

Hazard Awareness:
Using Compressed Air and Compressed Oxygen
To Provide Breathable Air Underground

There are hazards inherent in using compressed air systems (positive pressure blowing systems or compressed air cylinders) and oxygen cylinder systems to provide breathable air in underground mining environments. This document discusses each of these systems and associated hazard awareness considerations.

I. Compressed air systems may consist of either of the following:

- A. Positive pressure compressed air being induced into the isolation area via a compressor outside the mine
- B. Compressed air cylinders stored in designated areas

II. Oxygen cylinder systems consist of compressed oxygen cylinders stored in designated areas

Each of these systems require training on handling, usage, and storage. Proper inspection and maintenance are critical in ensuring the viability of these systems.

I. Compressed Air Systems

A. Outside Positive Pressure Compressed Air

Storage, Handling and Use

Mines should ensure compressors have the capacity to deliver the required volume of air at the point(s) of expected usage. Additional considerations should also include the type of respirator / mask used and the number of miners expected to use them.

Air lines, taps, valves, and breathing devices should be buried and/or protected from fire and explosion forces.

Compressor air intakes should be installed to ensure that only clean, uncontaminated air enters the compressors. Care should be exercised when using compressors in the vicinity of other equipment having gas or diesel engines. Gas engines emit carbon monoxide (toxic fumes) and diesel engines emit sulfur dioxide (noxious fumes) and nitrogen oxides. Compressors requiring oil can generate carbon monoxide (CO) internally which can be supplied inadvertently to miners. Oil-type compressors could be used; however, the air quality must be sampled and/or controlled using CO filtration. Oil-less compressors do not generate carbon monoxide; thus, no CO filtering is required.

Listed below are the recommended standards for breathable air as identified by American National Standards Institute /Compressed Gas Association Commodity Specifications for Grade D breathable compressed air as defined below:

- Oxygen 19.5% - 23.5%
- Carbon Monoxide maximum 10 parts per million (ppm)
- Oil / Hydrocarbon maximum 5 milligrams per cubic meter (mg/m³)
- Carbon Dioxide maximum 1,000 parts per million (ppm)
- Lack of noticeable odor

A redundant compressor and power source should be installed to ensure continuous operation.

Piping, couplings, and regulators should be installed in a manner that prevents contamination into the system.

Mines should provide means of removing and preventing water buildup in the air supply line.

Piping should be of a quality to allow for a long-life system to remain free of corrosion, rust and other contaminants.

Designs using a respirator/breathing apparatus should employ only NIOSH-approved units with means of flow and pressure regulation.

Respirators/breathing apparatus should be able to connect only to the breathable compressed air line. Tool compressed airlines are not recommended for providing breathable air and should not have means of allowing respirators / masks to connect to them.

B. Compressed Air Cylinders

Storage, Handling, and Use

Use a suitable hand truck for moving cylinders. Do not drag, roll, or slide cylinders.

Valve protection caps should remain in place unless container is secured with valve outlet piped to use point.

Cylinders should be stored upright and firmly secured to prevent falling or being knocked over.

Do not store cylinders in areas where temperatures exceed 125°F (52°C).

Designs using a respirator/breathing apparatus should employ only NIOSH-approved units with means of flow and pressure regulation.

Never ground a compressed air cylinder or allow it to become part of an electrical circuit.

II. Compressed Oxygen Cylinders

Storage and Handling

The cleanliness of oxygen systems is critical for their safe operation. Small combustible particles and oils could provide a fuel source for a fire and explosion if they enter a compressed oxygen system.

Always wear gloves when working on oxygen hardware. Gloves keep the oil from human hands away from the parts.

Ensure that oxygen filling stations and maintenance areas are in a locked, air-conditioned room that is clean and free of dirt, oils, and grease and that signs are posted stating "OXYGEN, NO SMOKING, NO OPEN FLAMES." Filling operations should never be conducted alone. A second person and a portable fire extinguisher should be present during the filling process.

Fire extinguisher equipment should be readily available near oxygen bottles due to the highly flammable characteristics of oxygen.

All components and materials used in the system should be suitable for oxygen service. Aluminum components should be avoided. Replace any oxygen regulators containing aluminum exposed to high-pressure oxygen with regulators made of brass.

Check for loose connections, leaking gas sounds, damage to hoses along their lengths or at their fittings, and broken gauges. Also ensure that tanks are secured and pressure regulators are properly set. Ensure wrenches and pliers are in proper working order.

Do not rely on the color of the cylinder to indicate the contents. Some manufacturers use different color cylinders for the same gas.

Use a suitable hand truck for moving cylinders. Do not drag, roll, or slide cylinders.

Valve protection caps should remain in place unless container is secured with valve outlet piped to use point.

Cylinders should be stored upright when possible and firmly secured to prevent falling or being knocked over.

Do not store cylinders in areas where temperatures exceed 125°F (52°C).

Store cylinders at least 20 feet away from flammable materials.

Never ground a compressed oxygen cylinder or allow it to become part of an electrical circuit.

Use

Compressed oxygen components must not be used with previously used compressed air system components due to the fire and explosion hazards resulting from pure oxygen coming into contact with oil and grease that is inherent with compressed air systems.

All oxygen valves should be opened slowly to prevent the oxygen from heating. Valves should be positioned away from the operator. This will (1) prevent flames from blowing on the miner in the event of an ignition and prevent oxygen saturation of clothing and (2) prevent spontaneous combustion from occurring if clothing is covered in grease and oil.

Due to the risk of spontaneous combustion, oxygen should not be used for cleaning or blowing out dirt and dust particles.

Regulating the release of oxygen and monitoring the safe haven environment to ambient oxygen content (19.5% - 23.5%) is essential. Breathing air that contains more than 80% oxygen at one atmosphere of pressure (sea level) for more than a few hours may cause nasal stuffiness, cough, sore throat, chest pain and breathing difficulty.

Designs using a respirator/breathing apparatus should employ only NIOSH-approved units with means of flow and pressure regulation.

Check valves should be used on oxygen cylinders to prevent cylinder contamination and flashbacks from going back into the tank and causing an explosion.