Oxygen Safety for Haskel Booster Users

Oxygen Usage - Best Practices Guide

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Oxygen Usage – Best Practice Guide

1. Introduction

Oxygen enriched systems possess a risk of fire and explosion since ignition and combustion hazards are present in all oxygen systems, and oxygen related fire incidents have occurred in many industries. Because ignition and combustion hazards are inherently present in most oxygen systems, a proper guidance for using Haskel oxygen service products is crucial to avoiding accidents and ensuring the safety of personnel and equipment.

2. Oxygen Hazards and Risks

Oxygen is a serious fire hazard. It makes materials easier to ignite and their subsequent combustion more intense, more complete, and more explosive than in air alone.

2.1. Causes of Fires in Oxygen

Many common ignition mechanisms and causes of oxygen system fires are recognized and well understood.

2.1.1. *Kindling Chain*

Ignition usually begins as a small event and grows into a fire through the kindling chain sequence. Once ignited, the material gives off enough heat to ignite bulk materials with higher ignition temperatures, which generate more heat, until the process is self-sustaining.

2.1.2. *Ignition Mechanisms*

Oxygen fires require a source of energy to trigger ignition. The most common ignition energy sources are:

2.1.3. *Mechanical Impact*

When one object impacts another, the absorbed energy appears as heat that can be sufficient to ignite materials at the point of impact.

2.1.4. *Particle Impact*

Small particles carried by flowing gas in the oxygen system strike surfaces of the system, such as piping intersections or valve seats. The kinetic energy of the particle creates heat at the point of impact, which can ignite either the particle or the target material.

2.1.5. *Friction*

The rubbing of two solid materials results in the generation of heat.

2.2. *Pneumatic Impact or Compression Heating*

When oxygen flows from high to low pressure through an orifice, such as when a valve is opened quickly, it often reaches sonic velocity and compresses the oxygen downstream against an obstruction, such as the seat of the next closed valve or regulator (Fig. 1). The gas temperature can reach the autoignition point of plastics, organic contaminants, or small metal particles.

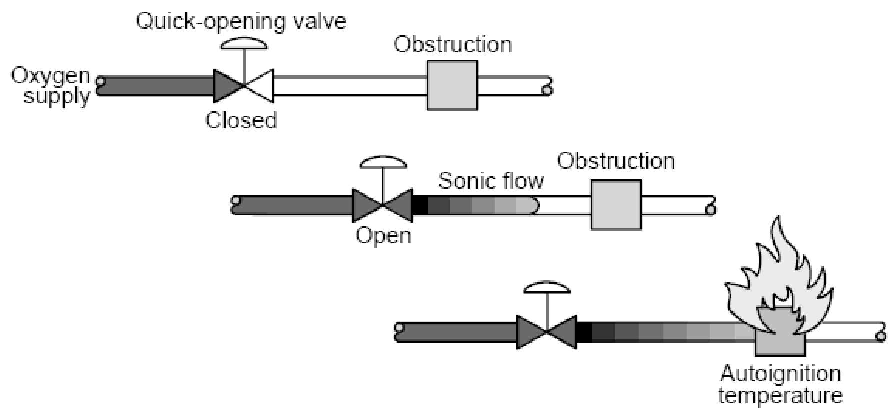


Figure 1

CAUTION: **DO NOT USE ¼" quarter turn ball valves on oxygen systems. Use needle valves only (Fig.1).**

3. Special Precautions and Operating Parameters

3.1. Do not exceed 5000 psig pressure output.

3.2. Do not use an oxygen booster for any other gas --even occasionally. Although other gases may be perfectly pure, we do not recommend this practice.

3.3. Service of the oxygen containing sections of the booster (or accessories) involves a more stringent procedure to insure cleanliness. It is strongly recommended that oxygen boosters to be returned to Haskel, Burbank for maintenance service. Factory training is available. Contact Haskel service department for details.

3.4. Maximum Compression Ratios (maximum output pressure psia, divided by minimum inlet pressure psia). The maximums shown in the following chart must be observed at all times to avoid excessive heat:

	Maximum Compression Ratios	
	O_2 Inlet < 150 psig	O_2 Inlet 150 psig or Higher
Single Stage	5 : 1	6 : 1
Two Stage	25 : 1	36 : 1
Three Stage	45 : 1	
For heavy duty, continuously operating applications, we recommend that the above compression ratios be reduced even further, where feasible, with additional staging and/or plenum coolers (now a standard optional Haskel accessory).		

3.5. Design booster circuit cycling rate no greater than 50 Cycle/Minute (CPM).

3.6. Use valves that can be opened gradually to reduce adiabatic compression such as needle valve, **DO NOT use ¼ or 180° ball valves, globe valves or butterfly valves**, which may cause particle impact.

3.7. Isolate oxygen containers from booster system with proper distance (12 ~ 15 feet).

3.8. When connecting pipe to the system, visually inspect cleanliness at open ports. Use clean lint-free cloth, safe zone spray clean and wipe the opening. Use clean Latex gloves when contacting exposed plumbing. Cap or bag all connection ports when not in use.

4. System Set-up:

4.1. Check booster nameplates to confirm that all components, Haskel and other products, are certified for **OXYGEN SERVICE**.

4.2. Before operation, make sure **ALL** tubing, hoses, piping, and connections are capable of the specified maximum pressures indicated on the drawing. Make sure **ALL** connections, pipe work, hoses, and other parts that will come in contact with oxygen, have been thoroughly cleaned for oxygen service. Make sure **ALL** openings at cylinder hose connections and piping are clean and free of dust, oil, and grease, visual inspection or/and wipe test are recommended.

4.3. Make sure that oxygen supply and fill bottles are separated from oxygen booster section with 12 ~ 15 feet safe distance.

4.4. Do not install a valve between the supply cylinders and the booster system, or between outlet of booster and fill cylinders.

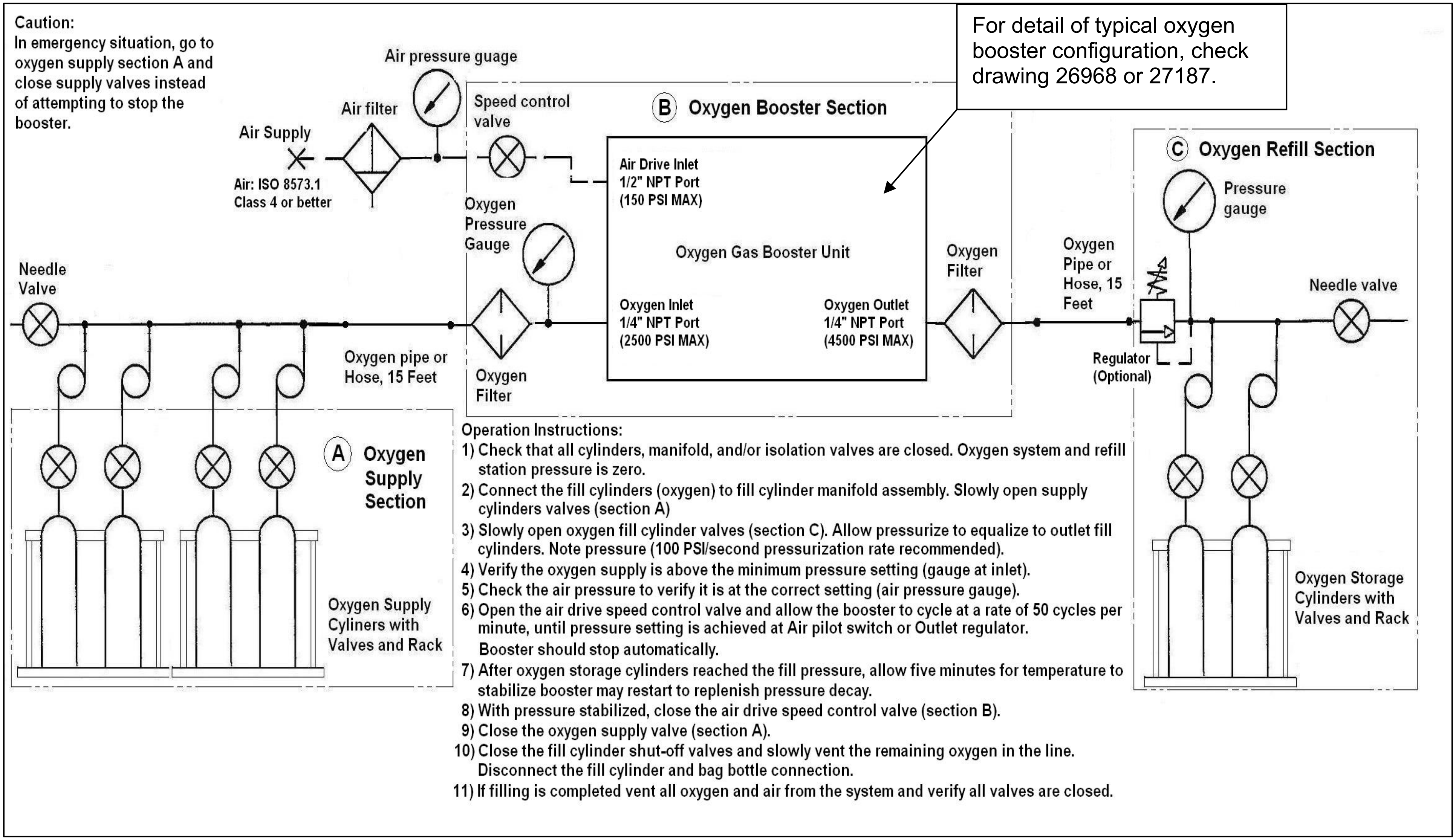
Caution: Do not use ¼ ball valves on Oxygen Section.
Needle valves only.

4.5. Connect air drive supply to the air inlet filter.

4.6. Connect oxygen supply to the oxygen inlet filter.

4.7. Connect fill cylinders to be pressurized.

5. Operation Instructions (Refer to Fig. 2 on Page 4)



Operation Instructions:

1) Check that all cylinders, manifold, and/or isolation valves are closed. Oxygen system and refill station pressure is zero.
2) Connect the fill cylinders (oxygen) to fill cylinder manifold assembly. Slowly open supply cylinders valves (section A)
3) Slowly open oxygen fill cylinder valves (section C). Allow pressurize to equalize to outlet fill cylinders. Note pressure (100 PSI/second pressurization rate recommended).
4) Verify the oxygen supply is above the minimum pressure setting (gauge at inlet).
5) Check the air pressure to verify it is at the correct setting (air pressure gauge).
6) Open the air drive speed control valve and allow the booster to cycle at a rate of 50 cycles per minute, until pressure setting is achieved at Air pilot switch or Outlet regulator.
   Booster should stop automatically.
7) After oxygen storage cylinders reached the fill pressure, allow five minutes for temperature to stabilize booster may restart to replenish pressure decay.
8) With pressure stabilized, close the air drive speed control valve (section B).
9) Close the oxygen supply valve (section A).
10) Close the fill cylinder shut-off valves and slowly vent the remaining oxygen in the line. Disconnect the fill cylinder and bag bottle connection.
11) If filling is completed vent all oxygen and air from the system and verify all valves are closed.

Fig. 2
Typical Configuration of
Haskel Oxygen System and Operation Instructions

6. Suggested Maintenance

Performance Interval	Maintenance Action	
Before/After each use.	a.	Perform overall visual check of system.
	b.	Drain and clean the air filter bowl.
	c.	Clean oxygen cylinder connections, cap connections
Every 20,000 cycles. (Or 3-6 months)	a.	Inspect and re-lubricate air cycling valve o-rings in air drive section. (Replace if necessary)
	b.	Check Booster for oxygen leaking from vents, external leakage, and overall performance.
	c.	Check tie rod bolts, relief valve and air pilot switch, hex nuts for loosing. Re-torque if needed.
Every 6 months.	a.	Test and calibrate all pressure gauges.
	b.	Replace oxygen and air filters.
Every 12 Months.	a.	Inspect piping at full system pressure.
	b.	Test relief valve, reset as needed
Every 500 - 1000 hours of continuous use, or every 18 Months.	a.	Reseal booster – gas section, air drive section as needed

Referenced Documents

NFPA 53 Recommended Practice on Materials, Equipment and Systems Used in Oxygen-Enriched Atmospheres

ASTM G128 Standard Guide for Control of Hazards and Risks in Oxygen Enriched Systems

ASTM G88 Standard Guide for Designing Systems for Oxygen Service

ASTM G-4 Standards Technology Training course *Controlling Fire Hazards in Oxygen Handling Systems*

EIGA 8/76/E Prevention of Accidents Arising from Enrichment or Deficiency of Oxygen in the Atmosphere