

HIGH VOLUME GASEOUS OXYGEN FROM LIQUID CONTAINERS

Liquid Oxygen is used daily to supply gaseous oxygen for a wide variety of construction and demolition projects. It's convenient size is advantageous when you consider that a single XL-45 liquid container will produce 4350 cubic feet of gaseous oxygen. This is equivalent to sixteen 276 cubic foot, high pressure cylinders.

With convenience there is always a drawback. In the case of liquid oxygen the down side is available pressure and volume. For potential users who do not know and understand the pressure versus volume issue, using liquid oxygen may cause performance problems with some equipment.

The volume of gaseous oxygen that a portable liquid container can supply is limited by the vaporization rate of the internal vaporizer. Typical stand-alone portable containers built prior to 1995 will supply a continuous flow of 250 cubic feet per hour (CFH) at 125 PSI, at an ambient temperature of 70° F. Newer models have been designed to supply up to 350 CFH at 250 PSI. Some models have been increased to 450 psi and up to 500 CFH, High-pressure cylinders, can supply 50 or more cubic feet per minute depending on the regulator and hose diameter. Manifold-ed together a bank of high-pressure cylinders with a typical high flow regulator can supply 8000 CFH (133 CFM) or more.

To better understand the use of liquid oxygen one needs to know how the system works and what affects it. In physics there is a group of laws called the Gas Laws. "Charles Law" states that; "At a constant pressure the volume of a gas is directly proportional to the change in the absolute temperature. If the pressure is kept constant and the absolute temperature is doubled, the volume will double. As temperature decreases, so does the volume".

A liquid oxygen container is a vacuum-insulated gas cylinder, basically a giant thermos bottle. It is designed to supply oxygen in either a liquid state or gas in the form of oxygen vapor. The boiling point of liquid oxygen is minus 297° F (297° below 0). When it reaches its boiling point, liquid oxygen becomes oxygen vapor. In order to get the optimum volume of vapor from the liquid source the temperature of the oxygen vapor must be elevated to ambient temperature. Portable containers incorporate an internal vaporizer (heat exchanger) to elevate the gas temperature.

When flow rate of gaseous oxygen exceeds the capacity of the internal vaporizer the temperature in the vaporizer will drop to the point that the external plumbing and the attached regulator will become crusted with ice. When this occurs, the density and temperature of the gas drops to the point that it becomes a safety hazard and can cause damage to regulators, hoses and other downstream components.

There are several methods that can be employed to increase the volumetric flow of gaseous oxygen. The first method is to manifold multiple liquid containers together. By manifold two or more containers together and making their internal evaporators common you can effectively increase the output by up to 90%. Therefore two 250 CFH containers will provide 450 CFH. You can manifold as many tanks together as are required for the application.

The second method is to add an external vaporizer (heat exchanger) to the liquid container. External vaporizers come in a variety of sizes from 250 CFH to over 10,000 CFH. The most common one hangs on the side of the liquid container and is rated at 250 CFH. Adding this vaporizer to a single 250 CFH liquid container will increase the flow rate to 500 CFH (based on ambient air temperature 70° F). Any combination of liquid containers and vaporizers can be assembled to meet the volume requirements.

When hooking multiple containers together you should first manifold all of the USE valves together. Second with a separate manifold, manifold the VENT valves together. This manifold will cause the liquid tanks to equalize so when gas is withdrawn from the system it draws equally from all of the tanks. When using multiple containers with or without an external vaporizer, the following valve settings are required for maximum vaporization: Liquid valve **CLOSED**, Vent valves **FULL OPEN**, Use valves **FULL OPEN**, and the Pressure Building valves **FULL OPEN**. When using the external heat exchanger, you connect the use valve or use valve manifold, to the input side of the vaporizer and the regulator on the output side. You **DO NOT** put the regulator between the liquid container and the external vaporizer.

For applications such as Oxylances (burning bars) where the volume requirements can be in excess of 40 cubic feet per minute (2400 CFH) it is imperative that the supply is capable of meeting the flow requirements both in pressure and volume. Also when using multiple oxylances it is recommended that the oxygen supply be plumbed into a manifold that has a station regulator for each oxylance holder. This way the supply to each holder is regulated independently and operators will not be affected as lances are turned on or off.

As a rule of thumb if using multiple oxylances, for each oxylance hooked to the oxygen supply, the supply volume should be increased by 10%. If using lances that require 40 cubic feet per minute and two systems are on line, available volume should be 40 CFM plus 40 CFM plus 8 CFM for a total of 88 CFM or 5280 cubic feet per hour.

It is also imperative to the use of Liquid Oxygen that you use the proper regulator. Standard Oxygen regulators are designed for use with high pressure cylinders. You must use a regulator that is designed for use with Liquid Oxygen. These line type regulators are designed for low pressure in and low pressure high volume out put.

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