

ESR: Qweak target and RRHX operating procedure

Purpose

This procedure is written to provide guidance to the Cryogenics group for cooldown and operation of the Qweak cryotarget/moeller from the ESR end. This involves two parts: cooling down the 4K cryotarget/Moeller circuit with flow from CHL while using the RRHX to take the ~20K, 1 atm return flow (coming from the hall on what was once the LN2 line). The second part involves cooling down the 15K target circuit and returning to the normal Hall C 20K return.

COOLDOWN

Initial Conditions

- The RRHX is at ambient conditions.
- There is no 4K flow from CHL
- There is no 15K flow to Hall C
- Valves are in the arrangement shown below,

Valve Loop	Input Signal	Set Value	Min. Position	Max. Position
<i>RRHX High Pressure Circuit</i>				
MV6610B	N/A	N/A	Full Closed	Full Closed
SV6510	N/A	N/A	Closed	Full Closed
EV6512	CTD6512	24.5 K	5%	N/A
EV6512A	CTD6624	16.3 K	5%	5%
<i>RRHX Low Pressure Circuit</i>				
MV6520	N/A	N/A	Full Open	Full Open
MV6521	N/A	N/A	Full Open	Full Open
PV6522	CPI60LP	1.12 atm	-15%	N/A
PV6522A	CTD6520	240 K	-15%	-15%
<i>Hall C 15K circuit</i>				
PV6614	CPI6614	12 K	-6%	-6%
EV6731C	CPI60MP	2.75 atm	20%	-6%
EV6741C	N/A	N/A	-6%	-6 %
<i>CHL 4K supply to ESR circuit</i>				
EV11139	N/A	N/A	-8%	-8%
EV6814	CFI11139	5 g/s	-8%	-8%
EV6712	CTD6712	6 K	50	50

Cooldown Procedure, 4K circuit

Relevant graphs: /cs/op/lib/stripTool/ESRGRAPHS/ESR/ESR_O_RRHXQW

1. Prepare the RRHX by opening SV6510 and slowly opening MV6610B such that PI6510 increases gradually.
2. Start CHL4K supply to target by opening EV11139 (to 40%) and EV6814 (to 75%, controlling flow to a maximum of 15 g/s). The target/moeller circuit will cool down at a rate determined by the hall (while not exceeding a set valve% movement per minute) until the point where the warm return valve can be closed.
3. As the target system cools, monitor CTD6522 for decrease in indicated temperature.
4. When CTD6522 has decreased to ~100 K, open EV6512 to min/max 5/5%.
5. Monitor CTD6512. If CTD6512 has not begun to decrease, open EV6512 in slow 3% increments but do not exceed min/max 15%/15%.
6. Monitor T1 Outlet Temperature CTD6624. If the temperature is rising too quickly, reduce the min/max position of EV6512 to compensate.
7. If CDT6512 exceeds 80 K at any point during the cooldown, reduce EV6814 min/max position or increase EV6512 to compensate.
8. Once CTD6512 has reached 30 K, set EV6512 min/max 7%/50%.
9. If desired, open PV6522 to the settings in "normal operation" and close MV6520 to send return flow from CHL Recovery to ESR Suction
10. The 4K cooldown procedure is complete. Close MV6521.

Cooldown Procedure, 15K

Relevant Graphs: /cs/op/lib/stripTool/ESR/HALLGRAPHS/Hall-C-15K-Target

1. Allow PV6614 to open to a maximum of 75% to control 15K supply pressure to 12 atmospheres.
2. Ensure there is enough CHL recovery capacity to handle the flow from both the RRHX and the 15K cooldown.
3. With the Hall 15K warm return open, open both CEV6741C and CEV6731C to ~60% in order to cool down the 15K supply and 20K return (reverse-flowing through the return).
4. When the supply and return circuits have cooled down sufficiently (<35K), allow the hall to close the warm return valve and send flow via the normal 15K supply and 20K return. Set the min and max on the supply valve to 20% and 75%. Lock the return valve open.

Normal Operation

- The low pressure circuit of the RRHX is switched to ESR Main Compressor Suction.
- During normal operation of the Qweak target, the parameters are set up as follows...

Control Loop /Valve	Input Signal	Set Value	Min. Position	Max. Position
<i>High Pressure Circuit</i>				
MV6610B	N/A	N/A	Full Open	Full Open
SV6510	N/A	N/A	Open	Full Open
EV6512	CTD6512	25 K	7%	N/A
EV6512A	CTD6624	16.3 K	7%	50%
<i>Low Pressure Circuit</i>				
MV6520	N/A	N/A	Full Closed	Full Closed
MV6521	N/A	N/A	Full Closed	Full Closed
PV6522	CPI60LP	1.12 atm	20%	N/A
PV6522A	CTP60LP	273 K	20%	100%
<i>15K Target Circuit</i>				
EV6731C	CFI6731C	20	15	80
EV6741C	N/A	N/A	100	100
PV6614	CPI6614	12 K	-6%	75%
<i>4K Target Circuit</i>				
EV11139	CPI6814	1.2	40	40
EV6814	CFI11139	20 g/s	20	80
EV6712	CTD6712	6 K	-6	-6

Normal Operation Notes:

- When there is >15 g/s flow from CHL supporting the Qweak target, there MUST be a total 15K load of at least 1000 watts in order to prevent the return flow at the LN2 level becoming so cold that it freezes nitrogen. If the Qweak 15K target load is insufficient for this purpose we can use the test heater connected to Hall B's 15K supply/20K valve box bayonets.

- When the flow from CHL exceeds 20 g/s, the ability to support 15K loads starts going down due to the limit of the flow that ESR's C2 can take.
- If desired, ESR can take some of the Qweak 4K load by allowing CEV6713 to open. This valve would control CTD6624 to 17-17.5K, and have a maximum position of ~20-30%. The CHL would scale back flow when this valve opens to maintain pressure at the supply to Hall C's 4K Qweak target.
- In the event that the 4K system's return temperature exceeds ~23K, the EV6512 setpoint can be changed from 25K to 30K and still support a 15K load, albeit at elevated temperatures.

Tested ESR operating points for various 4K/15K loads:

CHL 4K Flow (g/s)	Min 15K heat load	Max 15K heat load	Note
5	N/A	1400 W	15K flow maxed
10	N/A	1700 W	15K flow maxed
12.5	N/A	1800 W	15K flow maxed
15	N/A	1870 W	15K flow maxed
20	1000 W	1940 W	15K flow maxed
25	1200 W	1700 W	Interstage Pressure Limited
30	1700 W	1700 W	Interstage Pressure Limited