Operation, installation, and troubleshooting of the LNCS

Description of Operation

Liquid nitrogen from a supply reservoir is fed through an inlet tube into the heat exchanger where the liquid nitrogen cools the DSC cell heat exchanger as it is vaporized into nitrogen gas.

The cooling byproduct, which includes nitrogen vapor and possibly some liquid nitrogen, exits the top of the heat exchanger cavity through an exhaust tube and proceeds towards the liquid detection/evaporator assembly.

Description of Operation

The Liquid detection/evaporator (diagnostic signal #9) assembly includes a liquid detector capable of determining the presence of liquid nitrogen in the exhaust. If it is determined that liquid is present in the exhaust the control electronics module adjusts a pressure control device to reduce the amount of LN2 supplied which eliminates liquid in the exhaust stream.

Description of Operation

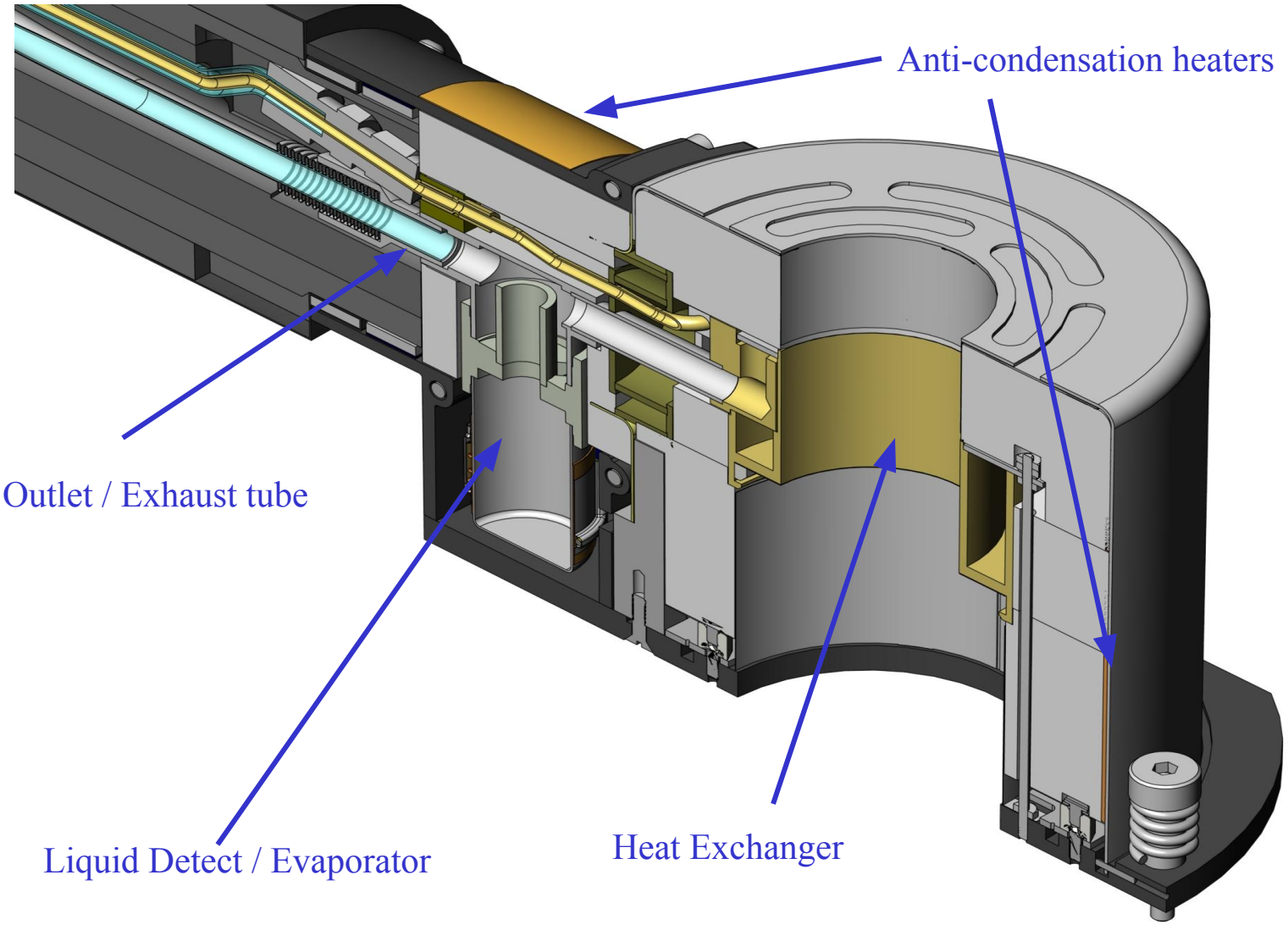
When liquid has been detected, in the liquid detect/evaporator assembly, droplets passing over the liquid detect/evaporator assembly fall to the bottom of the evaporator can within the liquid detect/evaporator assembly. Because the evaporator is maintained at about 40°C, the liquid droplets are vaporized. The resulting nitrogen vapor rises back to the top of liquid detect/evaporator assembly and is carried out the exhaust tube to be vented.

Description of Operation

In this design, the evaporator can not only evaporates droplets of cooling agent , but also provides a source of heat to the thermocouple so that liquid can be detected from the sharp drop in temperature when liquid nitrogen contacts the thermocouple bead.

The evaporator temperature (diagnostic signal #11) is maintained at 40°C by a strip heater and controlled by feedback from a control thermocouple secured to the side of the evaporator can.

Inside the cooling head



Components of the LNCS

COMPONENT DESCRIPTION

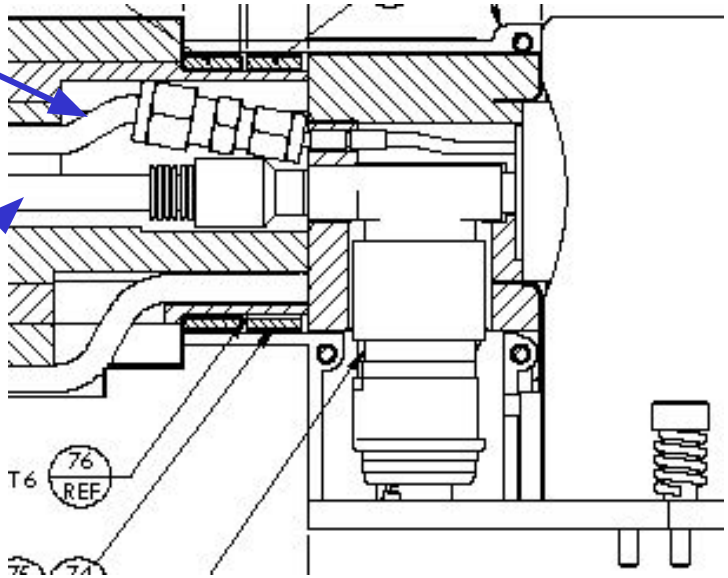
ANTI-CONDENSATION STRIP HEATERS

Both strip heaters use 24V and are always ON. The 24V is supplied by the LNCS.

HEAT EXCHANGER The DSC cell and furnace heater are connected to a cooling device assembly comprised of thermal resistance nickel rods and a Nickel cooling flange. The heat exchanger couples the LNCS to the flange of the DSC cell. A graphite gasket is installed on the heat exchanger to increase the thermal contact at the heat exchanger / flange interface. The cooling flange is coupled to the heat exchanger at its top surface. So that the predominant heat transfer mechanism is via the top surface of the cooling flange.

Components of the LNCS

INLET TUBE **Transfers liquid Nitrogen from the LNCS dewar to the heat exchanger head.**



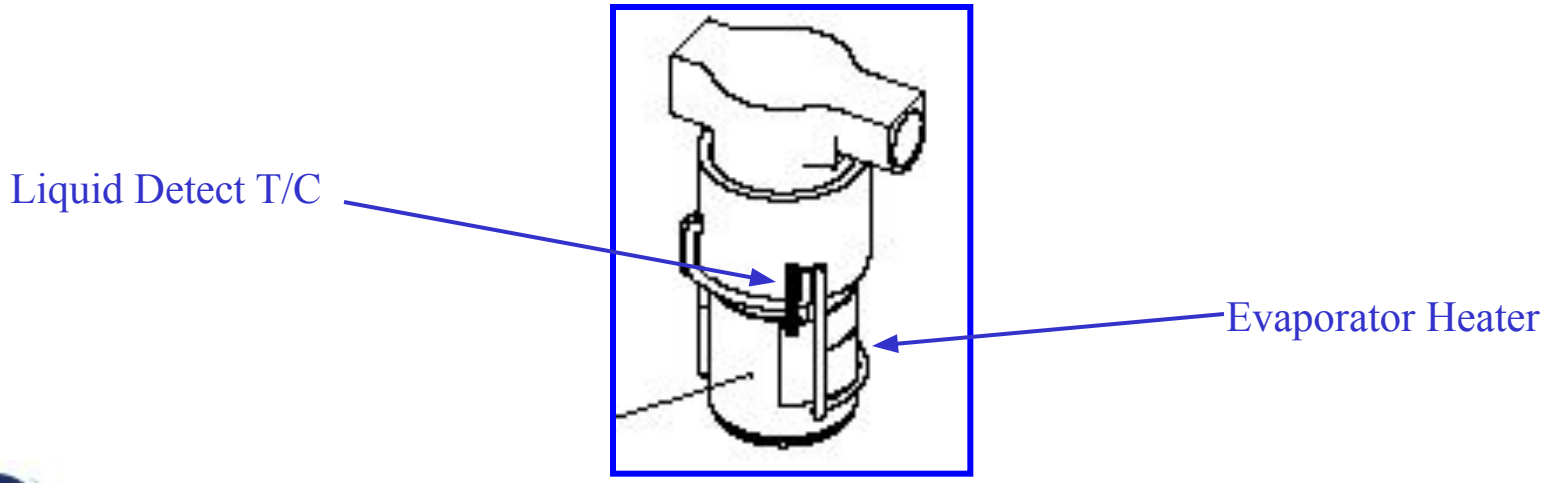
OUTLET TUBE

Carries exhaust back to the tank

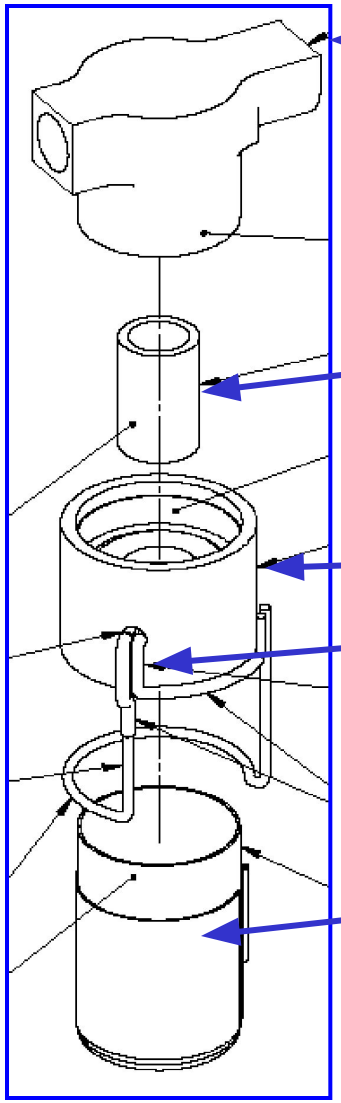
Components of the LNCS

LIQUID NITROGEN DETECTION - EVAPORATOR ASSEMBLY

The liquid detect/evaporator assembly detects and vaporizes liquid in the exhaust from the heat exchanger.



Components of the LNCS (Liquid Detect)



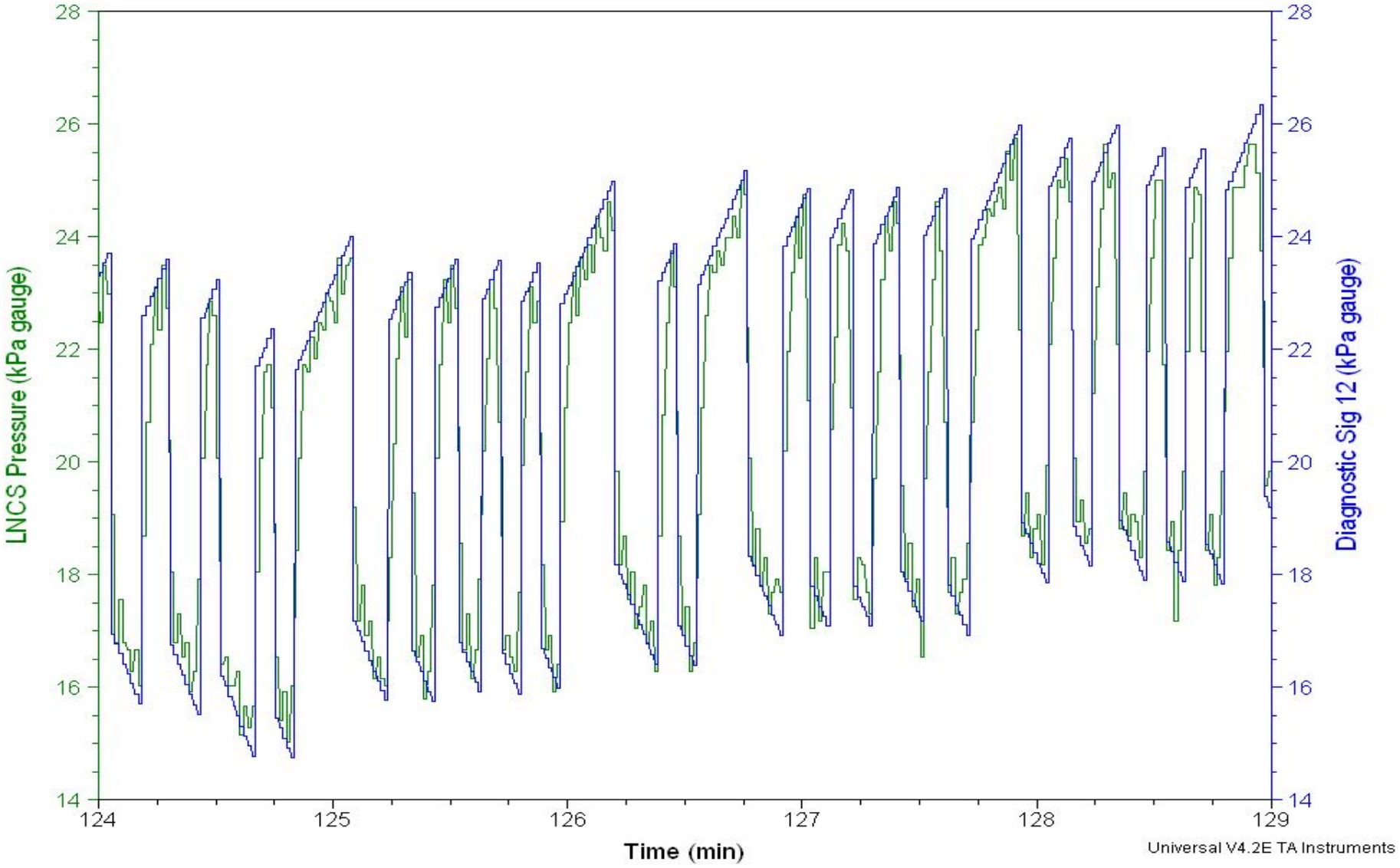
Exhaust from the heat exchanger enters here

Exhaust port

Liquid detect chamber with
Copper/Constantan thermocouple

Evaporator can with heater controlled to 40°C

LNCS Pressure Control



LNCS Pressure range

Coolant pressure requirements will vary with the heat load on the heat exchanger, e.g., from less than 2 psi at -180°C to 6 psi or higher at 500°C (1psi= 7 kPa).

The preferred method of pressurization is to connect the LNCS dewar to a clean, dry source of external Nitrogen regulated at 10 psi.

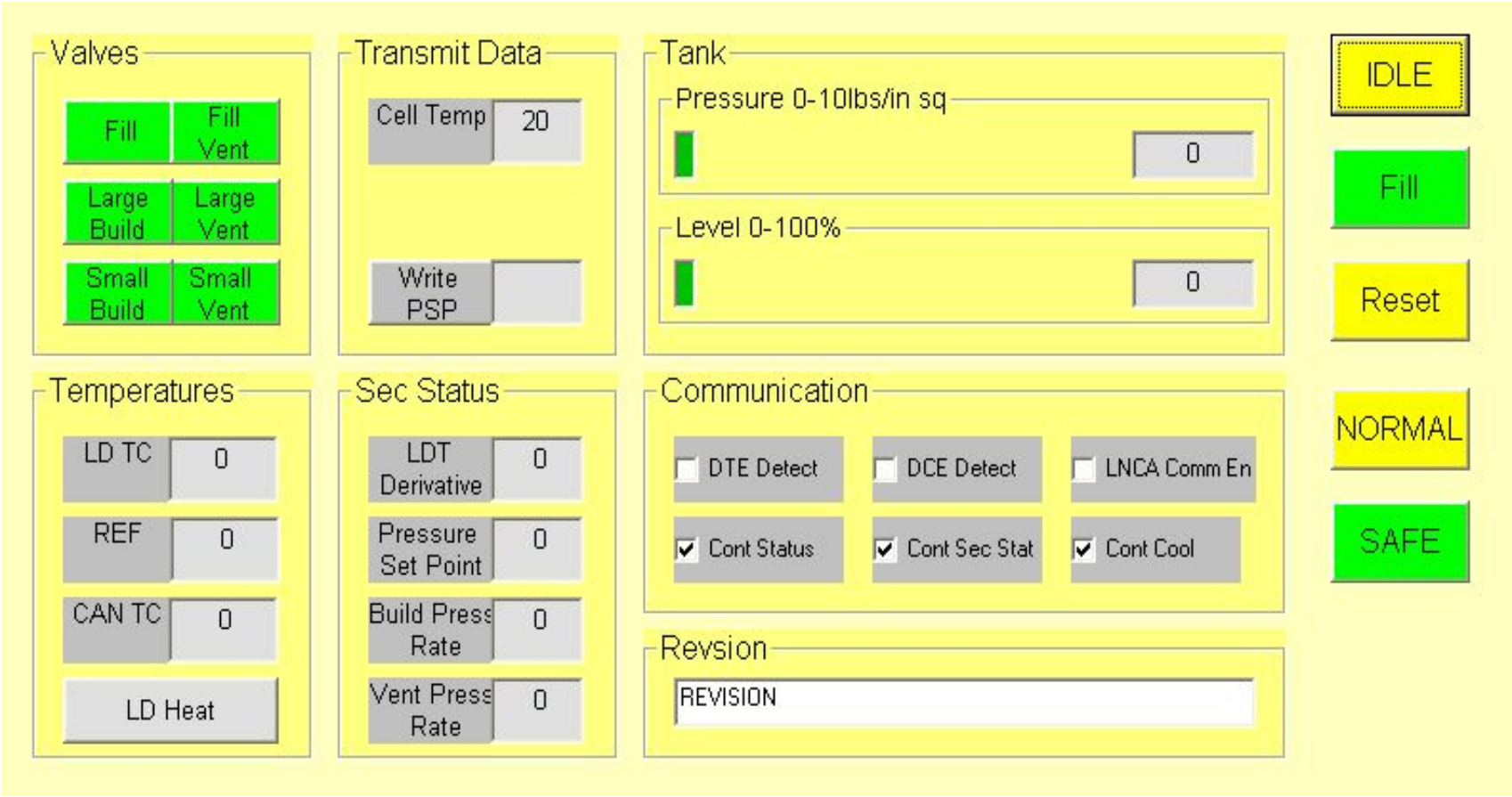
However, this pressure source should NOT be connected to the same regulator as the base purge or cell purge.

Dewar pressure control

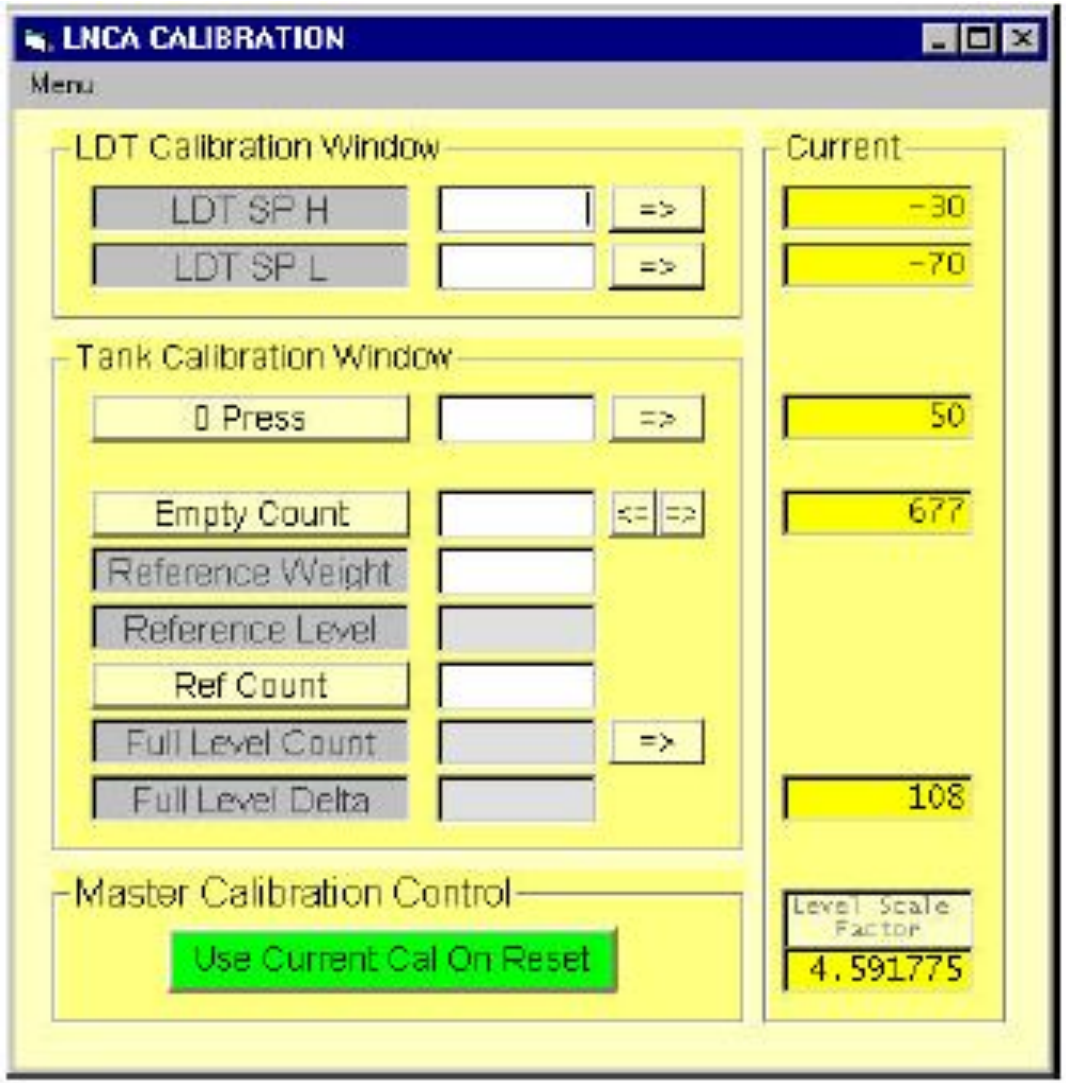
The dewar pressure is controlled by a pressure control valve assembly, which *regulates the amount of cooling agent supplied to the heat exchanger*. This pressure is generally controlled with a feedback loop from the liquid detect / evaporator temperature (signal #9). Explain calibration (what does this number mean?). Coupled to a manifold on the neck of the dewar are four pressure control valves that comprise the pressure control assembly. The pressure control valves are employed to increase pressure and decrease pressure based on liquid detection.

Calibrating the LNCS

The LNCS control screen



The LNCS calibration screen



Calibrating the LNCS

To calibrate the LNCS before using it, follow these steps:

1. Select Menu/Control Windows/Calibration from the menu.
2. The current calibration is displayed on the right side of the screen.
3. With the empty tank (no liquid nitrogen) and at Zero Pressure (ambient), click on the 0 Press button and a number will appear in the box to the right of the button. Write this number

down. Press the Empty Count button and a number will appear in the box to the right of the button. Write this number down.

4. Press Ctrl X to close the Calibration Window.

Calibrating the LNCS

- 5. Click on the Commands pull down menu.
- Select Fill to the Neck. The LNCS will fill the
- tank.
- 6. Select Menu/Control Windows/Calibration from the menu.
- 7. Enter the 0 Press and Empty Count values that were written down in step 3 of this calibration
- into the box to the right of the buttons. Click on the => button for each value to send the
- number to the box on the right.
- 8. Enter 100 in the box to the right of the Reference Level.
- 9. Click the Ref Count button. Click on the box to the right of the Full Level Count. The software will calculate the Full Level Count and the Full Level Delta. Click on the => button next to the "Full Level Count" button to send the number to the box on the right.

Calibrating the LNCS

- 10. Ensure that the Master Calibration Control is set to “Use Current Cal on Reset”.
- 11. Press Ctrl X to close the window. Press the Reset button on the LNCS for the calibration to take effect.
- **Calibration Ranges**
- 0 Press (Zero Pressure) 25-65
- Empty Count 625-700
- Ref Count (Reference Count) 505-610
- Full Level Delta (Empty Count-Ref Count) 90-120

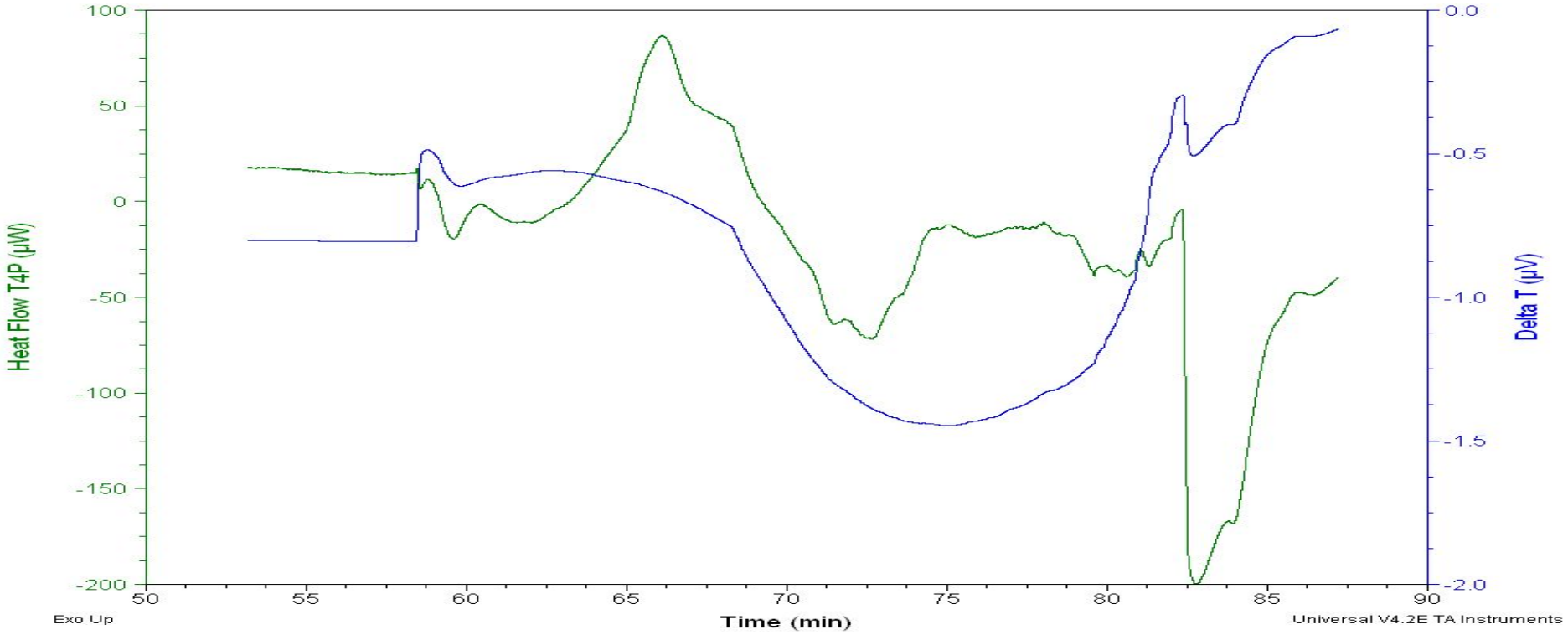
How to troubleshoot a LNCS

- Troubleshooting a LNCS system adds another layer of complexity to an already difficult situation.
- The best way to see the effect of the LNCS on the QDSC system is to look at the interface between the two components.
- That interface would be the Flange Temperature. It can influence the control of the cell heater control and the heating rate.

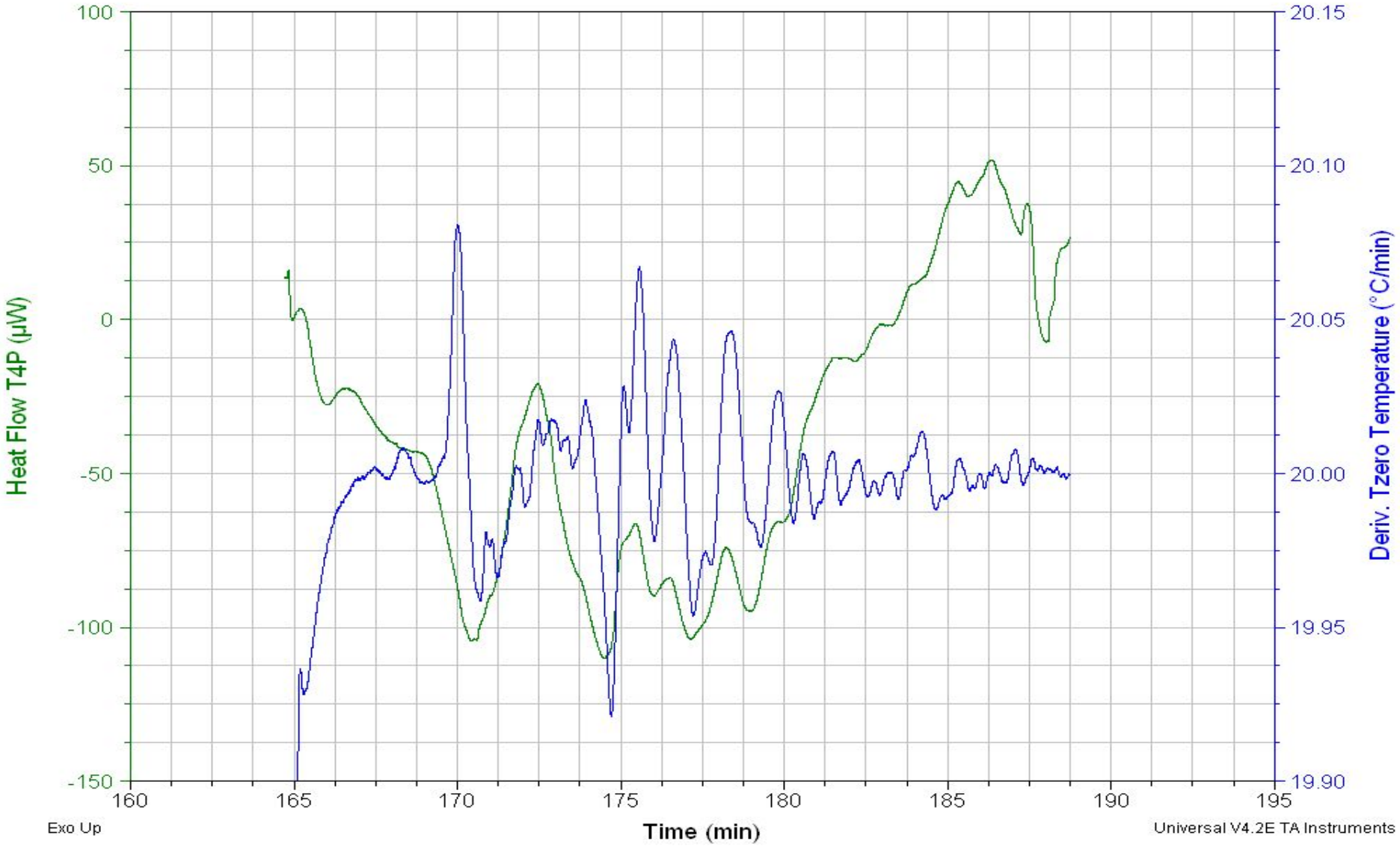
How to troubleshoot a LNCS

- The signals used to troubleshoot a LNCS are….
- The Heat Flow or Delta T signals

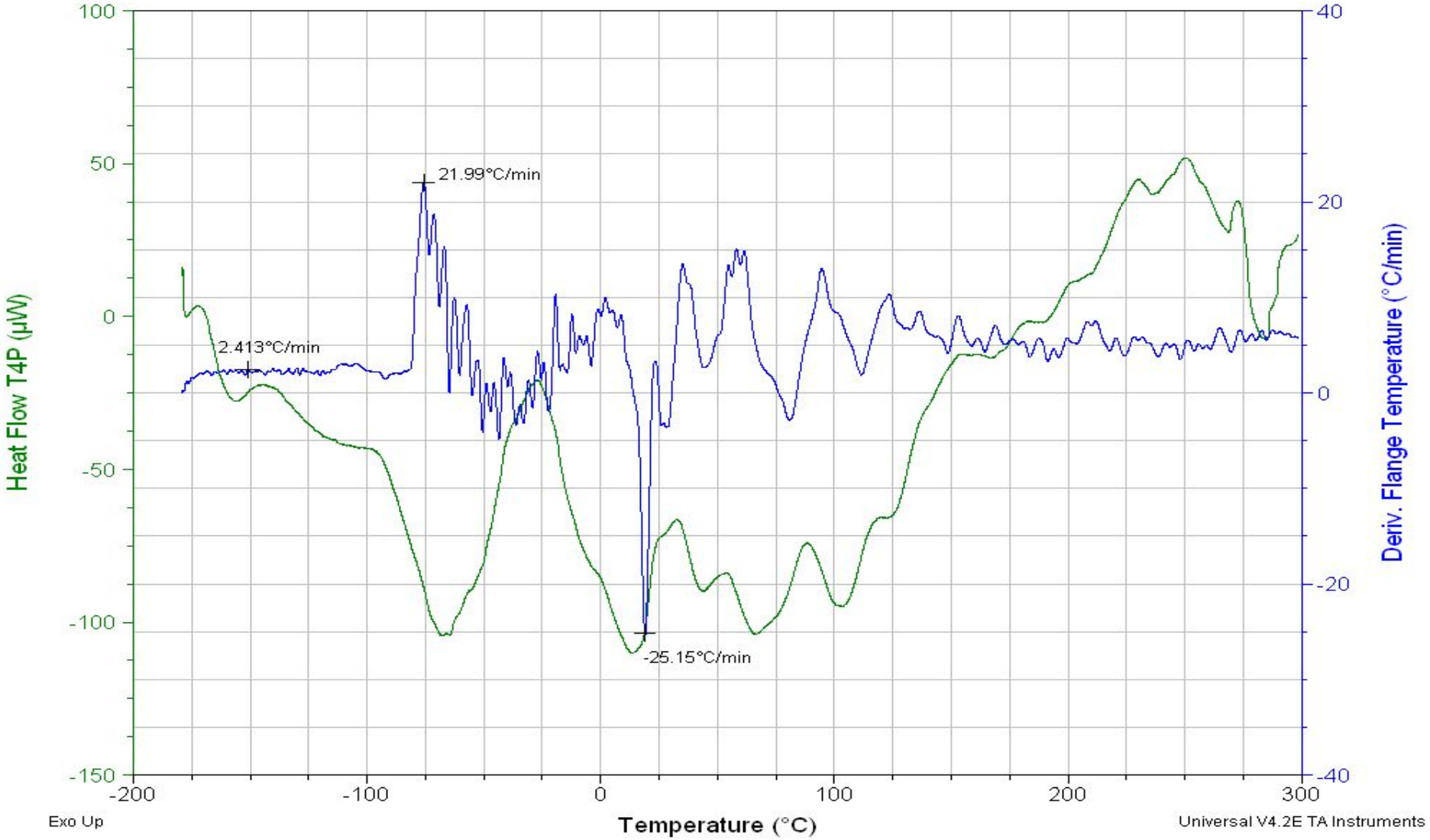
Used to show where the problem is happening



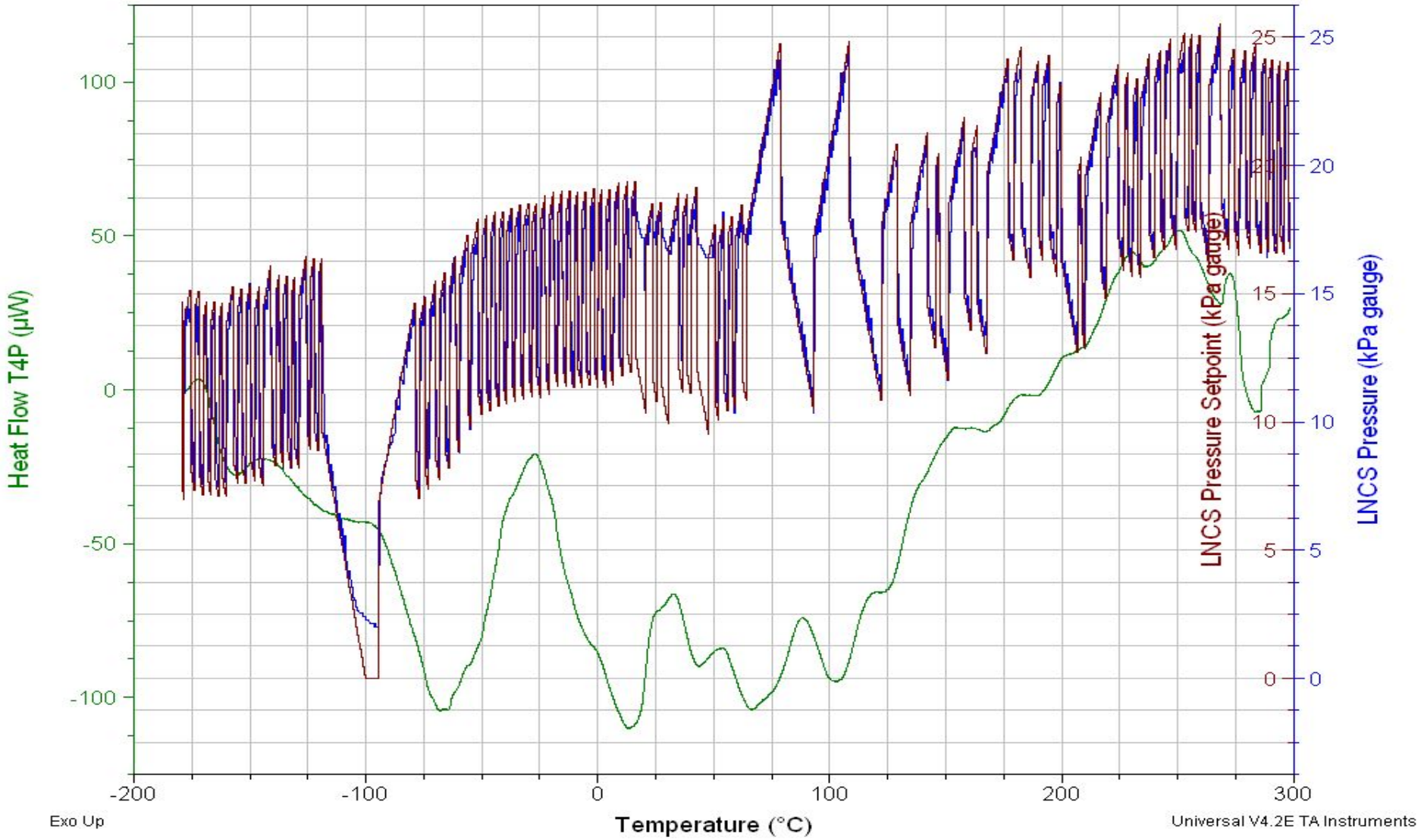
How to troubleshoot a LNCS



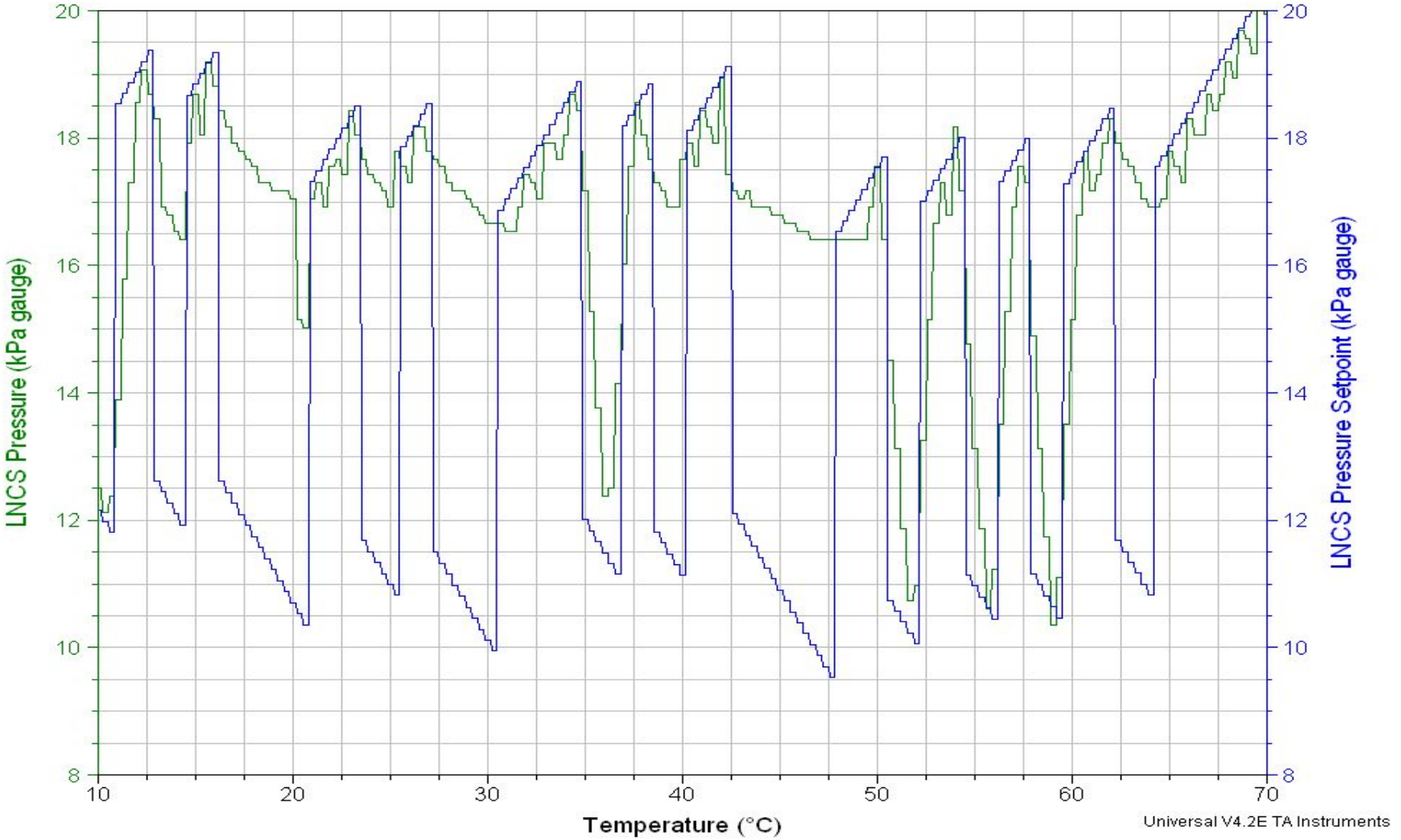
How to troubleshoot a LNCS



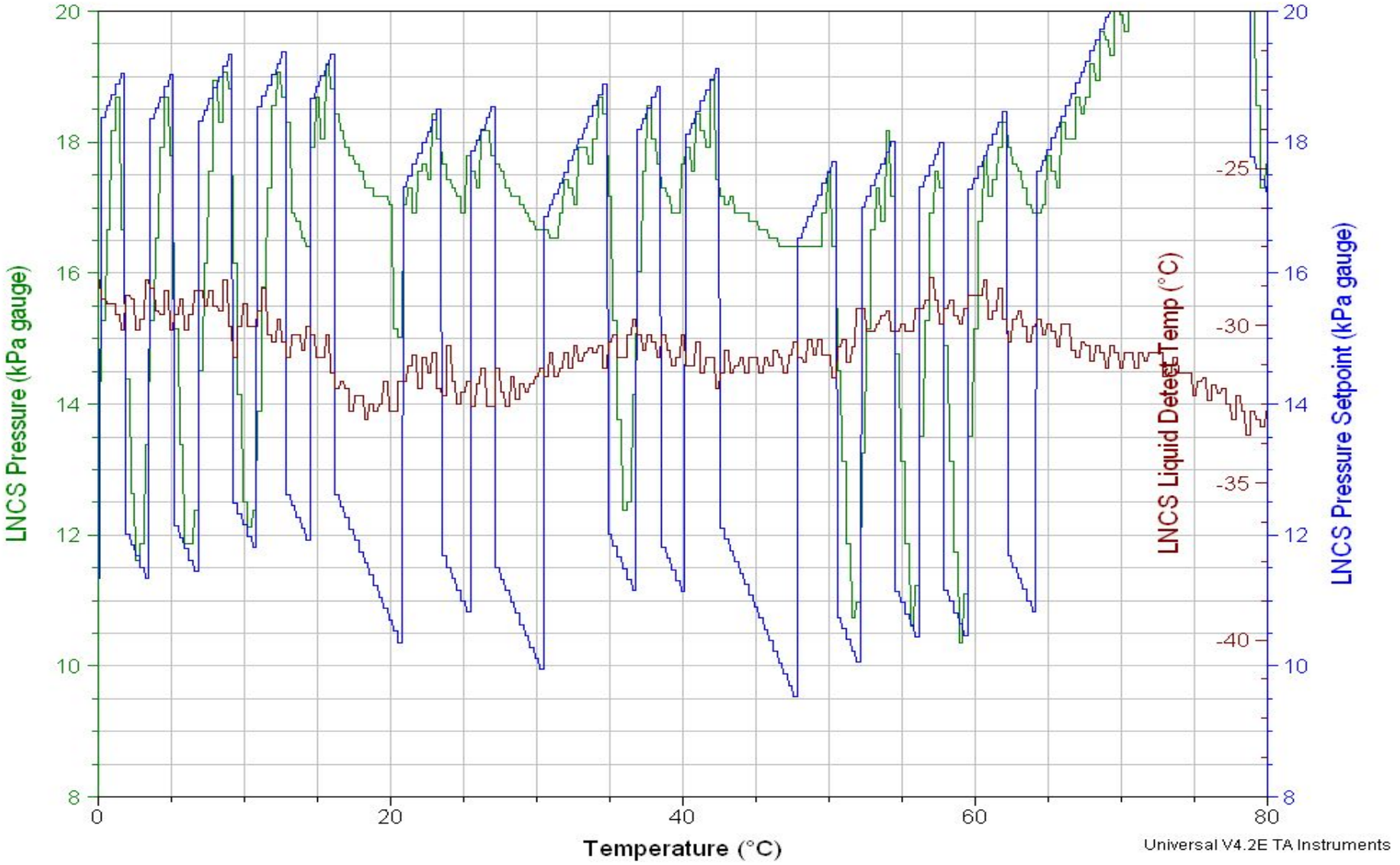
How to troubleshoot a LNCS



How to troubleshoot a LNCS



How to troubleshoot a LNCS



How to troubleshoot a LNCS