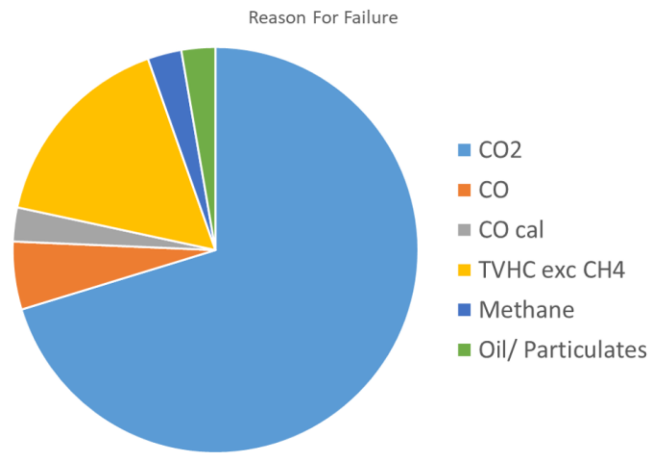
Why Compressed Breathing Air Systems Fail

A compressed breathing air test is conducted by collecting a sample of air from the hose where the worker attaches their respirator/hood. The CSA standard specifies the acceptable concentration of a number of chemicals that may be present in the sample. Below is some information regarding the most common problems that occur with compressed breathing air systems and why units fail.



A review of testing of compressed air results shows that 32% of units fail. By far the most common reason for a unit to fail is carbon dioxide. The CSA Standard sets a limit of only 600 ppm. Other standards for compressed air (OSHA, SCUBA, diving grade air) allow up to 1,000 ppm.

Particulate: Particulate levels above 1 mg/m^3 constitutes a failure.

a) The most common particulate is rust. This is generally caused by operating the compressor for extended periods of time with high moisture content. This condition can be avoided by replacing the filters according to the manufacturer's directions. Analysis of an air sample can determine if there is rust in your particulate sample. This can be corrected by giving your compressor and lines a good cleaning.
b) Other types of particulate include particles from the filter media itself. This is likely caused by large changes in pressure on the filter causing a breakdown of the filter media. Follow the manufacturer's recommended procedure for a filter change. If a filter starts to show signs of damage or degradation, it is time to change the filter.
c) Oil mist is also considered a particulate. This can occur when a compressor operates at high temperatures. Compressors should be located in a clean room large enough for air movement around the unit so as to prevent overheating and dieseling of the compressor oil. In rooms of inadequate size, mechanical ventilation must be installed. Compressors rooms that are warm when you enter them are a possible indication of a future problem. In reciprocating compressors, lubricating oil applied to cylinders causes small droplets by the shearing action of the piston to enter the air system as a mist. Oil

mist can cause breathing discomfort, nausea and pneumonia, and create unpleasant taste and odors. Centrifugal compressors are oil free.
d) Some materials may be introduced by the compressor itself. In non-lubricated compressors, teflon, carbon and other materials are used as lubricants. Frictional wear can cause particles from these materials to enter the air stream.

Carbon Monoxide: Levels above 5 ppm constitute a failure

a) The source of air for the compressor intake must be far away from any combustion exhaust. This is particularly important when a portable air compressor is used with a gasoline or diesel generator. The Z180.1 Standard requires that a mobile compressor driven by an internal combustion engine be equipped with a CO monitor. When using a portable compressor with a generator, make sure that the exhaust is travelling away from the air intake of the compressor. Avoid a day when there is a thermal inversion.
b) If the compressor is operated outside its normal temperature range it may produce CO due to the combustion of the compressor oil. Many filters contain a catalyst, Hopcalite, which converts toxic CO to less dangerous CO2. Compressors should be located in a clean room large enough for air movement around the unit so as to prevent overheating and dieseling of the compressor oil. In rooms of inadequate size mechanical ventilation must be installed.

Carbon Dioxide; Levels above 600 ppm constitute a failure

Breathing air samples containing more than 600 ppm carbon dioxide (CO2) do not meet the CSA Standard. Outside air normally contains 350-380 ppm CO2. Because CO2 is a product of respiration, it is not considered a toxic substance. In some cases, such as thermal inversions, outdoor levels can approach or even exceed this level. Also building exhaust can swirl around a building and be captured by the air intake of the compressor. An ambient (outdoor) sample can also be collected to screen for this and prevent false negatives.

a) The air intake for a Breathing Air Compressor should be outside the building. The point of collection should be 10 feet off the ground and 50 feet (as a minimum) from possible contaminants such as car exhaust or air exhausted from the building. High levels of CO2 are common inside buildings due to work processes and human respiration.
b) Both CO and CO2 can be produced if a compressor is operating outside its specified temperature range.

Note: The CSA standard used to specify a level of 500 ppm but the allowable level was raised to 600 ppm in 2013.

VOC levels above 5 ppm

VOC or TVHC levels can be elevated from one of the following reasons:

Reintrainment: The exhausted air is being captured by the fresh air intake. This is indicated by the makeup of the hydrocarbons matches the paint or other product being used.

Leakage in suction side of system: There may be a crack or hole in the suction side of the line inside the building. This would cause it to suck in indoor contaminants.

The compressor is overheating: When a compressor overheats, it gives off hydrocarbons. The temperature of the compressor should be checked.

Hose contamination: In some cases, the hose has been cleaned with solvents to remove accumulated paint. The solvents have soaked into the hose and are offgassing into the airstream through the hose. The makeup of the hydrocarbons would be cleaning solvents such as methylene chloride, acetone and toluene.

Methane: Levels above 10 ppm constitute a failure

The acceptable limit for Methane is 10 ppm. Methane is the major component in natural gas and is present in outside air at 1-2 ppm. Methane is a simple asphyxiant. High levels can cause Central Nervous System impairment and loss of consciousness. If this component is present in high levels, there is likely an outside source causing the failure, such as a sewer gas problem, nearby landfill or a natural gas leak.

Insufficient Air Flow

The CSA standard specifies a minimum flowrate for different types of respirators. This requirement is to ensure that there is sufficient airflow to protect the worker from contaminants entering the hood or facepiece. For example, a loose-fitting hood relies on a sufficient air flow to provide a strong continuous airstream flowing down out of the hood so that airborne contaminants cannot be drawn up into the hood and into the workers breathing zone. The flowrate should be tested at the time of collecting an air sample.

Required Flowrates as Specified by CSA Standard

Type of Facepiece	Required Airflow
Loose fitting hood	170 lpm
Tight Fitting Facepiece	114 lpm

Lpm = litres per minute

Number of Workers Who can Use an Ambient Air Pump

HP Rating	# of loose hoods	# of Tight Facepieces
3/4	1	2
1.5	2	3
2	2	4

* Example: ¾ HP compressor can provide air to 1 loose hood OR 2 tight facepieces