

in these systems never exceeds 40% by volume.

(b) *Analyzing O₂*. This proposed condition requires 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. These provisions would ensure that the proportions of O₂ and diluent gas in the breathing-gas mixtures conform to pre-established levels of these gases, thereby ensuring that divers remain within the 24-hour single-exposure O₂ limits under proposed Condition 4 above. The accuracy requirements specified by these provisions are consistent with the accuracy requirements for O₂ found in other requirements of this proposal, and serve the same purpose described for these requirements (see the detailed discussion of these requirements in proposed Condition 2(c) above).

(c) *Commercially supplied breathing gas*. When the breathing gas is a commercially supplied nitrox breathing-gas mixture, this proposed condition requires employers to ensure that the O₂ is Grade A (also known as "aviator's oxygen") or Grade B (referred to as "medical-industrial oxygen"), and meets the specifications, including the purity requirements, found in the ANSI-Compressed Gas Association Commodity Specification for Air, G-7.1-1997. In addition, employers 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 believes that many employers covered by this proposal purchase breathing-gas mixtures commercially. Specifying grades A and B for the O₂ would ensure that divers use the purest O₂ with optimal moisture content in their nitrox breathing-gas mixtures, thereby preventing them from inhaling contaminants, including hydrocarbons, that are known safety hazards. In addition, the O₂ would be at comfortable moisture levels, which would help maintain normal pulmonary function.

The proposed condition also controls the O₂ levels in the mixture by requiring

that the accuracy of the method used to analyze O₂ conforms to the tolerance limits specified above under proposed Condition 5(b). The commercial suppliers must analyze the breathing-gas mixture actually contained in the SCUBA cylinders to determine the fraction of O₂ that the divers will breathe, unaffected by O₂ in the storage banks used to fill the SCUBA cylinders. The employer must ensure that the supplier of the breathing-gas mixture documents the O₂ fraction contained in the cylinder mixture, and certifies these results in writing. The written certification serves as a measure of quality assurance, and provides employers with documentation that the breathing-gas mixture contains the required fraction of O₂.

(d) *Using a compressor*. When employers produce nitrox breathing-gas mixtures, before using a compressor in which the gas pressure in any system component exceeds 125 psi, this proposed condition requires them to do the following: (i) Have the compressor manufacturer 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) ensure that the compressor is oil-less or oil-free and rated for O₂ service unless the employer complies with the requirements of proposed Condition 5(e) below; and (iii) ensure that the compressor meets the requirements specified in paragraph (i)(1) and (i)(2) of § 1910.430 whenever the highest O₂ fraction used in the mixing process exceeds 40% by volume. The purpose of these proposed conditions is to prevent O₂ explosions during the mixing process, the risk of which increases when gas pressure in a system component exceeds 125 psi.

The requirements of Condition 5(d) would provide quality assurance that the compressor is designed and built so that its components cannot serve as ignition sources that could cause an O₂ explosion. However, if the compressors are not rated as oil-less or oil-free (*i.e.*, oil is used to lubricate components), paragraph (ii) of this condition requires that the compressors comply with the provisions of Condition 5(e) below to prevent the lubricating oil from serving as an ignition source. 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 proposed 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. Together with the other provisions of this proposed condition, these equipment requirements would reduce the risk of an O₂ explosion.

(e) *Oil-lubricated compressors*. Before an 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 requires that the employer: (i) 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; (ii) filter the high-pressure air to produce O₂-compatible air; (iii) have the filter-system manufacturer certify in writing that the filter system used for this purpose is suitable for producing O₂-compatible air; (iv) continuously monitor the air downstream from the filter for hydrocarbon contamination; and (v) use only uncontaminated air (*i.e.*, air containing no hydrocarbon particulates) for the nitrox breathing-gas mixture.

Oil-based lubricants contain hydrocarbons that can ignite in the presence of an enriched O₂ environment during the mixing process, causing an explosion that can injure or kill employees. OSHA believes that these proposed requirements would reduce this risk by ensuring that high-pressure O₂ being pumped through the compressor remains isolated from the oil-based lubricant. Under the proposed conditions, the employer's actions will assure that the air used for the nitrox breathing-gas mixture is not contaminated, while the manufacturer's certification will provide assurance that the equipment will produce and filter this mixture safely. As an additional safety precaution, the monitoring requirement proposed under paragraph (v) would warn the employer that high-pressure O₂ is mixing with the oil-based lubricant, and to take emergency action (*e.g.*, shut off O₂ flow to the compressor and then purge the compressor with an inert gas).

(f) *Compliance with other OSHA standards*. Under this proposed condition, employers must ensure that SCUBA equipment using nitrox breathing-gas mixtures or pure O₂ under high pressure (*i.e.*, exceeding 125 psi) complies with the requirements specified by paragraphs (i)(1) and (i)(2) of § 1910.430. This provision ensures