Title: Standard Operating Procedure for Whatman and Air Liquide model hydrogen generators		
Procedure No: SOP-006	Revision No: 1.0 January 24, 2011	Page No.: 1 of 4

1. INTRODUCTION AND SCOPE

The Whatman and Air Liquide model hydrogen generators are engineered systems designed to produce ultra-pure dry hydrogen gas from deionized water and electricity. They separate the molecular water composition using electrolytic dissociation of water and diffusion through a palladium membrane to produce the hydrogen gas. This SOP will explain the principle and details of that operation.

2. PRINCIPLE OF THE METHOD

The electrolytic dissociation of water occurs in the electrolytic cell of the hydrogen generator. The anode (produced from nickel) and the cathode (produced from palladium) form the operational components. The electrolysis reaction of removing oxygen from hydrogen occurs in the cell as electricity is introduced through the deionized water. Oxygen and other impurities collect at the anode and are subjectively vented from the generator. The hydrogen ions are collected at the cathode and pass through the palladium tubes, pulled by the applied electrical potential. Because of the palladium tubes small atomic size, hydrogen and the subsequent isotopes can pass through. The hydrogen then recombines to form molecular hydrogen. Output is supplied on demand and controlled through a pressure controller.

3. MEASUREMENT RANGE AND SENSITIVITY

Both hydrogen generators will output up to 150 cc/min hydrogen at 0 – 60 psi discharge pressure.

4. EQUIPMENT AND APPARATUS

The following model is used in this method.

- Whatman 75-32 and Air Liquide H2 Flow 150 hydrogen generators

5. INTERFERENCES

The deionized water must be supplied on a regular basis and should be of 5 Megohm/cm or better quality deionized water. Water of less quality (i.e. tap water containing metallic ions and suspended solids) may poison the palladium membrane, rendering the cell inoperable.

6. PRECISION AND ACCURACY

The output of the hydrogen gas output by both manufacturers should be in excess of 99.99998% pure hydrogen.

7. SITE REQUIREMENTS

The hydrogen generator should be located on the floor or desktop in the coolest practical location not subject to freezing temperatures. The operating life should be maintained in ambient temperatures between 10 and 40 ^{o}C (50^{o}F to 104^{o}F) and free from excessive ambient dust or dirt.

8. INSTALLATION REQUIREMENTS

NOTE – Read the MSDS for the electrolyte solution for handling and disposal procedures. In the event of a spill or splash, follow the instructions for remedial actions.

For detailed procedures on start up and shut down please refer to technical information bulletin or manual associated with the hydrogen generator.

Startup

The hydrogen stream from the hydrogen generator is branched for carrier and fuel gas applications. If the user requires H2 carrier, uncap the port and attached as required. Any other case the carrier port must be left capped. Attach required tubing with 1/8" ferrule fitting to required ports.

It is recommended to vent the oxygen port to the room. The operator should make efforts to avoid backpressure buildup in the exhaust line. On first use of the generator, pour electrolyte solution into the feed water opening with a funnel. **Use extreme care to avoid spills when pouring electrolyte solution.** Fill the remainder with 3.0 liters of deionized water. The level indicator on the front panel should be approximately 1" above the 'Refill' level. Press the reset button to initiate the process.

As pressure build-up is occurring, set the electronic pressure control set to intended output. After 48-hour warm up is completed, refill water compartment to full levels.

Shut down

For short period shut-downs, leave the power switch on, set the output pressure to 0 psi, and move the hydrogen output switch to the 'closed' position. Shutting the unit down in this manner will minimize water and energy consumption and allow the cell to cool to room temperature. For long term shutdown or shipment, the system must be drained and unplugged following the overnight shutdown procedure.

9. OPERATIONAL REQUIREMENTS

If the water supply in the feed water bottle reaches the indicated **Refill** level, the LED indicted as "Refill Water" will illuminate and an audible signal will sound. The signal will be reset when the water bottle is completely refilled. When refilled, press the red button under the cover to reset.

The electrolyte solution must be changed once each year to maintain efficient operation of the hydrogen generator and remove impurities which may be accumulating over usage and extend the life of the generating cell.

NOTE – Read the MSDS and the manual for the electrolyte solution handling and disposal procedures.

Dispose of the used electrolyte solution properly as dangerous goods.

10. CALIBRATION

Not applicable.

11. APPLICABLE DOCUMENTS

- **EM-006a** "Installation, Operation and Maintenance of Parker Balston 75-32 and 75-34 Hydrogen Generators", Technical Information Bulletin TI-7532/34 R, Parker Hannifin Corporation, 2001.
- **EM-006b** "Installation, Operation, and Maintenance of Parker Balston Model 920071 Sodium Hydroxide", Parker Hannifin Corporation, Oct 1995.
- **EM-006c** "Whatman Quick Start Summary, Models 75-32 and 75-34", Technical Information Bulletin TI7532/34XS L, Whatman Inc., 1998.

12. LITERATURE REFERENCES

1.0 "Installation, Operation and Maintenance of Parker Balston 75-32 and 75-34 Hydrogen Generators", Technical Information Bulletin TI-7532/34 R, Parker Hannifin Corporation, 2001.

2.0 "Installation, Operation, and Maintenance of Parker Balston Model 920071 Sodium Hydroxide", Parker Hannifin Corporation, Oct 1995.

13. REVISION HISTORY

Revision 0 (new document)

Revision 1 Grammatical changes.

14. APPROVAL

Approved by: **Harry Benders** **Date: January 24, 2011**

Title: **Air Monitoring Manager**