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Compressed Air Used in Self-contained Underwater Breathing Apparatus

Sec. 19-66c-1. Testing procedures for air for scuba diving

The following tests should be done on a sample of air obtained from the compressor after it has been in operation for at least ten minutes thereby permitting observation of the effects of heating the motor.

(a) **Oxygen: 20-21 percent.** Compressed ambient air will be considered to meet the oxygen standard without testing. If such tests are required, a sample blown into a plastic bag, such as polyvinyl chloride (pvc) film or aluminized Scotchpak or flushed through an all-glass evacuated flask, may be analyzed with an oxygen indicator such as the Portable Oxygen Indicator of the Portable Gas Analyzer.

(b) **Carbon dioxide: Less than .03 percent (300 ppm).** Compressed ambient air will be considered to meet the carbon dioxide standard without testing. If such tests are required, a sample blown into a plastic bag, such as pvc or aluminized Scotchpak or flushed through an all-glass evacuated flask, may be analyzed with a gas analysis apparatus or with gas detector tubes such as the Kitagowa Gas Detector.

(c) **Carbon monoxide: Less than .001 percent (10 ppm).** Carbon monoxide may be analyzed by first collecting an air sample directly from the compressed gas tank or compressor into a plastic bag, such as pvc or aluminized Scotchpak, or into an all-glass evacuated flask. The collected sample may be analyzed by means of direct reading indicating tubes or by means of a direct reading CO Indicator, or by means of the laboratory techniques with iodine pentoxide or infrared spectrophotometry.

(d) **Oil mist: Less than 5 mg/M³.** Oil mist may be analyzed by first collecting an air sample on oil-free silica gel or on a molecular filter sampler. Since oil droplets tend to settle on the walls of any holding container, the air sample should be passed directly from the air compressor or air tank to the silica gel or molecular filter sampler.

When the sample is collected on silica gel, the oil may be analyzed by extraction with a known volume of carbon tetrachloride and compared for fluorescence under a "dark lamp", using known quantities of S.A.E. No. 30 petroleum lubricating oil in carbon tetrachloride for standards.

An alternate method may be used, by collecting a known volume of air on a molecular filter sampler and comparing the "black light" fluorescence with known standard quantities of S.A.E. No. 30 oil. For example, with the "RV Black Light", a 30 microgram quantity of lubricating oil can be detected on a 47 mm molecular filter paper. Thus a 6 liter air sample, through a molecular filter, will detect a concentration of 5 mg/M³ of oil mist. Repeated samples, at higher or lower total air volume, can be collected to estimate the magnitude of oil mist concentration.

Mineral or silicone oil which occasionally are used for compressor lubrication do not fluoresce under ultraviolet light. Where these oils are used assay should be done by gravimetric analysis at a micro-chemical laboratory.

(e) **Total oxidants: Less than 0.05 ppm.** Total oxidants in compressed air may be analyzed by two methods:

(1) A 20 liter air sample may be collected directly from the tank or compressor into an all-glass midget impinger of fritted glass absorber sampler, containing 10 ml of phenolphthalein reagent.

(2) A 20 liter sample may be collected in a Mylar plastic bag and returned to a microchemical testing laboratory for analysis by the phenolphthalein reagent method. Since total oxidants in air are not chemically stable, their analysis should be undertaken within a few hours of collection.

(f) **Total hydrocarbons: Less than 50 ppm.** Total hydrocarbons may be analyzed by two methods:

(1) A sample of compressor or tank air may be collected into a plastic bag, such as aluminized Scotchpak or Mylar, and returned to the laboratory for analysis by gas chromatography.

(2) The magnitude of the total hydrocarbon concentration may be estimated, semi-quantitatively, by means of combustible gas indicator. Most combustible gas indicators indicate a concentration of approximately 50 ppm with a 5 percent of full-scale deflection for most hydrocarbons.

(g) **Odor: None detectable.** No quantitative tests have been standardized for odor measurement. Therefore, any odor, detectable by olfactory sensation, will be considered unacceptable. Yaglou and Borum have classified odor sensations as: (1) neutral, (2) perceptible, (3) moderate or acceptable, (4) strong, (5) very strong, and (6) over-powering or nauseating. Any classification above (1), will be considered unacceptable for SCUBA use.

(h) **Water vapor: No quantitative test for water vapor is recommended.** Compressed air, at 3,000 psi, saturated with water vapor, contains less than 1 grain of water per pound of bone-dry air. When this air expands to normal atmospheric pressure, or even two or three atmospheres of pressure, the relative humidity is less than one percent.

(Effective April 29, 1974)

Sec. 19-66c-2. Availability of information

It shall be the responsibility of each vendor of compressed air for SCUBA use to obtain annually such analyses and have this information on file at his place of business, available for inspection by a representative of the State Department of Health.

(Effective April 29, 1974)

Sec. 19-66c-3. Inspection and sampling

The work area and compressor shall be opened for inspection and collection of samples by a representative of the State Department of Health, if needed, during usual working hours of the vendor.

(Effective April 29, 1974)