

LAr Filter Regeneration Procedure

Yun-Tse Tsai

May 11, 2022

General steps:

1. Preheat the LAr filter to 175 – 180°C with Ar gas at 160 slpm (~ 6.7 scfm on the flowmeter). It takes about 3 hours.
2. Use 1 – 2% H₂ balanced with Ar to regenerate the LAr filter. Keep the temperature between 175 and 225°C. With the flowrate of 80 slpm (3.3 scfm on the flowmeter), we expect to use 5 gas bottles, each takes a bit less than an hour.
3. Cool down the system with ultra high purity Ar gas.

Time to stop regeneration:

- Humidity plateaus. Better plateaus at 0%.
- 5 hours of 2% H₂ gas at 80 slpm (3.3 scfm on the flowmeter).
- Temperature in the LAr filter does not rise anymore.

Notes:

- All the doors of the LNTF hut have to be open, the intake fan has to be turned on, and oxygen deficiency sensor and monitor (ODM) have to be checked.
- V3, V5, V6, V9, V18 isolate the LAr filter. During the regeneration, V3, V5, and V6 should be always closed.
- Control V9 and V18 carefully to avoid compromising the LAr filter; V9 is the gas inlet and V18 is the exhausting valve.
- The torque for V9 is 50 inch-pound, 7/8" socket.
- The torque for V18 is 21.7 foot-pound, 3/4" socket. Need different torque wrenches for V9 and V18 typically.
- The gas flow has to be greater than 2 scfm (marked on the flowmeter) to prevent the heater from getting too hot.
- We should keep the gas flow (Ar or 2%H₂+Ar) between 2 and 6.7 scfm (marked on the flowmeter), but preferably at 6.7 scfm.
- Maintain the catalyst temperature between about 175°C and 225°C.
- Do NOT exceed 225°C, even though 250°C may be tolerated.
- If we keep the gas flow at 6.7 scfm Air, a gas bottle should be finished in about an hour.
- If seeing smoke or smelling something unusual, shut down the variac power supply (heater) and investigate.

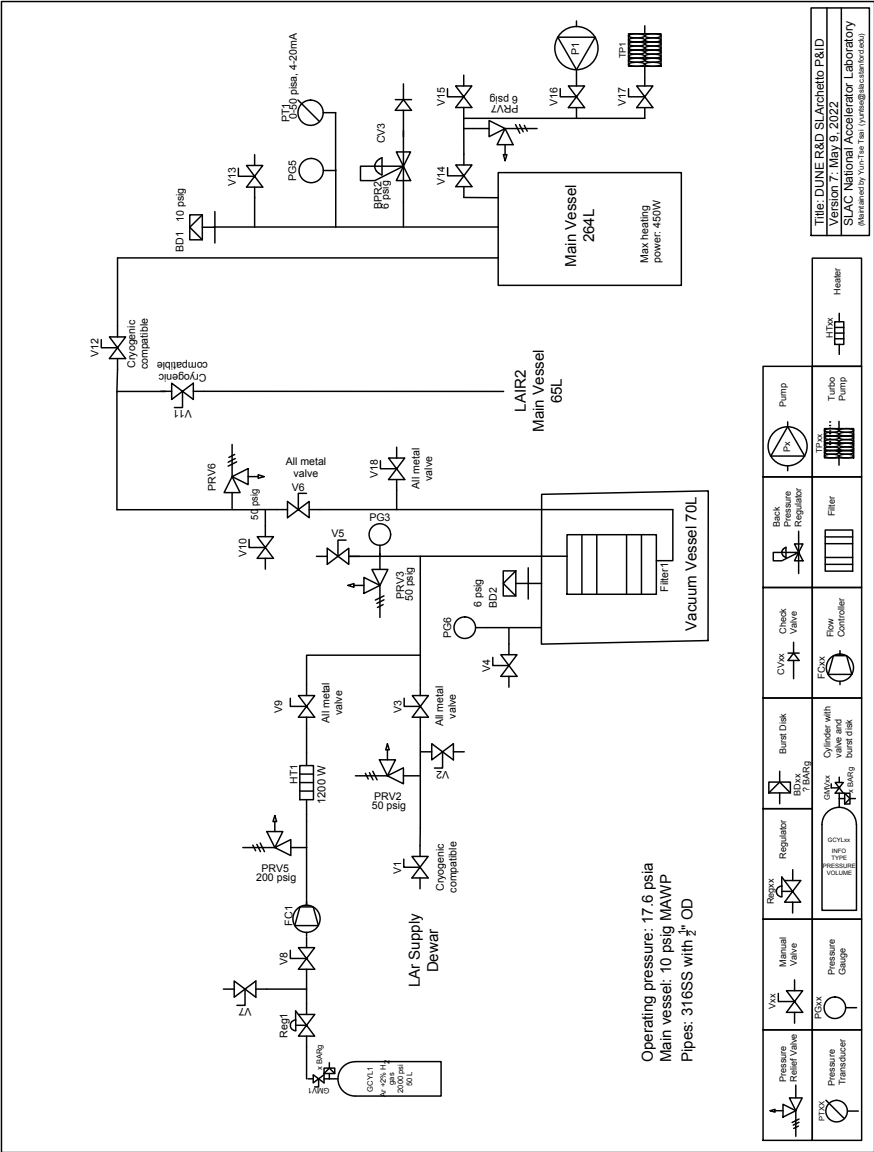


Figure 1: P&ID

Checklist	What to Do and Detailed Description
Preparation	
3 bottle of ultra high purity Ar gas (TBC)	
5 bottles of Ar+2%H ₂ gas (TBC)	
Tubes connecting the heater and the LAr filter wrapped with aluminum foils for thermal insulation	
V4 connected to the scroll pump	Prepare to evacuate the vacuum vessel
V4 open, scroll pump on	Evacuate the vacuum vessel
V3, V5, V6, V7, V8, V9, V10, V11, V12, v18 closed	
Exhausting gas line connected and humidity meter hooked	
All the doors of the LNTF hut open	
Intake fan on	The emergency button is yellow
Oxygen deficiency sensor in place, oxygen deficiency monitor green	
Preheating with Ar gas	
V3, V5, V6, V7, V8, V9, V10, V11, V12, V18 closed	
PG6 at 0 psi	
Variac power supply off. Voltage set at 0	
Heater plugged in to the variac power supply	
Ar gas bottle connected to Reg1 and V7/V8 line	
GMV1 opened, Reg1 increased, V7 opened, air purged	Purge the air in the connection tube
V7 closed	Finish purging
V8, V9 opened	
PG3 at 5 – 10 psig, V18 opened	
Gas flow ~6.7 scfm, stable	
Variac power supply on, increase the voltage	Turn on the heater
Humidity plateaued at 0% for > 10 minutes	Molecular sieves regenerated
Preheated for > 2 hours	
TC0, 1, 2, 3 at 175 – 180°C	
Variac power supply off. Voltage set at 0	Turn off the heater
V8, V9, V18 closed	

GMV1 and Reg1 closed

Regenerating copper sieves

Ar+2%H₂ gas bottle connected to Reg1 and V7/V8 line

GMV1 opened, Reg1 increased, V7 opened, air purged Purge the air in the connection tube

V7 closed Finish purging

V8, V9 opened

PG3 at 5 – 10 psig, V18 opened

Gas flow between 50 and 160 slpm (Ar), or between 2.2 and 6.7 scfm (marked as Air). Preferably at 3.5 scfm Air

Variac power supply on, increase the voltage Turn on the heater

Should the temperature exceed 225°C anywhere in the bed, switch to H₂-free gas until the hot zone cools back down to 200 – 210°C, then resume feeding the H₂ gas mixture

The temperature of the all catalyst bed is stable or subsiding

Humidity plateaued at 0% for > 10 minutes Copper sieves regenerated

Variac power supply off. Voltage set at 0 Turn off the heater

V8, V9, V18 closed

GMV1 and Reg1 closed

Completion; cooling down

Variac power supply off. Voltage set at 55 V

Ultra high purity Ar gas bottle connected to Reg1 and V7/V8 line

GMV1 opened, Reg1 increased, V7 opened, air purged Purge the air in the connection tube

V7 closed Finish purging

V8, V9 opened

PG3 at 5 – 10 psig, V18 opened

Gas flow ~6.7 scfm, stable

Variac power supply on, decrease the voltage Turn on the heater

Variac power supply off. Voltage set at 0 Turn off the heater

V8, V9, V18 closed

GMV1 and Reg1 closed
