

Breathing-Air Quality in an Abrasive Blasting Context

By Thomas Enger, MS, CSP, Chmm

Product Safety Engineer, Clemco Industries Corp.

Info for the Safety Professional:-

The Occupational Safety and Health Administration (OSHA) sets the requirements for Supplied-Air Respirator breathing air in 29CFR, Section 1910.134(i), titled "Breathing Air quality and Use." This explanation deals only with Compressed-Air Quality. OSHA Requirements are:

1910.134(i) *Breathing air quality and use.* This paragraph requires the employer to provide employees using atmosphere-supplying respirators (supplied-air and SCBA) with breathing gases of high purity.

1910.134(i)(1) The employer shall ensure that compressed air, compressed oxygen, liquid air, and liquid oxygen used for respiration accords with the following specifications:

1910.134(i)(1)(i) Compressed and liquid oxygen shall meet the United States Pharmacopoeia requirements for medical or breathing oxygen; and

1910.134(i)(1)(ii) Compressed breathing air shall meet at least the requirements for Grade D breathing air described in ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989, to include:

1910.134(i)(1)(ii)(A) Oxygen content (v/v) of 19.5-23.5%;

1910.134(i)(1)(ii)(B) Hydrocarbon (condensed) content of 5 milligrams per cubic meter of air or less;

1910.134(i)(1)(ii)(C) Carbon monoxide (CO) content of 10 ppm or less;

1910.134(i)(1)(ii)(D) Carbon dioxide content of 1,000 ppm or less; and

1910.134(i)(1)(ii)(E) Lack of noticeable odor.

1910.134(i)(2) The employer shall ensure that compressed oxygen is not used in atmosphere-supplying respirators that have previously used compressed air.

1910.134(i)(3) The employer shall ensure that oxygen concentrations greater than 23.5% are used only in equipment designed for oxygen service or distribution.

1910.134(i)(4) The employer shall ensure that cylinders used to supply breathing air to respirators meet the following requirements:

1910.134(i)(4)(i) Cylinders are tested and maintained as prescribed in the Shipping Container Specification Regulations of the Department of Transportation (49 CFR part 180);

1910.134(i)(4)(ii) Cylinders of purchased breathing air have a certificate of analysis from the supplier that the breathing air meets the requirements for Grade D breathing air; and

1910.134(i)(4)(iii) The moisture content in the cylinder does not exceed a dew point of – 50 deg.F (-45.6 deg.C) at 1 atmosphere pressure.

1910.134(i)(5)

The employer shall ensure that compressors used to supply breathing air to respirators are constructed and situated so as to:

1910.134(i)(5)(i) Prevent entry of contaminated air into the air-supply system;

1910.134(i)(5)(ii) Minimize moisture content so that the dew point at 1 atmosphere pressure is 10 degrees F (5.56 deg.C) below the ambient temperature;

1910.134(i)(5)(iii) Have suitable in-line air-purifying sorbent beds and filters to further ensure breathing air quality. Sorbent beds and filters shall be maintained and replaced or refurbished periodically following the manufacturer's instructions.

1910.134(i)(5)(iv) Have a tag containing the most recent change date and the signature of the person authorized by the employer to perform the change. The tag shall be maintained at the compressor.

1910.134(i)(6) For compressors that are not oil-lubricated, the employer shall ensure that carbon monoxide levels in the breathing air do not exceed 10 ppm.

[1910.134\(i\)\(7\)](#) For oil-lubricated compressors, the employer shall use a high-temperature or carbon monoxide alarm, or both, to monitor carbon monoxide levels. If only high-temperature alarms are used, the air supply shall be monitored at intervals sufficient to prevent carbon monoxide in the breathing air from exceeding 10 ppm.

[1910.134\(i\)\(8\)](#) The employer shall ensure that breathing air couplings are incompatible with outlets for non-respirable worksite air or other gas systems. No asphyxiating substance shall be introduced into breathing air lines.

[1910.134\(i\)\(9\)](#) The employer shall use only the respirator manufacturer's NIOSH-approved breathing-gas containers, marked and maintained in accordance with the Quality Assurance provisions of the NIOSH approval for the SCBA as issued in accordance with the NIOSH respirator-certification standard at 42 CFR part 84.

The OSHA regulations quoted above mandate that breathing air meets The “Compressed Gas Association Standard,” CGA G7.1 – 1989 (Note: CGA G7.1 standards updated after 1989 will also comply with OSHA regulations) for Grade-D breathing air. In addition to the CGA standard, OSHA states that the air must have “no noticeable odor.” The odor requirement differs from the CGA standard, which has the subjective requirement of “slight odor.” In summary, table one (1) below summarizes the OSHA and the Compressed Gas Association requirement for acceptable breathing air:

Table 1: Breathing-Air Requirements		
Characteristics	OSHA Requirements	CGA Requirements
Percent Oxygen	19.5% - 23.5%	19.5% - 23.5%
Water, ppm (v/v) Dew Point	Not to exceed a dew point of – 50 deg.F (-45.6 deg.C) at 1 atm. (I.E. No dry air which may cause nose bleed)	None
Oil (mg/m³)	5	5
Carbon Monoxide (ppm)	10	10
Carbon Dioxide (ppm)	1000	1000
Odor	No Noticeable Odor	Slight Odor

There is no OSHA regulation requiring a separate breathing-air source. It is common for employers to use a single compressor for both abrasive blasting and breathing air for the supplied-air respirator. There are both high- and low-pressure compressors, which are rated and marked for breathing air. However, there are hazards associated with both low- and high-pressure systems.

OSHA Technical Manual (OTM), Section VIII: Chapter 2 addresses these hazards in the instructions they give their inspectors:

A. Other Specific Requirements

1. Where compressors are used for supplying air, the compressor must be constructed and situated so contaminated air cannot enter the air-supply system. The location of the air intake is very important, and must be in an uncontaminated area where exhaust gases from nearby vehicles, the internal combustion engine that is powering the compressor itself (if applicable), or other exhaust gases being ventilated from the plant will not be picked up by the compressor air intake.

2. In addition, compressors must be equipped with suitable in-line, air-purifying sorbent beds and filters to further ensure breathing air quality, and to minimize moisture content so that the dew point at 1 atmosphere pressure is 10°F (5.56°C) below the ambient temperature. Sorbent beds and filters must be maintained and replaced or refurbished periodically according to the manufacturer's recommendations, and a tag must be kept at the compressor indicating the most recent change date and the signature of the person authorized by the employer to perform the change.
3. For **compressors that are not oil-lubricated**, the employer must ensure that carbon monoxide levels do not exceed 10 ppm. This requirement can be met by several different methods, including the use of continuous carbon monoxide alarms, carbon monoxide sorbent materials, proper air intake location in an area free of contaminants, frequent monitoring of air quality, or the use of high-temperature alarms and automatic shutoff devices, as appropriate. Employers have flexibility in selecting the method(s) most appropriate for conditions in their workplace. Since no single method will be appropriate in all situations, several methods may be needed. For example, it may be necessary to combine the use of a carbon monoxide alarm with a carbon monoxide sorbent bed where conditions are such that a reliable carbon monoxide-free area for air intake cannot be found.
4. **Oil-lubricated compressors** can produce carbon monoxide if the oil enters the combustion chamber and is ignited. This problem can be particularly severe in older compressors with worn piston rings and cylinders. Consequently, if an oil-lubricated compressor is used, it must have a high-temperature or carbon monoxide alarm, or both, to monitor carbon monoxide levels. If only a high-temperature alarm is used, the air from the compressor must be tested for carbon monoxide at intervals sufficient to prevent carbon monoxide in the breathing air from exceeding 10 ppm.
5. Breathing air couplings must be incompatible with outlets for non-respirable plant air or other gas systems to prevent accidental servicing of air line respirators with non-respirable gases or oxygen. Also, no asphyxiating substance must be allowed in the breathing air lines.

OSHA Instructions to their inspectors can be found in OSHA Instruction #CPL 2-0.120, titled "Inspection Procedures for the Respiratory Protection Standard." Section VII, paragraphs "J" and "K" directs the inspectors on inspection of Breathing-Air Quality and Sorbent Bed Filters, as follows:

- J. **Breathing Air Quality and Use 1910.134 (i)**: Compressed breathing air must meet at least the requirements for Grade D breathing air. The ANSI/CGA G.7-1 - 1989 specifies the contents of Grade D breathing air as: oxygen (volume/volume) of 19.5 to 23.5 %; hydrocarbon (condensed) of 5 mg/m³ of air or less; carbon monoxide of 10 ppm or less; carbon dioxide of 1,000 ppm or less; and the lack of a noticeable odor.
 1. Inspection Guidelines. If compressors are used to supply breathing air, the CSHO should note the location of the compressor intake and ensure it is located in an area uncontaminated by either combustion exhaust gases produced by vehicles or the compressor itself (if applicable), or by other exhaust gases ventilated from plant processes. A tag containing the signature of the person authorized by the employer to change the in-line sorbent beds and filters and the date of the latest change must be maintained at the compressor.

For air compressors that are **not** oil lubricated, a CO alarm is not required. However, the employer is required to ensure that carbon monoxide levels in the breathing air do not exceed 10 ppm. Some practical methods for ensuring that the carbon monoxide level does not exceed 10 ppm include; placing the air intake for the compressor in an area that the employer knows is free from contaminants; frequent or continuous monitoring of the breathing air supply; the use of carbon monoxide filters; or the use of a high temperature alarm or shut off devices.

If the employer is using an oil-lubricated air compressor, it must have either a carbon monoxide alarm, high temperature alarm, or both. If only a high temperature alarm is used, then the breathing air must be tested for the presence of carbon monoxide at intervals sufficient to ensure that carbon monoxide levels do not exceed 10 ppm. The alarm must be able to alert the users or another employee who knows to alert any respirator users.

If cylinders are used they must be marked with a NIOSH approval label. Cylinders of purchased breathing air must have a certificate of analysis from the supplier that the breathing air meets the required Grade D air and moisture content.

If compressed or liquid oxygen is used, it must meet the specifications for breathing oxygen outlined by the United States Pharmacopoeia (USP). Compressed oxygen must not be used for any respirators that previously used compressed air.

All breathing air couplings must be incompatible with those of non-respirable air or other gases used at the site to prevent inadvertent servicing of air line respirators with non-respirable gases or oxygen.

- K. **Identification of Filters, Cartridges, and Canisters 1910.134 (j)**: The employer must ensure that all canisters and filters are properly labeled and color coded with the NIOSH approval label and that the label is not removed, obscured, or defaced while in service. This requirement enables the employee using the respirator to check and confirm that the respirator has the appropriate filters before the respirator is used and also allows fellow employees, supervisors, and the respirator program administrator to readily determine that the employee is using the appropriate filters.
1. Inspection Guidelines. The CSHO should verify that properly labeled filters and canisters are being used, and that the labels remain legible.
 2. Citation Guidelines. Date and time labels applied to the filters/cartridges should not be considered violations, but the employer must obscure as little as possible of the label to allow ready identification.

Based on my experience, the OSHA inspector will also ask how you know the employer has Grade-D breathing air. While it is not an OSHA requirement, in my opinion, it is best for the employer to verify that they have Grade-D breathing air by testing it; reference: a testing organization such as www.airtesting.com.

When it comes to breathing air quality, my suggestion to any employer using an oil-lubricated or non-oil-lubricated compressor is the following:

1. Ensure your compressor is properly maintained.
2. Locate the compressor intake away from any toxic source, such as factory or vehicle exhaust.
3. Ensure the compressor is capable of providing adequate airflow and pressure for its intended purpose.
4. Ensure your plant air lines are made of stainless steel, ABS plastic, carbon steel, black iron, or copper, and your flexible air lines are pressure-rated and manufactured for the purpose of carrying breathing air.
5. Perform an annual Breathing Air Quality Test using a testing company such as www.airtesting.com.
6. Have an in-line or personal Carbon Monoxide Monitor.
7. Provide an in-line sorbent bed filter to remove objectionable oil, odors and mists; and inspect this filter on a monthly basis

8. Have an active and compliant Respiratory Protection Program as outlined in 29CFR, Section 1910.134. This regulation may be found at:
https://www.osha.gov/pls/oshaweb/owalink.query_links?src_doc_type=STANDARDS&src_unique_file=1910_0134&src_anchor_name=1910.134

Contact info:

Thomas E. Enger, MS, CSP, Chmm

Product Safety Engineer

636.239.8163

tenger@clemcoindustries.com

Clemco Industries, Corp.