

# Orange Cryostat Operating Instructions

## 1 Test report for Risø 'Orange' cryostat, 50 mm access cryostat and non standard tail set

### Physical dimensions

Sample diameter, maximum	49 mm access
Sample length	See Fig. 3
Beam height	100 mm
No. of screens	4
Total thickness of screens	10 mm

### Test report

Liquid N <sub>2</sub> bath boil off	2.4 litres gas per minute
Liquid N <sub>2</sub> bath volume	7.5 litres at 420 mm height
Liquid N <sub>2</sub> bath hold time	30 hours
Liquid <sup>4</sup> He bath boil off	0.6 litres gas per minute
Liquid <sup>4</sup> He bath volume	10 litres at 400 mm height
Liquid <sup>4</sup> He bath hold time	181 hours
Base temperature (cryostat)	With an Alcatel mechanical pump, 1.7 K
Heating time 1.5 - 26 K (12 V)	Takes 15 minutes with 12 volts
Cooling time 50 - 4.2 K	5 litres gas per minute - In total 16 minutes
Cooling time 4.2 - 1.5 K	1.4 liter per gas minute - In total 7 minutes
Minimum flow through the needle valve	0 litres per minute when warm, 0.9 litres per minute when cold
Leak test pipe work (bubble test)	OK at 4 psi

## 2 Operating procedures for the Risø 'Orange' cryostat

### 2.1 Cooling down the cryostat:

- Before commencing the cool down you should pump the isolation vacuum via the valve V1 (Fig. 1) to better than  $10^{-2}$  mbar. Be sure to use a flexible tube which has **NEVER** been used for pumping helium.
- Connect the Risø temperature controller to the socket #13 (Fig. 1). Verify that the thermometers indicate the ambient temperature and test that the heater and regulation are operating correctly for example by heating to 310 K.
- Connect the temperature well marked #8 via valve V3 (Fig. 1) using the flexible tube NW25. Connect the  $^4\text{He}$  volume to the pump unit via valve V2 (Fig.1) using the flexible tube NW16. Connect the  $^4\text{He}$  siphoning port #12 (Fig. 1) to the  $^4\text{He}$  pressure vessel. Open the needle valves V4 and V6 and open the valves V2, V3 and V5 (turn V5 vertically down to open). Pump for 15 minutes.
- Close the valves on the pump unit and assure that there is no pressure rise. *If the pressure rises, there is a leak in the system. Verify that all connections OK and check in particular the "O" ring joints.*
- Open the valve V3 and connect it to the NW25 connection. Connect the pressure instrument to the NW25 side of the pump unit. Fill the  $^4\text{He}$  volume, which have been pumped out together with the rest of the system, with  $^4\text{He}$  from a pressure bottle via the hose connected to #12 (Fig. 1). The pumping out and refilling of the whole system (flushing) should be done twice. Finally, pump out again and close the two needle valves V4 and V6. Fill up the  $^4\text{He}$  reservoir with  $^4\text{He}$ . Open the cold valve V4 (Fig. 1) and verify that the pressure in the temperature well increases indicating that the cold valve is clean. After the pressure has increased to 500 mbar, you should close the cold valve V4 (Fig. 1) and open the warm valve V6 (Fig.1). After having performed the above operation, the capillary tube, the cold valve and the warm valve is free of air and moisture.
- Connect the  $\text{N}_2$  vessel to the filling port #11 (Fig. 1) and fill the nitrogen bath.
- 15 minutes after filling with  $\text{N}_2$ , you may start to transfer liquid helium.
- **The normal scheme for transfer of liquid helium will be as follows:**  
45 minutes after start, the cryostat will start to collect liquid helium. After another 15 minutes the cryostat should be full. The total consumption of liquid helium should be about 10-14 litres.

### 2.2 Working with the cold cryostat:

#### 2.2.1 Loading the sample and getting it cold:

Mount the sample on the sample stick and insert the sample stick in the sample well of the cryostat. Pump the well via the blue three way valve V5 (Fig. 1) which should be pointing up. Close the valve V5 with a 1/4 turn to the horizontal position. Connect a rubber hose, about 10 cm long, containing  $^4\text{He}$  to V5 and introduce this  $^4\text{He}$  into the sample well as exchange gas.

#### 2.2.2 Cooling down the sample and changing the sample temperature:

Make sure that the Risø temperature controller is connected to the sample stick via the connector marked #14 (Fig. 1) at the top of the sample stick. Make sure that the correct temperature control files have been loaded into TASCOM. You may get a listing of the sample environments available at Risoe by executing the TASCOM command DTEM.

*Requested set temperature  $T_{control} > 10 K$*

Set the required temperature using the Risø temperature controller. Close valves V2 (perpendicular to the tubes when closed) and V3. Open fully the needle valves V4 (cold) and V6 (warm). When the set temperature is reached, close progressively V6 until the power input from the Risø temperature controller is about 5%-10% (this corresponds to a flow of 1-2 litres/minute on the flow meter in the recovery system). The power input is listed in the printout at the temperature control screens placed at the spectrometer shielding and at the top of the electronics in the spectrometer cabins. The input from the Risø temperature controller need not to be exact, but should be as low as possible for the temperature region you wish to use in order to minimise the  $^4\text{He}$  consumption and make the time between  $^4\text{He}$  as long as possible.

*Requested set temperature  $T_{control} < 20 K$*

Connect a flexible pump hose to valve V3 (Fig. 1) and pump it out. Close the valves V6 and V4 and open V3. An impedance in the cold valve (V4) assures the necessary flow required for cooling. Set the required temperature on the Risø temperature controller. Wait until this temperature is reached and has stabilised.

*Changing the temperature to  $T_{control} > 20 K$*

To heat up, set the temperature controller to the appropriate temperature and wait until the set temperature is reached.

To cool down, set controller to the appropriate temperature and slightly open the valve V6. Once the set temperature is reached you must reset V6 to its initial setting.

*Changing the temperature to  $T_{control} < 20 K$*

To heat up or cool down, set the temperature controller to the required temperature and wait until the set temperature is reached.

### 2.2.3 Changing the sample:

Set the control temperature  $T_{control}$  to 100 K and wait until this temperature has been reached. Connect the helium bath and the sample well via the blue three way valve V5 (Fig. 1) which should be pointing down. Disconnect the Risø temperature controller from the sample stick by removing the cable connected to the connector marked #14 (Fig. 1). Pull the sample stick with the sample out of the cryostat.

Change the sample on the sample stick and you are in principle ready to insert the sample stick again. ***Attention: Before inserting, the sample stick must be absolutely dry. If using the hot air blower do not heat the thermometers above 80°C.***

Pump out the sample well via the three way valve V5 (Fig. 1) which should be pointing up and reintroduce the correct quantity of exchange gas (see section 2.2.1.).

Slightly open the cold valve V4 to reach 60-70 mbar on the gauge of the helium pumping unit in order to minimise the cool down time, then close the cold valve V4. The low temperature impedance of the valve assures the correct flow.

## 2.3 Helium transfer:

Before the cryostat is totally empty, open the  $^4\text{He}$  pressurisation valve V2 to depressurise the bath and fill up the cryostat with liquid  $^4\text{He}$  in the normal way.

### 3 Figures

- V1. Vacuum valve
- V2. He pressure
- V3. Tail pumping
- V4. Cold valve
- V5. Exchange gas
- V6. Warm valve
- V8. Pressure regulation
- 8. Temperature well
- 9. Heat exchanger
- 10. Sample chamber
- 11. Nitrogen fill
- 12. Helium fill
- 13. Temp. controler cryostat
- 14. Temp. measurement sample stick

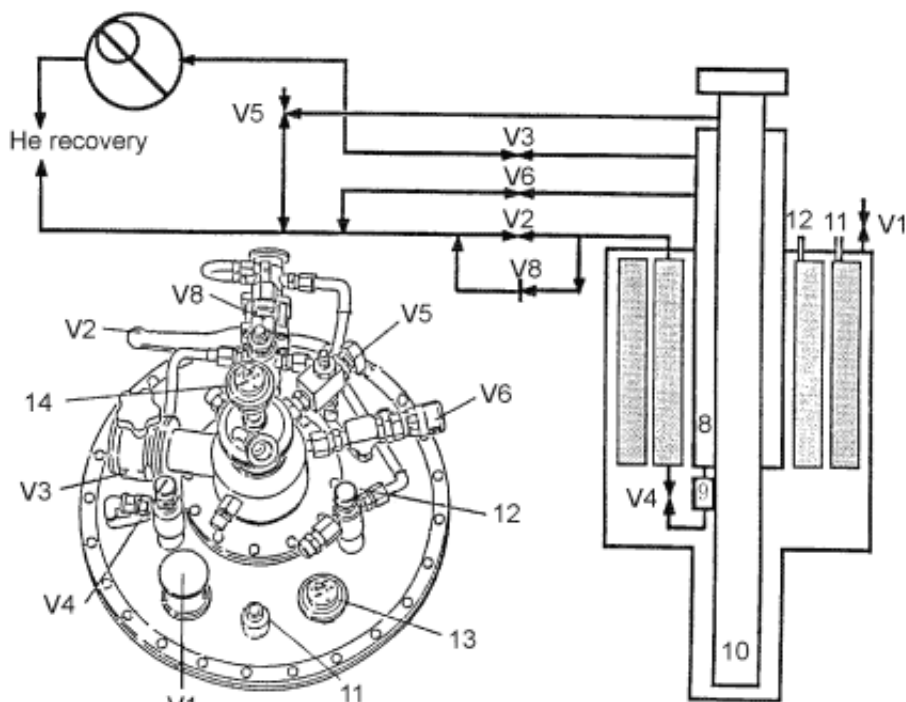


Fig.1

Figure. 1

### Risø 'Orange' Cryostat main dimensions

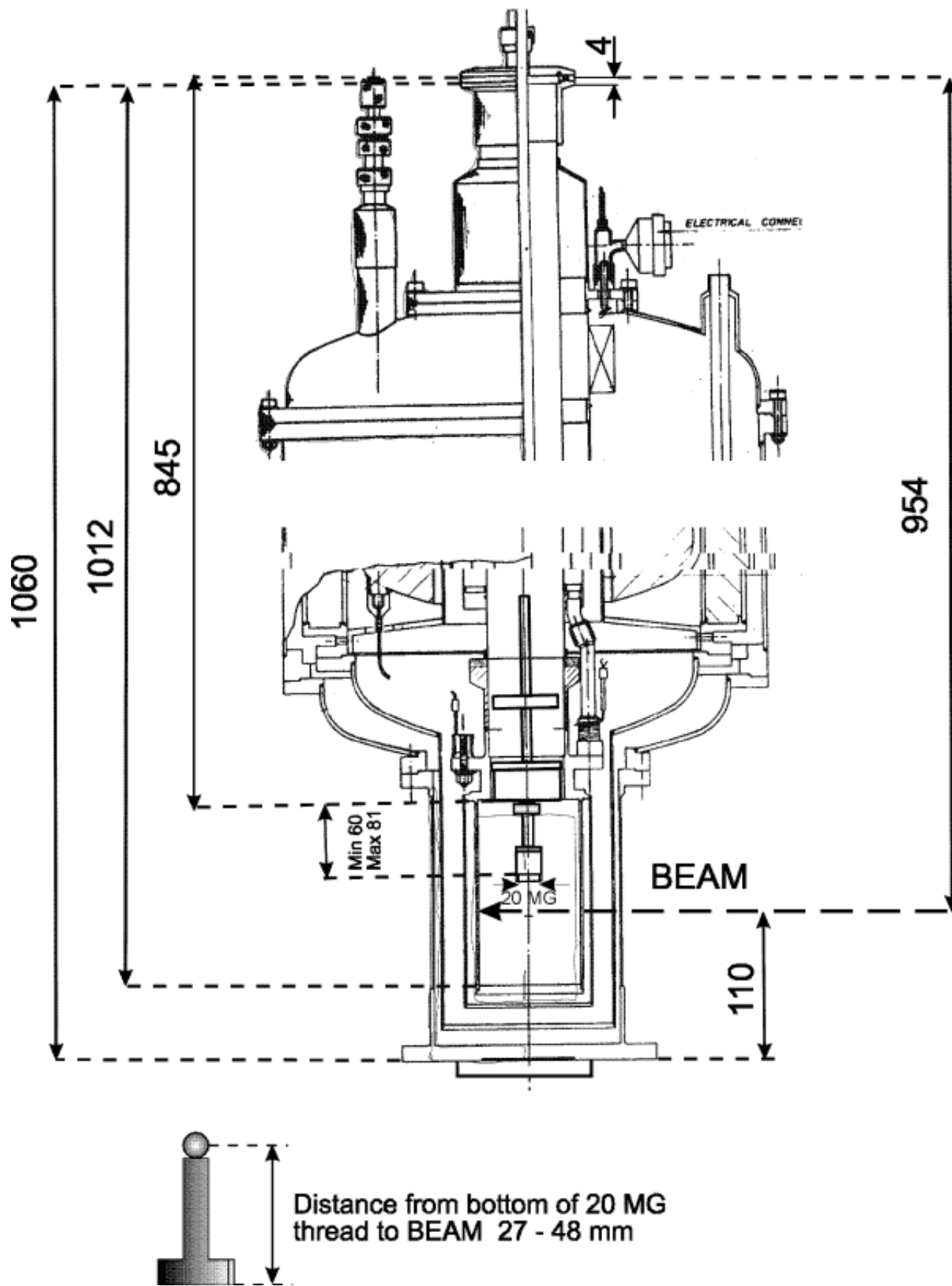
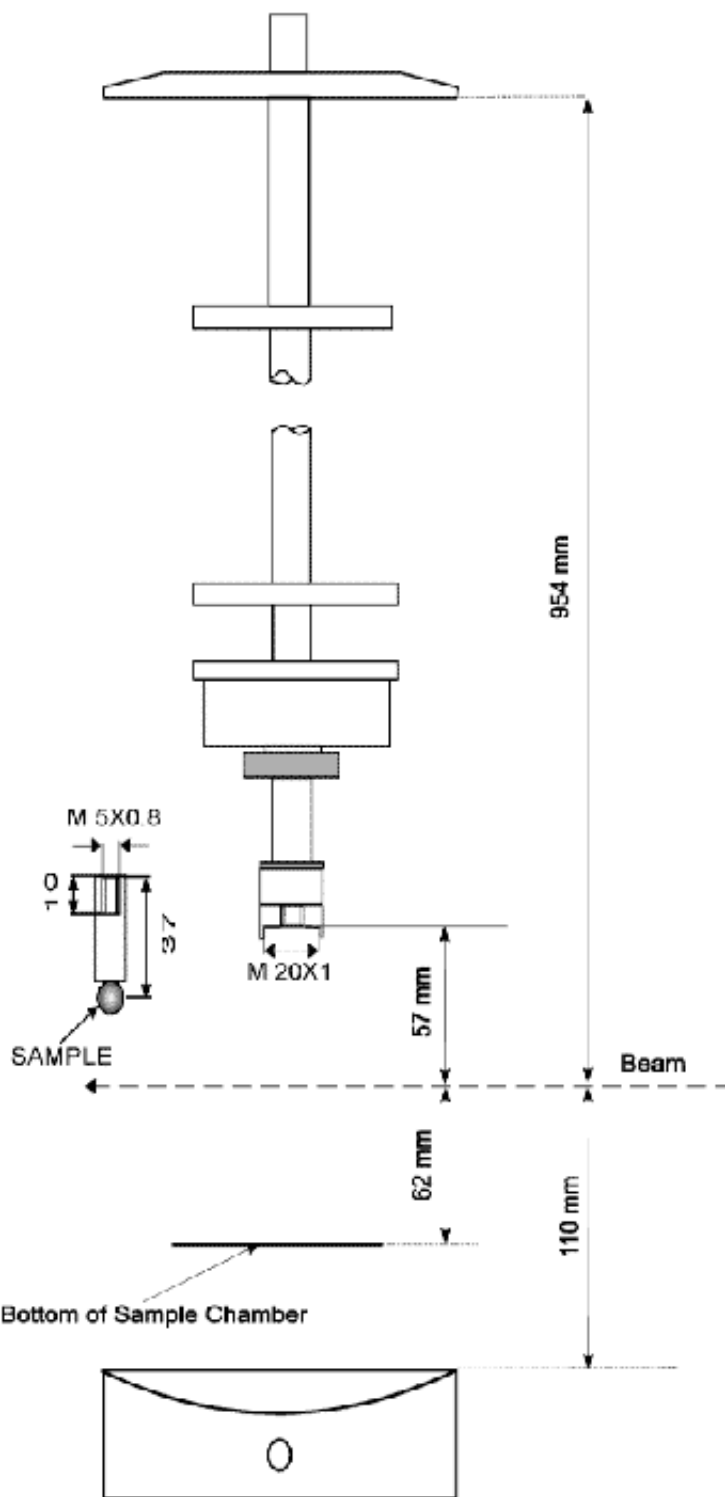


Figure. 2

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### Sample Stick 'Orange' Cryostat



**Figure. 3**

# Temperature cabling

## for Risø 'Orange' Cryostat

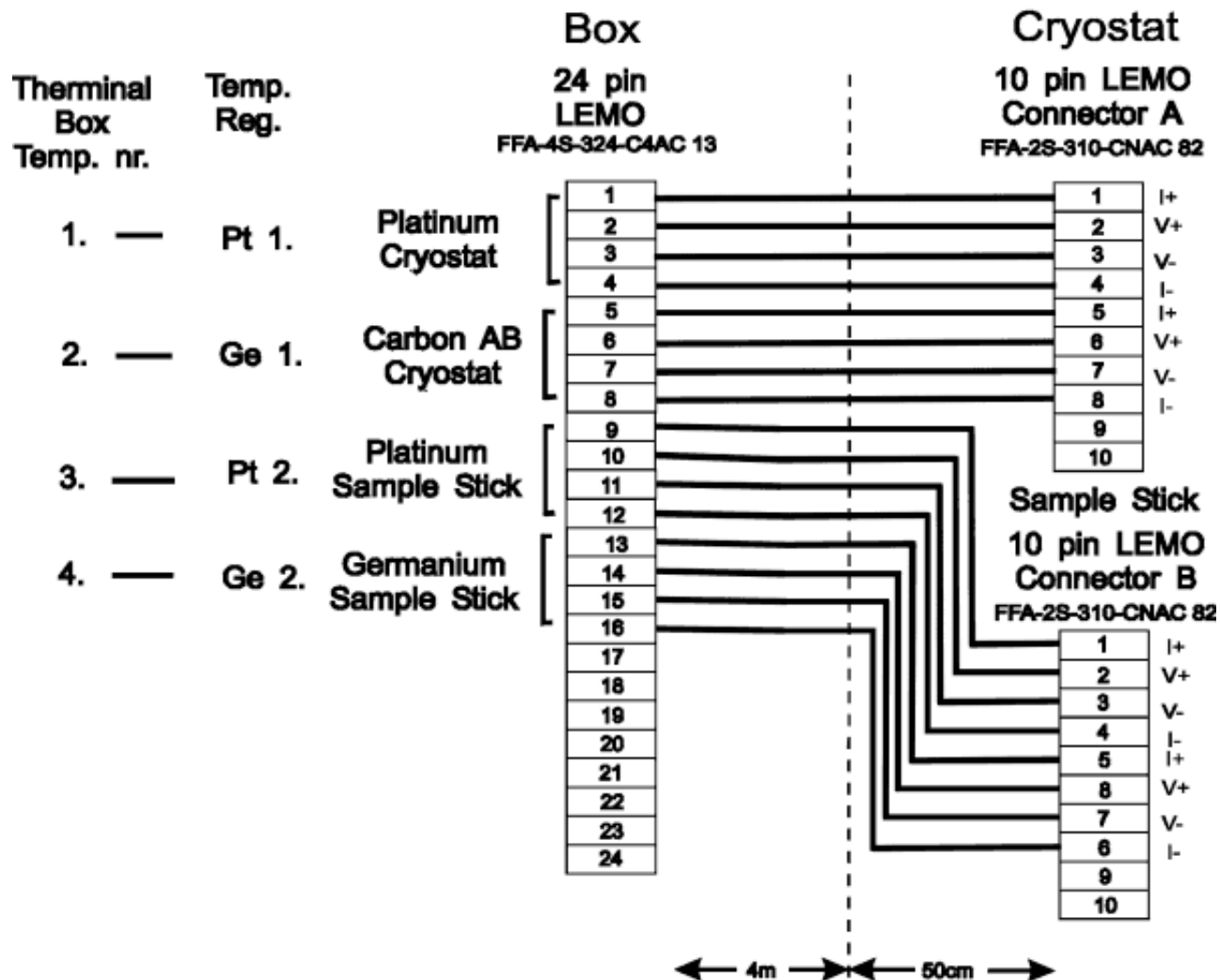


Figure. 4

# Heater cabling for Risø 'Orange' Cryostat

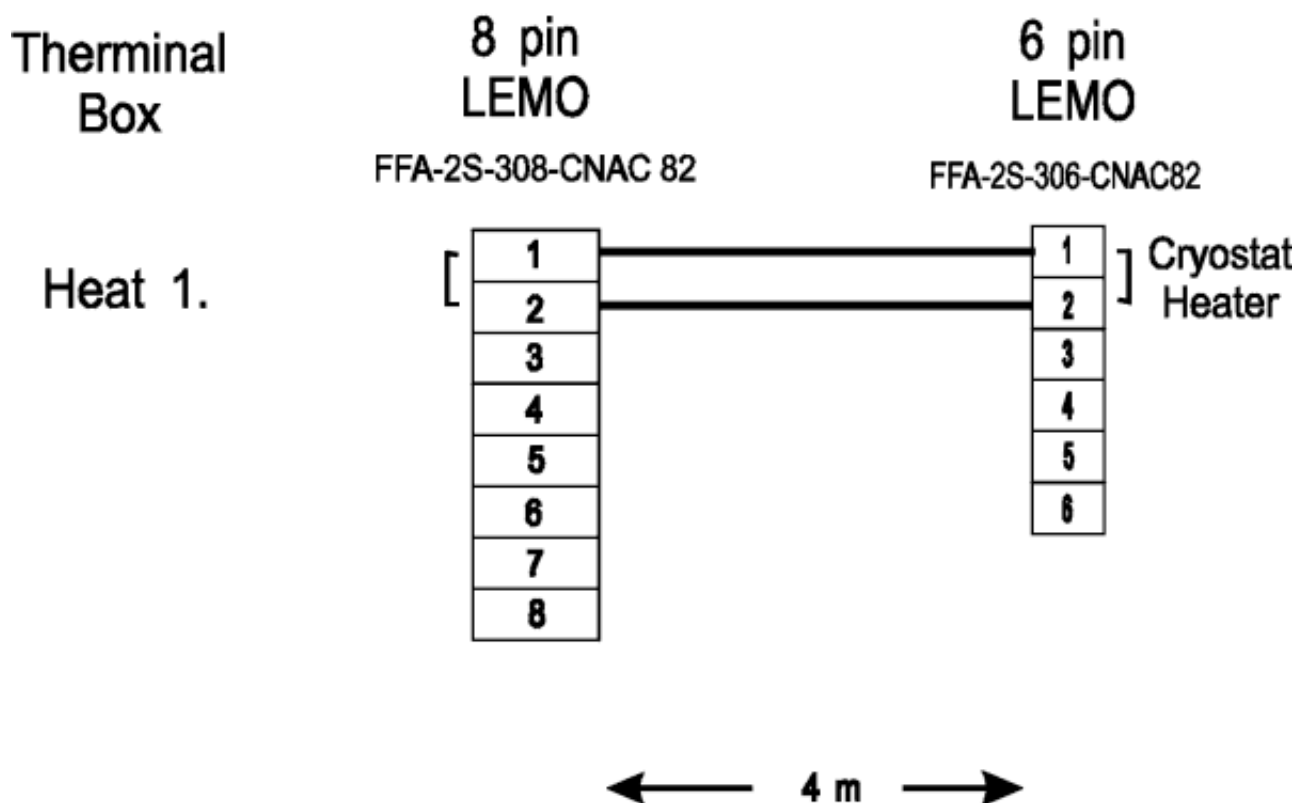


Figure. 5