2024/04/16 - Li Oven Turn on Procedure - 5 Torr oven

Goal of this procedure: Enter oven mode and reach desired oven profile

Instructions: To keep track of changes to the procedure - copy this page, date it, and add execution notes in red. Remember to save changes.

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Link to elog summary:

enter here

Procedure

Update 4/8/2024 for simplified

Checkout and setup - Perform these steps several hours before opening the oven valves

	Procedure	Execution notes
1	***Record*** goal density and helium buffer pressure	1. Buffer gas = 5 Torr 2. Oven current goal of ~8.2 A 3. Oven temp: TC4 /TC5 = ~850 degC TC1/TC7 = ~445/485 degC 1. Plasma density = 4.3 e16 cm-3
2	Set 10 Torr gauge set points to plus and minus 1 Torr of desired pressure ○ Note: the hysteresis value is where the trip occurs, the lower value is where the fault will clear	5.50 set Sp, 6.05 Hyst SP 4.5 set Sp, 4.05 Hyst SP
3	Set the 1000 Torr gauge setpoint to 30 Torr	30 set, 33 Hyst
4	If using DPS, confirm it is operating nominally and record the starting IP pressure (VGCC 3259)	DPS running, 3259 at 2.4e-9 Torr

Figures:

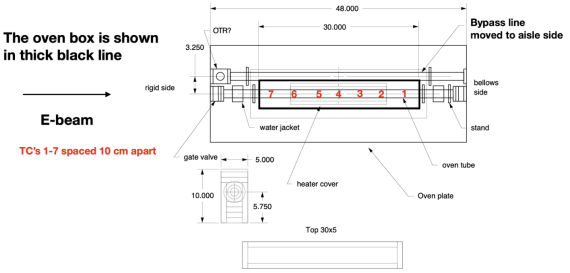
Useful material

E300 Google Drive folder

How to perform a static fill with DPS

TDK-Lamdba GEN100-15 oven heater power supply manual

Li oven sketch with TC locations



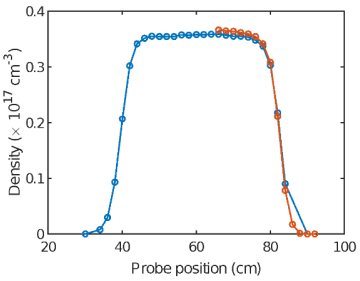
Li density profiles

From: Summary of FACET II lithium oven measurements - June 3, 2021

More profiles available in doc (3 Torr, 4 Torr, 6 Torr, 8 Torr

4	Confirm helium gas bottle is connected to fill line #1, regulator set to 5-10 psig. ***Record*** gas type, starting bottle pressure, and regulator pressure	Helium, 2300psi, new bottle ~13psi on regulator
5	Confirm that the fill line #2 is closed, and that the IOTA controller in rack FKG20-22 is turned off.	done
6	Zero the 10 and 1000 Torr gauges	done
7	Fill IP with He to goal IP pressure using: How to perform a static fill with DPS **Note** - the US2/3/4 gauges will trip off shortly after starting the static fill. You will need to restart the gauges (turn cathode HV On), then reset the valve interlocks, reopen the beamline valves, then continue with the static fill. This will happen once every time you pass the threshold of ~1e-3 Torr on US1.	done flow 480 for 5torr pressure

Measurement 1 (blue)			Measurement 2 (red)		
Pressure = 4.061 Torr			Pressure = 4.048 Torr		
	VOLTS	AMPS WATTS		VOLTS	AMPS WATTS
PS1	68.5	8.06 552.11	PS1	68.5	8.06 552.1
TC1	429.6		TC1	435.4	
TC2	803.3		TC2	809.3	
TC3	831.8		TC3	831.9	
TC4	835.5		TC4	835.4	
TC5	835.4		TC5	835.1	
TC6	819.6		TC6	815.3	
TC7	475.8		TC7	466.3	

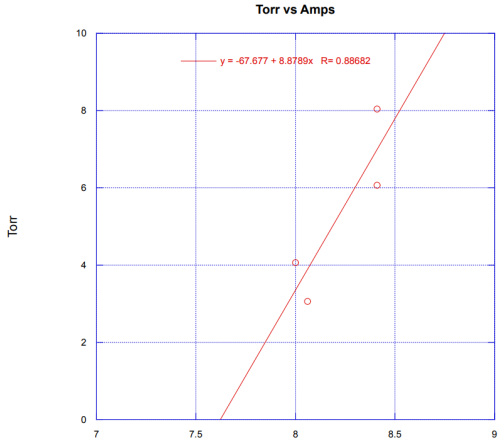


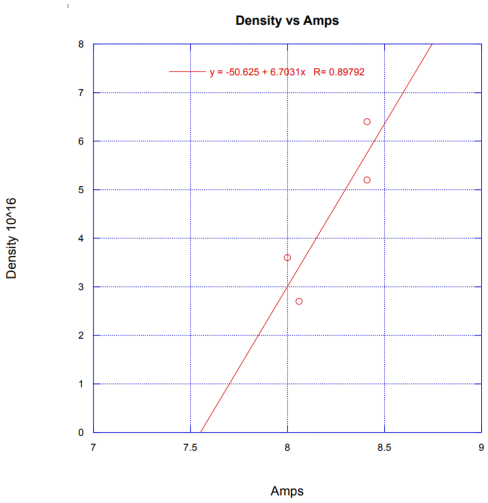
From Ken 4/8/2024:

- At pressures less than 3 Torr, stay below ~450C on TC 1 and 7.

Procedure for oven turn on

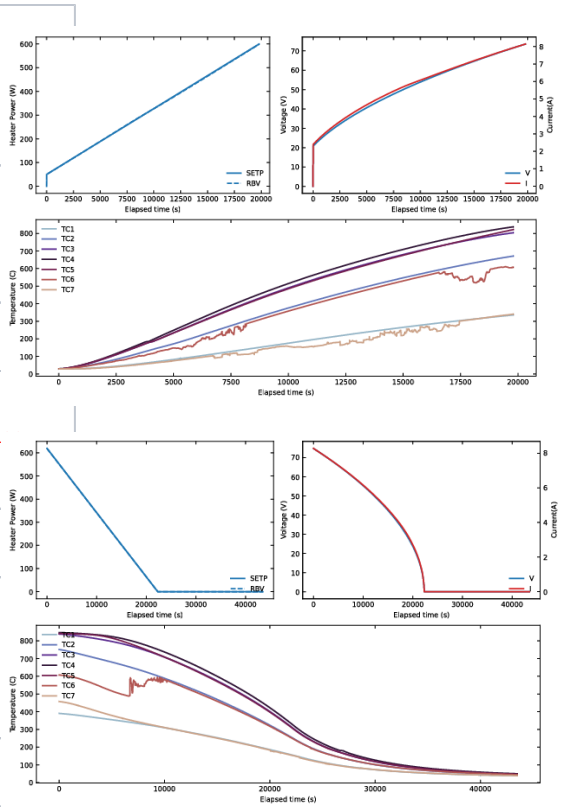
	Procedure	Exec notes
1	Allow gas to flow for a minimum of 30 minutes. Stop the flow from the mass flow controller	done
2	Ensure that gauges US1, US2, US3 and DS1 CC are bypassed.	done
3	Confirm the 10 and 1000 Torr setpoints are set appropriately for the desired oven pressure	done
4	Confirm the Beryllium window valve VV3208 is closed - close it if not!	done
5	Set up strip-tool of pressure in the plasma oven: ○ VGCM:LI20:M3201:PMONRAW ○ VGCM:LI20:M3203:PMONRAW • Saved as DPS_Pressures.stp Set up striptool of oven thermocouples plus the thermocouples on the bypass line, cooling water jackets, base-plate and air. • Saved as Li_oven_startup.stp	done
6	**Head out the FKG20 racks**	
7	Set EPS EXPERT Mode to be “ON” by turning the interlock key in the EPS box in FKG20-27 in the gallery. ○ Note: EXPERT mode is “OFF” if the LED light is OFF and EXPERT mode is “ON” if the red light is ON)	done
8	Unlock oven gate valves: Use the key to switch the valve controller labeled VV3183 VV3187 in rack FKG20-22 to "CAMAC" mode	done



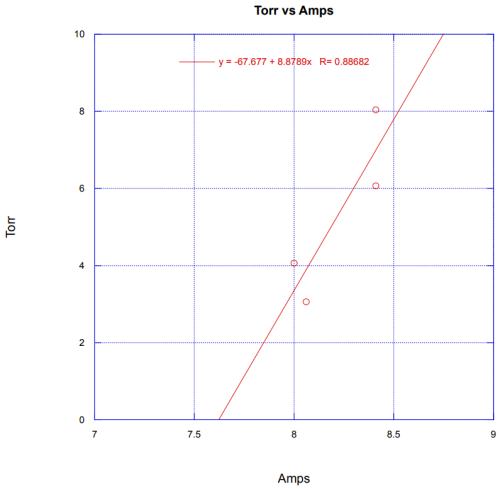


Temperatures from heat up (8 Torr)and shut down (from 5 Torr)

9	Lock the Be window valve to be inserted: Use the same key to switch the valve controller labeled VV3208 to "LOCAL ONLY" and remove the key. Note: the EPICS controls for this valve is also password protected so this will be very well configuration controlled.	done
10	Open oven gate valves 3183 and 3187. (there might be a small amount of helium between the valves). If the interlock is faulted then perform a valve interlock reset.	done
11	Turn on the oven heater power supply. Open the "Genesys Expert..." panel and select "PS On" to ON	done
12	Restart the gas flow from the MFC and fill back to the goal pressure. **Note** - the beamline valve interlock will likely trip again. If it does, restart the gauges and continue as described above.	done flow - 4
13	When you are at the goal pressure - Hit EPS Reset to clear the low pressure fault	done
14	Set EPS EXPERT Mode to be “OFF” by turning the interlock key in the EPS box in Rack 20-27 in the gallery. (Note: EXPERT mode is “OFF” if the LED light is OFF and EXPERT mode is “ON” if the red light is ON) . **You are now done at the racks.**	done
15	Perform another EPS reset (this is needed to enable the heater)	done
16	Raise heater power slowly (~ 100 Watts per hour) while monitoring the oven pressure and temperature until desired operating conditions and are reached. This can done manually by entering the voltage setpoint on the E300 panel, Or - use the automated tool (instructions TBD) During the oven heat up: • ***Record I, V, P and time.*** • Monitor temperature of bypass. Do not exceed 100 C on viewports. If 100 C is reached, shut down oven following shut down procedure. ▪ (I don’t think this ought to be a concern since it has never gone above 50 degrees and if it does, it may just mean the TC is loose and striking the oven).	The goal current for the 5 Torr oven is 8.2 A Starting Robert's script, target power 575W (~8A) (had a few problems with script, heater already working a bit before the real start, so TC4 higher than ambient)



		■ 11:15 - 20.78V, 2.4A = 50W - TC4 = 40C ■ 11:45 - 29.4V, 3.4A = 100W - TC4 = 96C ■ 12:45 - 41.8A, 4.8A = 200W - TC4 = 286C ■ 13:45- 51.8 V, 5.8 A = 300W - TC4 = 480C 14:45- 59.9 V. 6.7 A = 400W - TC4 = 637C 16:16 - 70.36 V, 7.80 A=548.9W, TC4=803.0C 16:31 - 71.97 V, 7.98 A=574.0W, TC4=820.7C http://physics-elog.slac.stanford.edu/facetelog/show.jsp?dir=/2024/16/16.04&pos=2024-04-16T16:31:56

17	Fine tune the heater power to reach the desired oven profile. This plot shows the desired heater current vs. pressure:  • At pressures less than 3 Torr, stay below ~450C on TC 1 and 7. **Note:** Reducing the helium gas pressure in a hot oven could cause loss of lithium! Reduce the heater power to achieve the desired oven temperature then slowly reduce the helium pressure. Slowly raising the buffer gas pressure will not harm the oven.	Ramped up to 608W in a few steps to get to 8.2A At 17:00: Oven pressure: 4.986 Torr Oven heater settings: 74.040 Volts, 8.199 Amps, 607.054 Watts Oven temperatures (C): TC1: 330.81 TC2: 695.78 TC3: 813.36 TC4: 835.06 TC5: 833.36 TC6: 726.47 TC7: 334.61

Procedure for oven shut down

9 hours turning down by hand- 11 hours until valves can be closed

	Procedure	Execution notes
1	Turn off heater supply slowly to reduce thermal stress to the oven tube and wick. Do this either by hand, or using the automated tool (~ 100 Watts per hour)	Started shutdown script at 4/19 01:40
2	After the heater power is turned down to 0, wait until oven thermocouples indicate the oven is near room temperature (less than 50° C). Lithium is liquid at 180°C. **Takes about 11 hours to reduce to 50C**	done
3	Write down the buffer pressure for the record in the facet elog	done (~5Torr)
4	Close oven gate valves 3183 and 3187. Turn the key to “CLOSE VALVE” in the PLC valve controller in rack FKG20-22 and remove the key. This will disable the valves from opening. Set the Be window valve 3208 back to CAMAC.	done
5	Drain all helium gas and open valves to restore pumping. If using DPS then follow: How to perform a static fill with DPS	done
6	Open the Be window valve, remove bypasses, and reset gas types on the gauges to nitrogen.	done, left bypasses

Emergency shut down procedure

If possible the oven should be cooled slowly using the above procedure to reduce thermal stresses on the oven. But in an emergency situation the oven may be put into a safe-mode to prevent loss of lithium using the following procedure. Note that depending on the situation, some of these steps are automatically taken by the EPS.

	Procedure	Execution notes
1	Close oven gate valves 3183 and 3187. *If there is an EPS fault then this happens automatically.*	
2	Turn off the oven heater power. *If there is an EPS fault then this happens automatically.*	
3	Secure the helium gas source – either drain the IP or ensure DPS is operating in the nominal static fill state: How to perform a static fill with DPS	
4	Log the details of the fault and shutdown: type of fault, reason if known, IP pressure, oven temp, and any other relevant information.	
5	Turn the key to “CLOSE VALVE” in the PLC valve controller in rack FKG20-22 and remove the key. This will disable the oven gate valves from opening.	
6	**Do not attempt to restart the oven until you investigate, find, and fix the source of the failure.**	