

## **USE OF VALVES AND REGULATORS WITH OXYGEN GAS**

Aqua Environment valves and regulators are not normally provided oxygen clean and they do not exclusively use oxygen compatible seals and lubricants. Consequently they are not recommended for gases containing over 25 % oxygen unless appropriate cleaning procedures, seals and lubricants are used. Additionally an evaluation must be made by the user to determine if aluminum bodies, used on most Aqua Environment products, are suitable for the particular oxygen service application.

High pressure oxygen has been known to ignite combustibles in piping resulting in burn-through of the piping walls and explosive release of pressure. Typically the combustible is a trace amount of oil, grease or other organic material. Heat to ignite the combustible material can come from heat of compression when pressure rises quickly in the piping. This could result from opening or closing a valve too fast. The resultant heat can then ignite the piping wall and burning continues - supported by oxygen in the pipe.

Aluminum is very active chemically and burns intensely in oxygen under some conditions. Consequently it's use in high pressure oxygen service is generally discouraged by agencies including NASA, ASTM, and CGA. Metals such as monel or brass are preferred as pressure boundary components. Under one test condition NASA reports aluminum does not ignite in oxygen below 1000 PSI<sup>1</sup>. Under other conditions (.12" diameter aluminum wire) ASTM reports aluminum will burn readily in 250 PSI oxygen<sup>2</sup>. Consequently the user must assess the suitability of Aqua Environment components, particularly aluminum, for oxygen service applications.

Oxygen cleaning can be done by companies specializing in this service. Typically cleaning is done with non-combustible cleaners and the parts are then inspected under black light to insure no combustible films remain.

Preferred non-metal materials for oxygen service include 90 durometer Viton and KEL-F. Preferred lubricants include Krytox and Cristo-lub Fluorinated greases. It should be noted that these, non-metal, materials will also burn in high pressure oxygen. So oxygen cleaning and proper system design to avoid ignition temperatures is important regardless of materials used.

Consult Aqua Environment for details regarding materials used in particular valves. The first 7 of the following references are particularly recommended to designers of oxygen systems. The following document service center or agencies can provide these.

Document Center, Belmont CA, 415 591 7600

NASA, National Technical Information Service, Springfield, VA 22161

ASTM (American Society for Testing and Materials), 100 Barr Harbor Dr., West Conshohocken, PA 19428

CGA (Compressed Gas Association Inc.) Arlington, VA 703 412 0900

NFPA (National Fire Protection Association), Boston, MA

### References:

1. NASA reference publication 1113, 1983, "Design Guide for High Pressure Oxygen Systems"
2. ASTM G 94-92, "Standard Guide for Evaluating Metals for Oxygen Service"
3. ASTM G 63-92, "Standard Guide for Evaluating Nonmetallic Materials for Oxygen Service"
4. ASTM G 88-90, "Standard Guide for Designing Systems for Oxygen Service"
5. ASTM G 128-95, "Standard Guide for Control of Hazards and Risks in Oxygen Enriched Systems"
6. CGA G-4.4 - 1993, "Industrial Practices for Gaseous Oxygen Transmission and Distribution Piping Systems"
7. NFPA No. 53M, 1969, "Fire Hazards in Oxygen-Enriched Atmospheres"
8. CGA G-4 - 1996 "Oxygen"
9. CGA G-4.1 - 1996, "Cleaning Equipment for Oxygen Service"
10. ASTM G 93-96, "Standard Practices for Cleaning Methods and Cleanliness Levels for Material and Equipment Used in Oxygen-Enriched Environments"
11. DOD MIL-STD-1330D 1996, "Standard Practices for Precision Cleaning and Testing of Shipboard Oxygen, Helium, Helium-oxygen, Nitrogen, and Hydrogen Systems"