

Daya Bay Near Experiment Hall

RPC Gas System

Procedure for replacement of the isobutane cylinder

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1. Purpose

Under normal operation mode a full isobutane cylinder is expected to be depleted every 15 days. By the time the weight of the isobutane cylinder drops below the preset limit (1kg) the cylinder needs to be replaced. Detector control system will monitor the weight of the cylinder, when it hits the low limit, a warning sign will be posted on the DCS screen to remind the shifter it is the time for replacement. This procedure is for the member of the gas team, the steps listed in the procedure must be strictly followed to keep the RPC system running safely and continuously without interruption.

2. Scope

This document covers the routine procedure for replacing the isobutane cylinder in the gas cabinet.

3. Policy

Princeton University has provided the RPC gas system, is responsible for the safely running this system, however the Daya Bay experiment needs a team to operate and maintain the normal operation of this system. The procedure mentioned in this document should be the routine task for this team.

4. References

The RPC gas system user's manual (DocDB #5441 <http://dayabay.ihep.ac.cn/DocDB/0054/005441/001/DayaBayGasSystemUserManual.pdf>) is the most comprehensive resource for those who want to know the details of the RPC gas system. It also includes detailed description of the gas cabinet and gas switchover panel. If there is any question about the gas cabinet and its related devices this manual should be the first place to be consulted.

5. Definitions

6. Precautions and Limitations

The gas cabinet involves four instruments: gas switchover panel, digital scale, HAD sensor and air flow velocity measurement system, some of which directly affect the gas system interlock mechanism. During the cylinder replacement caution must be taken to avoid unexpected system shut down due to the system interlock. General precaution for handling and storage of isobutane cylinder can be found in the endnote¹.

7. Parts and Equipment:

ResTek leak detector, see "Procedure for the RPC gas system routine leak check"; wrenches.

8. Procedure

1. Use the cylinder transport cart to bring a full isobutane cylinder, which is located at the underground gas cylinder storage area that is just outside of the experimental hall, to the gas cabinet room. The underground gas cylinder storage area has very limited stock of Isobutane, SF₆ and R134A, probably only one cylinder for each gas. Be sure to check cylinder's valve for any leak when the valve is fully closed with the ResTek leak detector and secure the cylinder on the cart before transporting;
2. Push the interlock BYPASS button on the Gas Flowmeters crate to temporarily disable the interlock mechanism, buzz should be heard from the Gas Flowmeters crate. At the end of 5 minutes push this button again will restart the timer for 5 minutes. Open the gas cabinet door, check the Digihelic reading on the Gas Status Crate;
3. Read the weight of the backup isobutane cylinder from a mechanical scale underneath the cylinder, make sure this cylinder has enough isobutane in it. If the net weight is less than 1 kg, replace this cylinder right away before replace the primary cylinder, otherwise direct proceed to step #5. Be advised that always check the gas tightness with ResTek for the just replaced cylinder before going to the next step. After place the backup cylinder on the mechanical scale adjust the zero scale knob until showing the net weight of the Isobutane (tare off the empty cylinder weight from the total weight);
4. To replace the backup cylinder follow the steps below: Close the backup cylinder's valve, disconnect the fitting from cylinder, remove the depleted cylinder, replace the full isobutane cylinder on the mechanical scale, tighten the cylinder fitting, open the cylinder's valve, use ResTek to check the gas tightness of the cylinder fitting to make sure there is no any detectable leak at the fitting, slowly open the ventilation valve #6 for 5 seconds to flush the inlet tube, then close the valve #6;

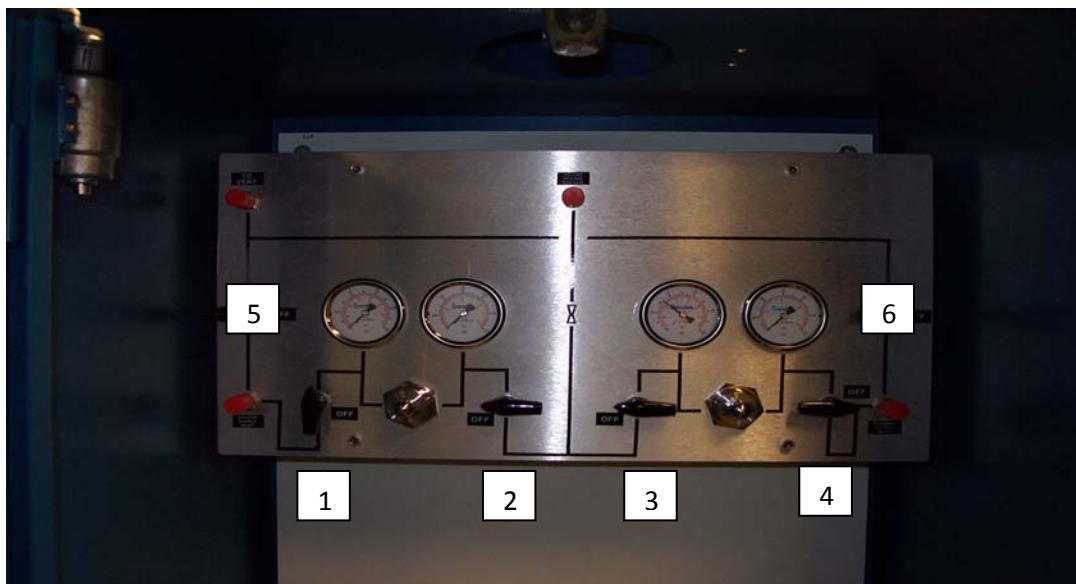


Fig. 1. Isobutane gas switchover panel mounted inside of the gas cabinet.

5. On the gas switchover panel close the valves on the primary supply side (valve#1 and #2) by turning the handle to OFF position; open the valves on the backup supply side (valve#3 and #4) by turning the handle perpendicular to OFF position;
6. Close isobutane cylinder valve, disconnect the fitting from cylinder, remove the depleted cylinder, replace a full isobutane cylinder on the platform of the Force Flow digital scale, tighten the cylinder fitting. Make sure the cylinder is placed on the center of the platform against the position restriction bar;
7. Open the cylinder valve, leak check the cylinder fitting with the ResTek leak detector to make sure it is gas tight;
8. Slowly open the ventilation valve #5 to flush the air contaminated gas pipe due to the replacement of the new cylinder, after 5 seconds, close valve #5;
9. Open valve #1, close valve #4;
10. Close valve #3, open valve #2;
11. Leak check the new cylinder fitting once again;
12. Close the gas cabinet door;
13. Wait until the BYPASS buzz to stop (in ~ 5 minutes), if the buzz is stopped before completing the cylinder replacement, push the BYPASS button again to extend additional 5 minutes;
14. Record the time, date and the digital scale reading on the Status crate for this replacement on the Gas System Record Book;
15. Use the cylinder transport cart to remove the empty gas cylinder from the gas room. Secure the cylinder on the cart, install the valve cap and bring it into the assigned empty cylinder returning area outside of SAB.

ⁱ Handling and storage of isobutane cylinder

Earth bond and ground all lines and equipment associated with the product system. Electrical equipment should be non-sparking and explosion proof.

Use only in well-ventilated areas. Valve protection caps must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure regulator when connecting cylinder to lower pressure (<250 psig) piping or systems. Do not heat cylinder by any means to increase the discharge rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow into the cylinder. Protect cylinders from physical damage. Store in cool, dry, well-ventilated area away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 130°F (54°C).

Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Full and empty cylinders should be segregated. Use a "first in-first out" inventory system to prevent full cylinders from being stored for excessive periods of time.

Post "No Smoking" signs in storage or use areas. For additional recommendations, consult Compressed Gas Association Pamphlet P-1.

Never carry a compressed gas cylinder or a container of a gas in cryogenic liquid form in an enclosed space such as a car trunk, van or station wagon. A leak can result in a fire, explosion, asphyxiation or a toxic exposure.