Gas Manifold System for the COLTRIMS Chamber, with Administrative Lockout Capability

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Purpose of the System:

The gas manifold system allows connecting up to 3 gas cylinders at the same time to the supersonic gas jet of the COLTRIMS apparatus. The objective is to make switching between the different gases easier and quicker. Special locking valves are provided to prevent accidental release of gas to the environment and inadvertent gas mixing in the manifold.

Description of the System:

[1] The manifold accommodates three inputs. The inputs (red, blue and white) can accept noble gases or hazardous gases (such as toxic, etc.) and gases which may be reactive.

[2] All three input valves can be locked closed with padlocks (retainer snaps can be used for non hazardous gases).

[3] The main high-pressure output leads to a small nozzle inside the vacuum chamber, providing a supersonic gas jet. The nozzle size is 5 to 100 micrometers in diameter. The manifold pressure (set at the regulator of the gas bottle) can be 0 to 60 bar (900 psi).

[4] The second high-pressure outlet leads directly to the vacuum pump foreline, bypassing the experiment chamber. The first valve in this line (black) is a high-pressure resistance valve, protecting the low-pressure side (convectron gauge and valve) from damage. The second valve is a vacuum foreline valve, which leads into the forevacuum pumping system (>1E-4mbar) of the main vacuum chamber. Both valves are open while pumping down the entire vacuum system and the manifold; they are also open for leak testing the manifold and the gas lines (which is required when toxic gases are connected for instance, see next section).

[5] The third outlet is dedicated to the evacuation of the manifold and its attached gas lines. A three-way valve (black) is either closed (middle position), open to the building exhaust-system via the gas-cabinet (pointing to the back), or open to a diaphragm pump (pointing to the front) used for evacuating the manifold lines.

Operation:

[1] Gas lines feeding inert gases to the inputs can be attached and detached at any time with the specific valve just closed as long as there are no other hazardous gases fed into the manifold system.

[2] While the exclusive use of inert gases does not require a locked valve, incompatible or hazardous (such as toxic) gases need special treatment, even when they are attached exclusively to the manifold. As specified by ALS safety inspectors for specific experiment

setups, padlocks may then be used to lock the valves (the valves can be locked with **non red**[†] padlocks).

NOTE: In case there is a hazardous gas fed into one or more input, the remaining valve(s) has(ve) to be closed AND locked in order to prevent accidental mixing or release of the gas to the environment (retainer snaps can be used for non hazardous gases).

[3] If health hazard gases are attached to the inlets, a vacuum leak test is required before using the manifold, per ALS Procedure BL 08-23: "Hazardous Gases and Gas Cabinets Used at ALS Beamlines" (an authorized ALS staff member must be present). Close the valve in front of the jet-nozzle (at the vacuum chamber). Then pump down the manifold using the bypass to reach a vacuum pressure reading of below 1E-1Torr at the convectron gauge (for this purpose the three-way valve to the diaphragm forepump has to be closed). The valve(s) to the gas bottles (including the regulators and any other valves in front of the bottle) has to be open. Once this pressure is reached, the vacuum pump valve at the manifold is closed; the pressure must not rise above 1 Torr for 3 minutes. In case it does, the leaks have to be fixed and a new test has to be conducted.

NOTE: Once approved by the ALS, do not disconnect the vacuum-tested gas lines, otherwise a new check must be done.

[4] The keys to the valve padlocks may be controlled by the investigator in-charge or by the safety staff of the Advanced Light Source – for non hazardous gases retainer snaps can be used. This will be determined for each specific experiment setup.

NOTE: Before you open any of the inlet valves, please protect the convectron gauge and the vacuum valve at the bypass outlet from overpressure damage by closing the black valve in front of it. Please also protect the (round) silver high pressure gauge using the black valve in front, if you exceed a pressure of 350psi at the gas cylinder regulator.

[5] **NOTE:** Any work, maintenance or change in the section of the gas manifold from the inlet valves to the three possible outputs (jet-nozzle, bypass, forepump and exhaust) has to be done while no gas bottle is attached to any inlet with the blue, red or white valves. The gas lines or bottles have to be detached ! **Locking the valves (either with padlocks, retainer snaps, or etc.) and leaving the gas lines and bottles attached, while tampering with the manifold, would result in a Lock Out Tag Out procedure (LOTO) violation, and it would bare a risk to life and health – this is strictly forbidden!**

[6] **NOTE:** During normal operation (not maintenance or changes) the padlocks (or retainer snaps if appropriate) are so called administrative locks, not LOTO locks. This is because the use of these locks a) take place during normal operations, b) is repetitive, routine, and thus integral to the use of the equipment, and c) is performed while using alternatives measures to provide effective personal protection. For these reasons the locks and thus the normal operation are excluded from LOTO, LOTO-procedures and LOTO-training.

Operating the Gas Jet:

[1] Close the gas bottle, the regulator, the valve at the regulator or the inlet valve to the manifold.

[†] The usage of red padlocks is allowed for LockOut-TagOut (LOTO) procedures only.

[2] Turn the arrow head of the three-way valve away from you in order to release any gas in the manifold (and the gas lines) to the exhaust system or gas cabinet. You will hear a fizzling sound.

[3] Once the fizzling stops, turn the arrow head of the three-way valve towards you, i.e., you open the line to the diaphragm pump to evacuate the manifold system. Let it pump for 1 to 3 minutes. You may want to check the pressure/vacuum by opening the black valve to the convectron gauge at the bypass line.

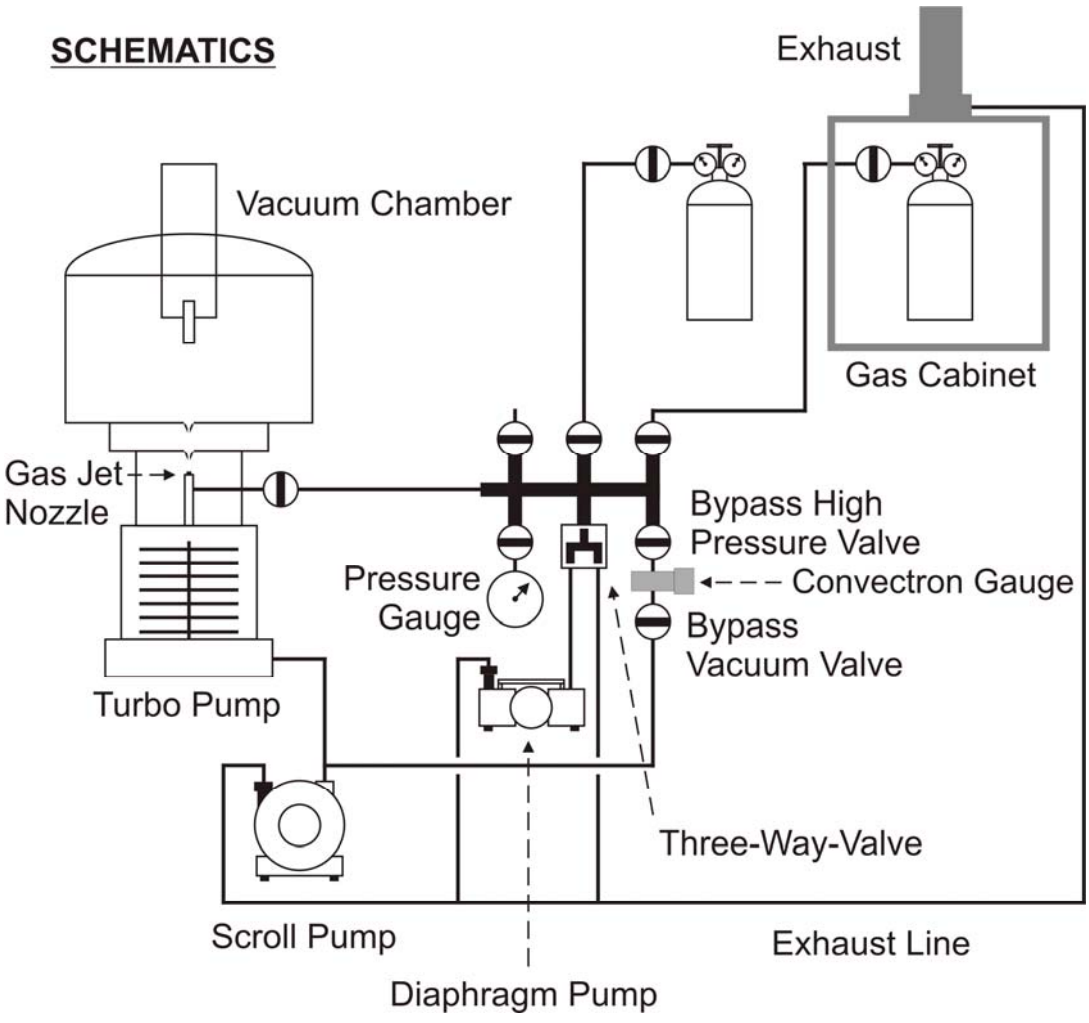
[4] Now close the black valve to the convectron gauge and the three- way valve to the fore-pump (middle position).

[5] Open the gas bottle, the regulator, the valve at the regulator or the inlet valve to the manifold. Adjust the cylinder pressure regulator for the desired pressure.

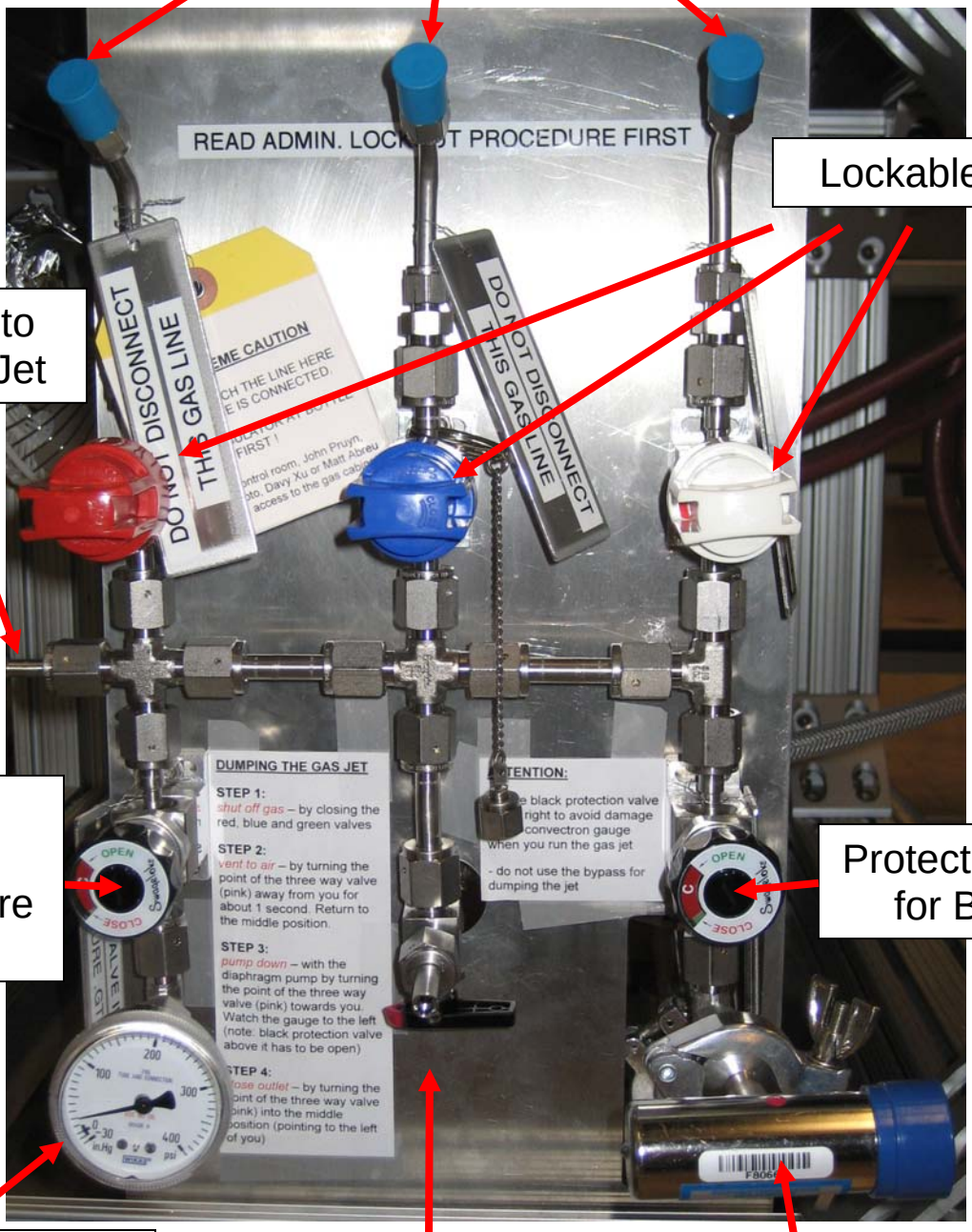
Schematics of the Gas Manifold at the COLTRIMS setup:

The Manifold can be found in the center of the sketch (not to scale). In the scenario shown here, there is no gas bottle connected to the first inlet. Once hazardous gases are connected to the manifold all inlet valves need to be controlled with padlocks. Hazardous or reactive gases may need a gas cabinet (shown in grey).

NOTE: In the sketch below, only the differential pumping system of the first stage of the supersonic gas jet is shown.



Picture of the Gas Manifold:



Important things to remember:

- Do not break the gas line containing the toxic gas before you have disconnected the bottle in the gas cabinet. For this an authorized ALS person is needed (Doug Taube, David Malone).

- Before using the gas manifold it has to be decided by the ALS safety staff if the usage of retainer snaps instead of padlocks is appropriate. This depends on the gases to be used throughout the experiment.

- Only persons authorized by the Principal Investigator are allowed to operate the padlocks of the valves. They need to have training: COLTRIMS On-the-Job-Training, gas cabinet On-the-Job-Training, and must have read and understood this procedure.

- Do not exchange the keys for the locks while setting up the system or changing gases.

- Do not use the manifold to mix gases.

- Make sure the exhausts of the manifold and all forepumps are connected to exhaust of the gas cabinet.

- Remember to protect the high-pressure and fore-vacuum gauges with the protection valves.

- In case of any queries do not hesitate to contact the Principal Investigator or the ALS Control Room. **Do not proceed when you are in doubt.**