects of three factors on canister performance: depth, exercise level (i.e., ventilation rate), and water temperature. Depth is the maximum depth at which a diver would use the CO₂-sorber material, which for this final rule is 130 fsw. For the other variables, OSHA has selected three combinations of ventilation rates and CO₂-injection rates from the NEDU protocol to simulate three diverse levels of exercise (light, moderate, and heavy). The four water temperatures used in the proposed protocol are 40, 50, 70, and 90 degrees F (4.4, 10.0, 21.1, and 32.2 degrees C, respectively); these temperatures represent the wide range of water temperatures that recreational diving instructors and diving guides are likely to encounter.

For this application, the Agency revised the NEDU protocol slightly by: limiting the maximum depth to 130 fsw; requiring an O₂ fraction of 0.28 in the nitrox breathing-gas mixture (this fraction being the maximum O₂ concentration permitted at this depth under the amendment); providing tolerance limits for water temperatures; and defining canister duration as the time taken to reach 0.005 ATA of CO₂ (a CO₂ partial pressure of 0.005 ATA is the level specified under Condition 1(e) as the maximum allowable amount of CO₂ in the breathing gas). In addition, the protocol expressly prohibits the employer from using extrapolation of the protocol results to establish a CO₂-sorber replacement schedule. NEDU's statistical procedures (Ex. 3-9) do not provide a method for extrapolating the duration of CO₂-sorber materials beyond the results obtained during the canister-testing trials.

The Agency is including this condition in the final rule as proposed to improve the validity and reliability of canister-replacement schedules. Accordingly, it will enable employers to replace CO₂-sorber materials before the sorber capabilities of these materials are depleted.

III. Legal Considerations

Employers covered by this final rule are currently covered by the commercial diving standard. The requirements of that standard are protecting their employees from significant risk. In issuing a variance from this standard to Dixie Divers, the Agency determined that the practices and protections in the

variance would provide Dixie Divers' recreational diving instructors and diving guides with comparable protection to that provided by the decompression-chamber requirements of the standard. This final rule extends these alternative protections to all such instructors and guides. In this regard, the amendment does not totally replace these existing requirements, but instead provides a limited alternative to them. OSHA finds that this final rule does not directly increase or decrease the protection afforded to employees, nor does it increase employers' compliance burdens. As demonstrated in the following sections, this amendment likely will reduce employers' compliance burdens by eliminating the requirement to have a decompression chamber at the dive site when they comply with the conditions specified in the final rule.

IV. Final Economic Analysis and Regulatory Flexibility Certification

This final rule is not a significant rulemaking under Executive Order 12866, or a major rule under the Unfunded Mandates Reform Act or Section 801 of the Small Business Regulatory Enforcement Fairness Act (SBREFA). The final rule imposes no additional costs on any private-or public-sector entity, and does not meet any of the criteria for a significant or major rule specified by the Executive Order or relevant statutes.

Employers of recreational diving instructors and diving guides who comply with the conditions in the final rule will be able to expand their operations to include nitrox diving, because they will not need to purchase and maintain a decompression chamber at the dive site. By providing regulatory flexibility to these employers, the final rule may reduce their costs and increase productive time. The Agency concludes that this final rule does not impose any additional costs on affected employers; consequently, the standard requires no final economic analysis. Furthermore, because the final rule provides an additional voluntary compliance option and, thus, does not impose expenditures on any employer, OSHA certifies that the rule does not have a significant impact on a substantial number of small entities. Accordingly, the Agency did not prepare a final regulatory flexibility analysis.

V. Paperwork Reduction Act

The final rule contains two collection-of-information (i.e., paperwork) requirements: Conditions 9(b)(i) and 9(b)(ii) of Appendix C. Condition 9(b)(i) requires employers to ensure that the

diving log conforms to the requirements specified by paragraph (d) ("Record of dive") of § 1910.423, while Condition 9(b)(ii) specifies that employers must keep a record of the dive according to the provisions of § 1910.440 ("Recordkeeping requirements"). However, these paperwork requirements already apply to these employers under subpart T, regardless of this final rule, because their divers are using a mixed-gas (*i.e.*, nitrox) breathing supply. The regulatory alternative provided by this final rule only exempts the covered employers from having to maintain decompression chambers at the dive site, and does not exempt them from the other provisions of subpart T that apply to mixed-gas diving operations. Accordingly, the Agency already incorporates the time and cost burdens associated with these two paperwork requirements under OMB Control No. 1218-0069.

VI. Federalism

The Agency has reviewed this final rule and its Commercial Diving Operations standards according to the most recent Executive Order on Federalism (Executive Order 13132, 64 FR 43225, August 10, 1999). This Executive Order requires that Federal agencies, to the extent possible, refrain from limiting State policy options, consult with States before taking actions that restrict their policy options, and take such actions only when clear constitutional authority exists and the problem is of national scope. The Executive Order allows Federal agencies to preempt State law only with the expressed consent of Congress; in such cases, Federal agencies must limit preemption of State law to the extent possible.

Under Section 18 of the OSH Act, Congress expressly provides OSHA with authority to preempt State occupational safety and health standards to the extent that the Agency promulgates a federal standard under Section 6 of the OSH Act. Accordingly, Section 18 of the OSH Act authorizes the Agency to preempt State promulgation and enforcement of requirements dealing with occupational safety and health issues covered by OSHA standards unless the State has an OSHA-approved occupational safety and health plan (*i.e.*, is a State-Plan State). (See *Gade v. National Solid Wastes Management Association*, 112 S. Ct. 2374 (1992).) Therefore, with respect to States that do not have OSHA-approved plans, the Agency concludes that this final rule conforms to the preemption provisions of the OSH Act. Additionally, Section 18 of the OSH Act prohibits States without approved plans

from issuing citations for violations of OSHA standards; the Agency finds that this rulemaking does not expand this limitation.

This final rule addresses problems that are national in scope. In this regard, for employers across the nation whose divers provide recreational diving instruction and dive-guiding services, the final rule provides an opportunity to safely perform nitrox diving operations at a maximum depth of 130 feet of sea water without the expense involved in purchasing a decompression chamber. The amendment also enables employers in every State to protect their recreational diving instructors and diving guides from the risks of decompression sickness and arterial-gas embolism while using a breathing-gas mixture consisting of a high percentage of O₂ mixed with nitrogen supplied by an open-circuit, semi-closed-circuit, or closed-circuit self-contained breathing apparatus.

Section 18(c)(2) of the OSH Act (29 U.S.C. 667(c)(2)) requires State-Plan States to adopt standards that are identical to OSHA standards, or adopt different standards, that are at least as effective as the OSHA rule. The final rule only provides employers with an alternative to the requirements of the Commercial Diving Operations standards. It does not impose additional requirements on employers. Accordingly, State-Plan States are not obligated to adopt this final rule. Nevertheless, OSHA strongly encourages them to adopt the amendment to provide these compliance options to employers in their States.

VII. State Plans

The Agency strongly encourages the 24 States and two Territories with their own OSHA-approved occupational safety and health plans to revise their current Commercial Diving Operations standards to reflect this final rule. OSHA believes that such a revision would provide employers in the State-Plan States the economic benefits that are likely to accrue from its enactment, while continuing to protect the safety and health of recreational diving instructors and diving guides. These States and Territories are: Alaska, Arizona, California, Connecticut (public-sector employees only), Hawaii, Indiana, Iowa, Kentucky, Maryland, Michigan, Minnesota, Nevada, New Jersey (public-sector employees only), New Mexico, New York (public-sector employees only), North Carolina, Oregon, Puerto Rico, South Carolina, Tennessee, Utah, Vermont, Virginia,

Virgin Islands (public-sector employees only), Washington, and Wyoming.

VIII. Unfunded Mandates

OSHA has reviewed this final rule according to the Unfunded Mandates Reform Act of 1995 (UMRA) (2 U.S.C. 1501 *et seq.*) and Executive Order 12875. As discussed above in Section V ("Final Economic Analysis and Regulatory Flexibility Finding") of this preamble, the Agency has made a determination that this rule imposes no regulatory burdens on any employer, either public or private. The substantive content of the amendment applies only to employers of recreational diving instructors and diving guides, and compliance with the amendment is strictly optional for the employers. Accordingly, the final rule requires no additional expenditures by either public or private employers.

OSHA standards do not apply to State and local governments, except in States that have voluntarily elected to adopt a State plan approved by the Agency. Consequently, this final rule does not meet the definition of a "federal intergovernmental mandate" (see Section 421(5) of the UMRA (2 U.S.C. 658(5)). In conclusion, this final rule does not mandate that State, local, and tribal governments adopt new, unfunded regulatory obligations.

IX. Applicability of Existing Consensus Standards

OSHA is not aware of any national consensus standards that are similar to this final rule.

List of Subjects in 29 CFR Part 1910

Health, Occupational safety and health, Safety.

X. Authority and Signature

This document was prepared under the authority of John L. Henshaw, Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington, DC 20210. Accordingly, pursuant to Sections 4, 6, and 8 of the OSH Act of 1970 (29 U.S.C. 653, 655, 657), Section 107, Contract Work Hours and Safety Standards Act (the Construction Safety Act) (40 U.S.C. 333), Section 41, Longshore and Harbor Workers' Compensation Act (33 U.S.C. 941), Secretary of Labor's Order No. 5-2002 (67 FR 65008), and 29 CFR part 1911, OSHA is hereby amending subpart T of 29 CFR part 1910 as set forth below.

Signed at Washington, DC on February 10, 2004.

John L. Henshaw,
Assistant Secretary of Labor.

XI. Amendment to Standard

■ For the reasons stated in the preamble, the Agency is amending 29 CFR part 1910, subpart T as follows:

PART 1910—[AMENDED]

Subpart T—[Amended]

■ 1. Revise the authority citation for subpart T of part 1910 to read as follows:

Authority: Sections 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, and 657); Section 107, Contract Work Hours and Safety Standards Act (the Construction Safety Act) (40 U.S.C. 333); Section 41, Longshore and Harbor Workers' Compensation Act (33 U.S.C. 941); Secretary of Labor's Order No. 8-76 (41 FR 25059), 9-83 (48 FR 35736), 1-90 (55 FR 9033), 6-96 (62 FR 111), 3-2000 (65 FR 50017), or 5-2002 (67 FR 65008), as applicable; 29 CFR part 1911.

■ 2. Add new paragraph (a)(3) to § 1910.401 to read as follows:

§ 1910.401 Scope and application.

(a) * * *

(3) *Alternative requirements for recreational diving instructors and diving guides.* Employers of recreational diving instructors and diving guides are not required to comply with the decompression-chamber requirements specified by paragraphs (b)(2) and (c)(3)(iii) of § 1910.423 and paragraph (b)(1) of § 1910.426 when they meet all of the following conditions:

(i) The instructor or guide is engaging solely in recreational diving instruction or dive-guiding operations;

(ii) The instructor or guide is diving within the no-decompression limits in these operations;

(iii) The instructor or guide is using a nitrox breathing-gas mixture consisting of a high percentage of oxygen (more than 22% by volume) mixed with nitrogen;

(iv) The instructor or guide is using an open-circuit, semi-closed-circuit, or closed-circuit self-contained underwater breathing apparatus (SCUBA); and

(v) The employer of the instructor or guide is complying with all requirements of Appendix C of this subpart.

* * * * *

■ 3. Add new definitions for “dive-guiding operations” and “recreational diving instruction” to the alphabetical list of definitions in § 1910.402, to read as follows:

§ 1910.402 Definitions.

Dive-guiding operations means leading groups of sports divers, who use an open-circuit, semi-closed-circuit, or closed-circuit self-contained underwater breathing apparatus, to local undersea diving locations for recreational purposes.

* * * * *

Recreational diving instruction means training diving students in the use of recreational diving procedures and the safe operation of diving equipment, including an open-circuit, semi-closed-circuit, or closed-circuit self-contained underwater breathing apparatus, during dives.

* * * * *

■ 4. Add a new Appendix C to 29 CFR part 1910, subpart T to read as follows:

* * * * *

Appendix C to Subpart T of 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-contained underwater breathing apparatuses (hereafter, “SCUBAs”)) according to the rebreather manufacturer's instructions.

(b) The employer must ensure that each rebreather 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 rebreather has a continuously functioning moisture sensor, and that:

(i) The moisture sensor connects to a visual (*e.g.*, digital, graphic, analog) or auditory (*e.g.*, voice, pure tone) alarm that is readily detectable by the diver under the diving conditions 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 according to the rebreather manufacturer's instructions.

(e) The employer must ensure that each rebreather contains a continuously functioning CO₂ sensor in the breathing loop, and that:

(i) The rebreather manufacturer approves the location of the CO₂ sensor in the breathing 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 maintain this accuracy as required by the sensor manufacturer's instructions; and

(iii) The calibration of the CO₂ sensor is accurate to within 10% of a CO₂ concentration of 0.005 ATA or less.

(g) The employer must replace the CO₂ sensor when it fails to meet the accuracy requirements specified in paragraph 1(f)(iii) of this appendix, and ensure that the replacement CO₂ sensor meets the accuracy requirements specified in paragraph 1(f)(iii) of this appendix before placing the rebreather in operation.

(h) As an alternative to using a continuously functioning CO₂ sensor, the employer may use a schedule for replacing CO₂-sorber material provided by the rebreather manufacturer. The employer may use such a schedule only when the rebreather manufacturer has developed it according to the canister-testing protocol specified below in Condition 11, and must use the canister within the temperature range for which the manufacturer 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-sorber replacement schedules, the employer must ensure that each rebreather uses a manufactured (*i.e.*, commercially pre-packed), disposable scrubber cartridge containing a CO₂-sorber material that:

(i) Is approved by the rebreather manufacturer;

(ii) Removes CO₂ from the diver's exhaled gas; and

(iii) Maintains the CO₂ level in the breathable gas (*i.e.*, the gas that a diver inhales directly from the regulator) below a partial pressure of 0.01 ATA.

(j) As an alternative to manufactured, disposable scrubber cartridges, the employer may fill CO₂ scrubber cartridges manually with CO₂-sorber material when:

(i) The rebreather manufacturer permits manual filling of scrubber cartridges;

(ii) The employer fills the scrubber cartridges according to the rebreather manufacturer's instructions;

(iii) The employer replaces the CO₂-sorber material using a replacement schedule developed under paragraph 1(h) of this appendix; and

(iv) The employer demonstrates that manual 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) and other electrical weaknesses or failures (*e.g.*, low battery voltage);

(ii) For a semi-closed circuit rebreather, a visual display for the partial pressure of CO₂, or deviations above and below a preset CO₂ partial pressure of 0.005 ATA; and

(iii) For a closed-circuit rebreather, a visual display for: partial pressures of O₂ and CO₂, or deviations above and below a preset CO₂ partial pressure of 0.005 ATA and a preset O₂ partial pressure of 1.40 ATA or lower; gas temperature in the breathing loop; and water temperature.

(l) Before each day's diving operations, and more often when necessary, the employer must ensure that the electrical power supply and electrical and electronic circuits in each rebreather are operating as required by the rebreather manufacturer's instructions.

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; and

(v) Ensure that the replacement O₂ sensors 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 "1995 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 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) Employer must comply with paragraph 6(e) of this appendix, unless the compressor is rated for O₂ service and is oil-less or oil-free; and

(iii) Employer must ensure that the compressor meets the requirements specified in paragraphs (i)(1) and (i)(2) of § 1910.430 whenever the highest O₂ fraction used in the mixing process exceeds 40%.

(e) Before producing nitrox breathing-gas mixtures using an oil-lubricated compressor to mix high-pressure air with O₂, and regardless of the gas pressure in any system component, the:

(i) Employer must use only uncontaminated air (*i.e.*, air containing no hydrocarbon particulates) for the nitrox breathing-gas mixture;

(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) Employer must filter the high-pressure air to produce O₂-compatible air;

(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 diving equipment using nitrox breathing-gas mixtures or pure O₂ under high pressure (*i.e.*, exceeding 125 psi) conforms to the O₂-service requirements specified in paragraphs (i)(1) and (i)(2) of § 1910.430.

7. Emergency Egress

(a) Regardless of the type of diving equipment used by a diver (*i.e.*, open-circuit SCUBA or rebreathers), the employer must ensure that the equipment contains (or incorporates) an open-circuit emergency-egress system (a "bail-out" system) in which the second stage of the regulator connects to a separate supply of emergency breathing gas, and 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 health-care 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-sorber material meets the specifications of the sorber 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):

TABLE I.—CANISTER TESTING PARAMETERS

Ventilation rates (Lpm, ATPS ¹)	Breathing machine tidal volumes (L)	Breathing machine frequencies (breaths per min.)	CO ₂ injection rates (Lpm, STPD ²)
22.5	1.5	15	0.90
40.0	2.0	20	1.35
62.5	2.5	25	2.25

¹ ATPS means ambient temperature and pressure, saturated with water.

² STPD means standard temperature and pressure, dry; the standard temperature is 32 degrees F (0 degrees C).

(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) Analysis of the canister-duration results using the repeated-measures statistics described in NEDU Report 2-99;

(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.

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DEPARTMENT OF DEFENSE

32 CFR Part 312

Office of the Inspector General: Privacy Act; Implementation

AGENCY: Office of the Inspector General, DoD.

ACTION: Final rule.

SUMMARY: The Office of the Inspector General, DoD (OIG, DoD) is exempting the system of records CIG-21, entitled "Congressional Correspondence Tracking System" from 5 U.S.C. 552a(j)(2), (k)(1) through (k)(7). The exemption is needed because during the course of a Congressional inquiry, exempt materials from other systems of records may in turn become part of the case records in the system. To the extent

¹ NEDU can provide the manufacturer with information on the temperature of a diver's exhaled breath at various water temperatures and ventilation rates, as well as techniques and procedures used to maintain these temperatures during the testing trials.

that copies of exempt records from those "other" systems of records are entered into the Privacy Act case records, the Inspector General, DoD, hereby claims the same exemptions for the records from those "other" systems that are entered into this system, as claimed for the original primary systems of records of which they are a part. In addition, two administrative changes are also being made.

The proposed rule was published on December 9, 2003, at 68 FR 68577. No comments were received; therefore, the rule is being adopted as published.

EFFECTIVE DATE: February 10, 2004.

FOR FURTHER INFORMATION CONTACT: Mr. Darryl R. Aaron at (703) 604-9785.

SUPPLEMENTARY INFORMATION: The proposed rule was published on December 9, 2003, at 68 FR 68577. No comments were received; therefore, the rule is being adopted as published.

Executive Order 12866, "Regulatory Planning and Review"

It has been determined that Privacy Act rules for the Department of Defense are not significant rules. The rules do not (1) Have an annual effect on the economy of \$100 million or more or adversely affect in a material way the economy; a sector of the economy; productivity; competition; jobs; the environment; public health or safety; or State, local, or tribal governments or communities; (2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another Agency; (3) Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs, or the rights and obligations of recipients thereof; or (4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive Order.

Public Law 96-354, "Regulatory Flexibility Act" (5 U.S.C. Chapter 6)

It has been determined that Privacy Act rules for the Department of Defense do not have a significant economic impact on a substantial number of small entities because they are concerned only with the administration of Privacy Act systems of records within the Department of Defense.

Public Law 96-511, "Paperwork Reduction Act" (44 U.S.C. Chapter 35)

It has been determined that Privacy Act rules for the Department of Defense impose no information requirements beyond the Office of the Inspector General and that the information collected within the Office of the Inspector General is necessary and

consistent with 5 U.S.C. 552a, known as the Privacy Act of 1974.

Section 202, Public Law 104-4, "Unfunded Mandates Reform Act"

It has been determined that the Privacy Act rulemaking for the Department of Defense does not involve a Federal mandate that may result in the expenditure by State, local and tribal governments, in the aggregate, or by the private sector, of \$100 million or more and that such rulemaking will not significantly or uniquely affect small governments.

Executive Order 13132, "Federalism"

It has been determined that the Privacy Act rules for the Department of Defense does not have federalism implications. The rules do not have substantial direct effects on the States, on the relationship between the National Government and the States, or on the distribution of power and responsibilities among the various levels of government.

List of Subjects in 32 CFR Part 312

Privacy.

■ For reasons stated in the Preamble, 32 CFR part 312 is amended as follows:

PART 312—OFFICE OF THE INSPECTOR GENERAL (OIG) PRIVACY PROGRAM

■ 1. The authority citation for 32 CFR part 312 continues to read as follows:

Authority: Pub. L. 93-579, 88 Stat. 1896 (5 U.S.C. 552a).

■ 2. Section 312.8, paragraph (a) is revised to read as follows:

§ 312.8 OIG review of request for amendment.

(a) A written acknowledgement of the receipt of a request for amendment of a record will be provided to the requester within 20 working days, unless final action regarding approval or denial will constitute acknowledgement.

* * * * *

■ 3. Section 312.12, paragraph (b) is revised and paragraph (i) is added to read as follows:

§ 312.12 Exemptions.

* * * * *

(b) The Inspector General of the Department of Defense claims an exemption for the following record systems under the provisions of 5 U.S.C. 552a(j) and (k)(1)-(k)(7) from certain indicated subsections of the Privacy Act of 1974. The exemptions may be invoked and exercised on a case-by-case basis by the Deputy Inspector General for Investigations or the Director,