4 Gas System Operations

The procedures and checklists in this chapter are divided into three categories: operations; maintenance/inspection; and safety/certification.

Both the master copy and a pdf version of each checklist are available from the DCh safety page:

www.slac.stanford.edu/BFROOT/www/Detector/CentralTracker/safety/index.html

4.1 Operations Procedures

In the complete cycle of preparing for a run, taking data, and shutting down following the run, the system can be in four different states. These states, and the transitions that are allowed between them are:

Rest—Air Present in Chamber
(installation or repair)
⇓⇑
Rest—Helium in Chamber
(normal shutdown state)
⇓⇑
Rest—He/Isobutane in Chamber
(alarm mode)
⇓⇑
Running Mode
(data-taking state)

All transitions start and end in “rest mode”, so that the valves are in well-defined settings. Note, however, that rest mode in itself does not correspond to any particular gas composition in the chamber.

The “Initial Checkout” procedure is used to place the system in a well-defined state following any extended shutdown or work on the gas system.

The complete list of all operations procedures is:

State Transitions Checklists

- Initial Checkout (set system to Rest Mode)
- Rest (O_2 Present) to Rest (Helium)
- Rest (Helium) to Rest (He:Iso)
- Rest (He:Iso) to Running Mode
- Running Mode to Rest (He:Iso)
- Rest (He:Iso) to Rest (Helium)
- Rest (Helium) to Rest (air) (includes filling chamber with air for repairs).

4.2 Maintenance and Inspection

Most of the routine monitoring of the performance of the gas system is handled via EPICs and the alarm handler, which warns shift takers that parameters have deviated from their nominal values. A table of safety sensors and allowable ranges is contained in chapter 5, "Gas System Alarms and Alarm Handler". Table 1 below lists the normal settings of adjustable equipment on the gas system.

Cryogenics technicians perform an inspection twice a day using the checklist included below. (The original is retained by the cryogenics group). The inspection concentrates on quantities not monitored by EPICs, such as the amount of gas remaining in bottles. The cryogenics group orders new bottles of non-flammable gases, while the drift chamber group orders and tests the isobutane.

There are several components of the gas system that require routine inspection or maintenance. The hazardous atmosphere detectors are inspected every three months; the calibration of the precision gas analyzers needs to be tested every two weeks; and there are two molecular sieves on the oxygen removal equipment, which are swapped and regenerated every three months. The schedules for these activities are posted in the gas hut and are checked by the cryogenics technicians as part of the shift checklist.

The testing of new isobutane bottles requires the use of the gain chamber and is undertaken when it is possible to do so without disrupting normal running.

The complete list of maintenance or inspection procedures is:

- Daily Checklist
- Inspection and Calibration of DCh HAD Sensors
- Calibration of the Gas Analyzers
- Regenerating a Molecular Sieve on the O_2 Removal System
- Testing a New Bottle of Isobutane

4.3 Safety Procedures

Once the gas system is in running mode, the only action that the shift takers need to take is to respond to an alarm. Copies of "What to do in case of a gas alarm" and "What to do in case of a chiller alarm"—documents intended for the non-expert user—are attached. The originals are tex files stored in CVS. The procedure to restore the system to running mode, which is also attached, is generally followed by an expert. Copies are placed near the console in the gas hut and completed checklists are stored in a binder to retain a record of alarms.

Other safety procedures are discussed in the relevant chapter and are not reproduced here. These include the procedures to certify the gas system and chiller prior to the start of a running period (Chapters 5 and 6 respectively) and the nanoautomate certification procedure (Chapter 5). Confined-space access procedures are in Chapter 9, while lock-and-tag checklists are in Chapter 10.

Table 1. Normal settings of devices in the gas system.

Item	*Setting*
Alarm LEDs	all green except “Isobutane Not Present”
Chamber pressure	4.00 mbar
Helium inlet pressure	1100 mbar
Isobutane inlet pressure	1100 mbar
Operation mode	running mode
Flows	
Helium 10 lt/min flowmeter	0
Helium 2 lt/min flowmeter	87%
Isobutane 2 lt/min flowmeter	0
Isobutane 0.5 lt/min flowmeter	21%
Circulation flowmeter	64%
Helium high-flow rotameter	0
Helium low-flow rotameter	0
Isobutane high-flow rotameter	0
Isobutane low-flow rotameter	0
Helium Security flowmeter	maximum
Front bulkhead flush rotameter	5 lt/min N_2
Rear bulkhead flush rotameter	5 lt/min N_2
Outer cylinder flush rotameter	0.5 lt/min N_2
Exhaust line nitrogen rotameter	100 lt/min

The complete list of safety or certification procedures is:

- What to do if there is a DCh gas alarm. (Original in CVS)
- What to do if there is a DCh chiller alarm. (Original in CVS).
- Recovering From a Gas Alarm.
- Gas System Alarm Checklist (Chapter 5).
- Gas System Chiller Alarm Checklist (Chapter 6).
- Nanoautomate Certification Procedure (Chapter 5).
- Access Checklist—Permit-Required Confined Space (Chapter 9).
- Access Checklist—Confined Space Permit NOT Required (Chapter 9).
- Lock-and-Tag: Drift Chamber Electronics Power Supply (Chapter 10).
- Lock Procedure: Drift Chamber High Voltage Supply (Chapter 10).

4.4 Drift Chamber Procedures

Copies of all operational and maintenance procedures, and some safety procedures are available from the DCh safety web site.