PXD Thermal Mock-up Study

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on behalf of DESY BelleII group

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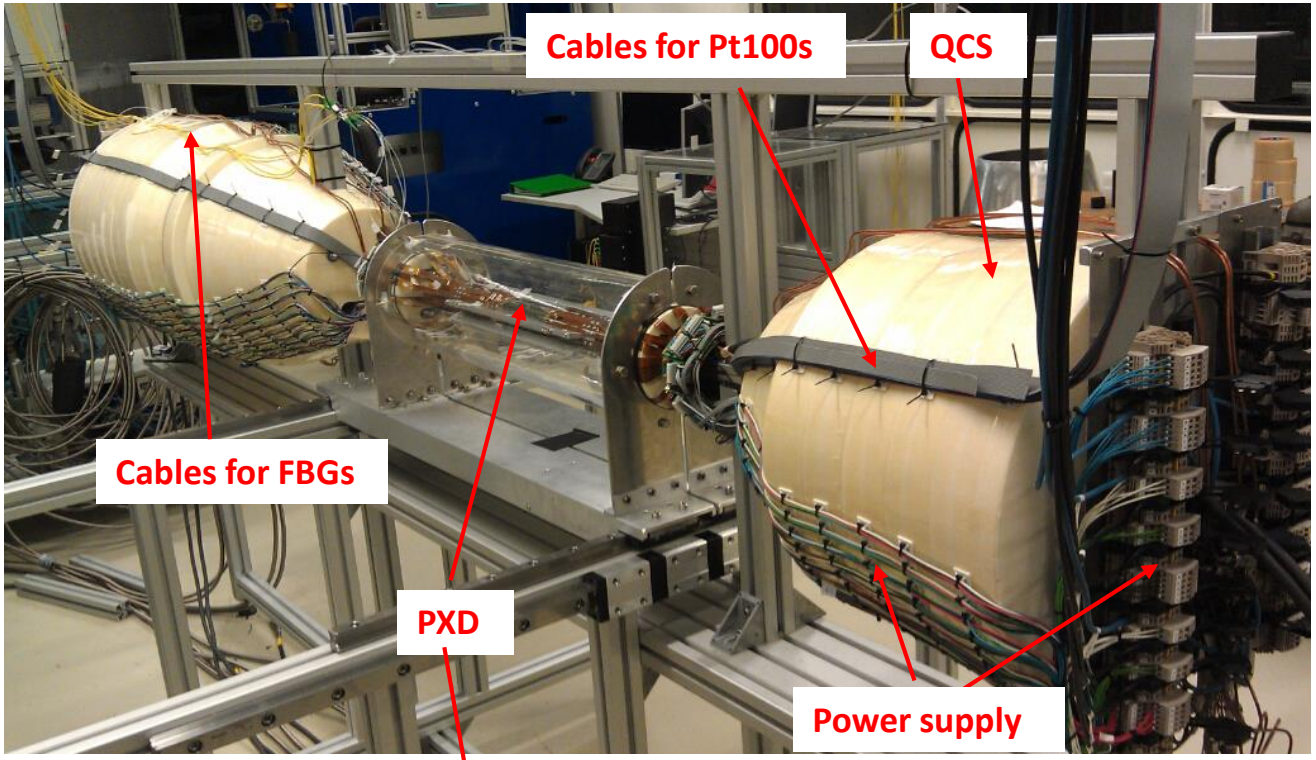
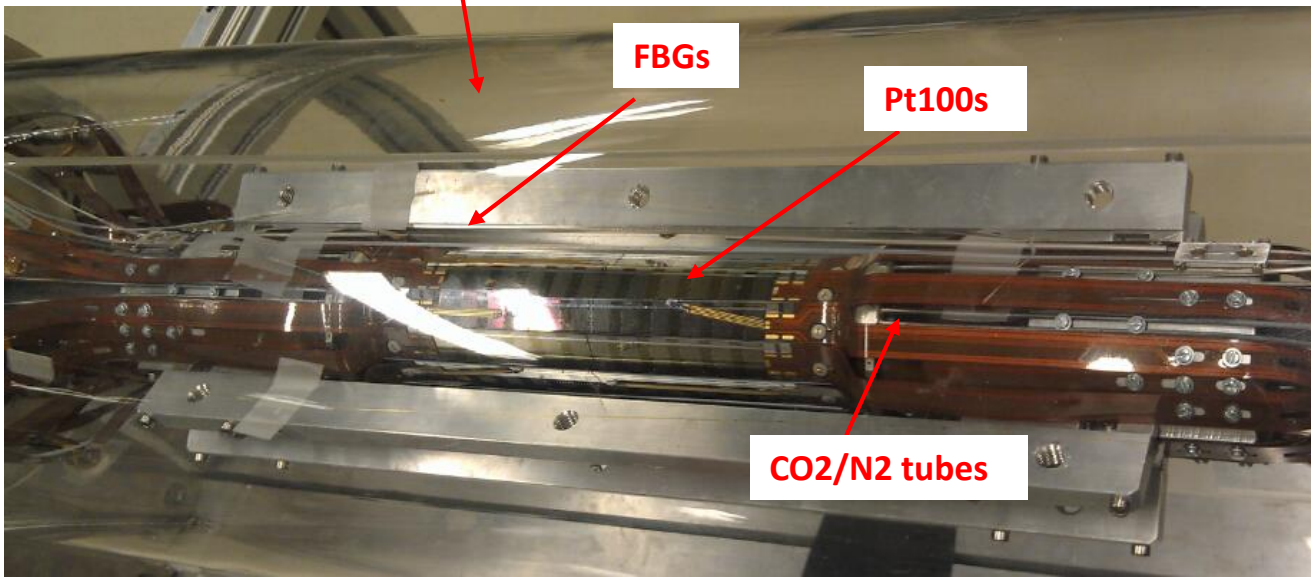
The thermal mock-up at DESY

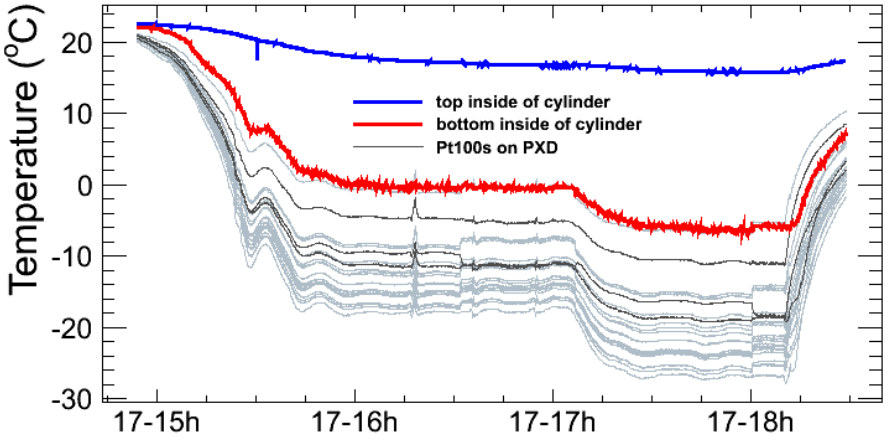


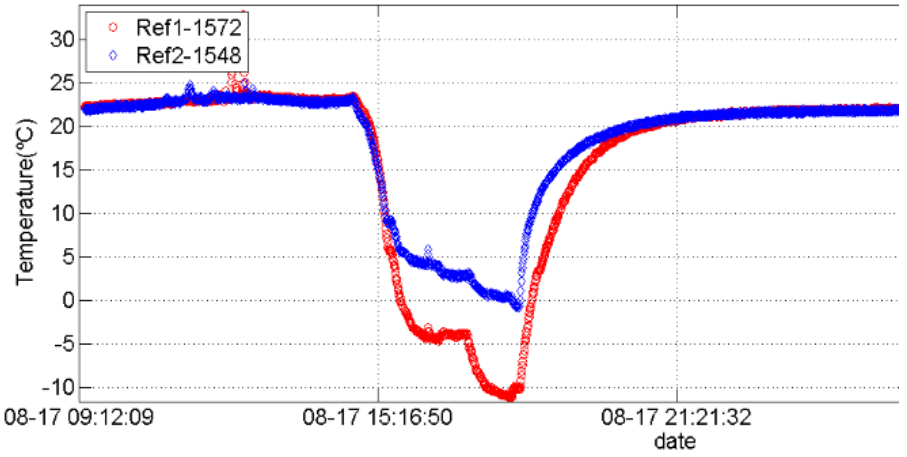


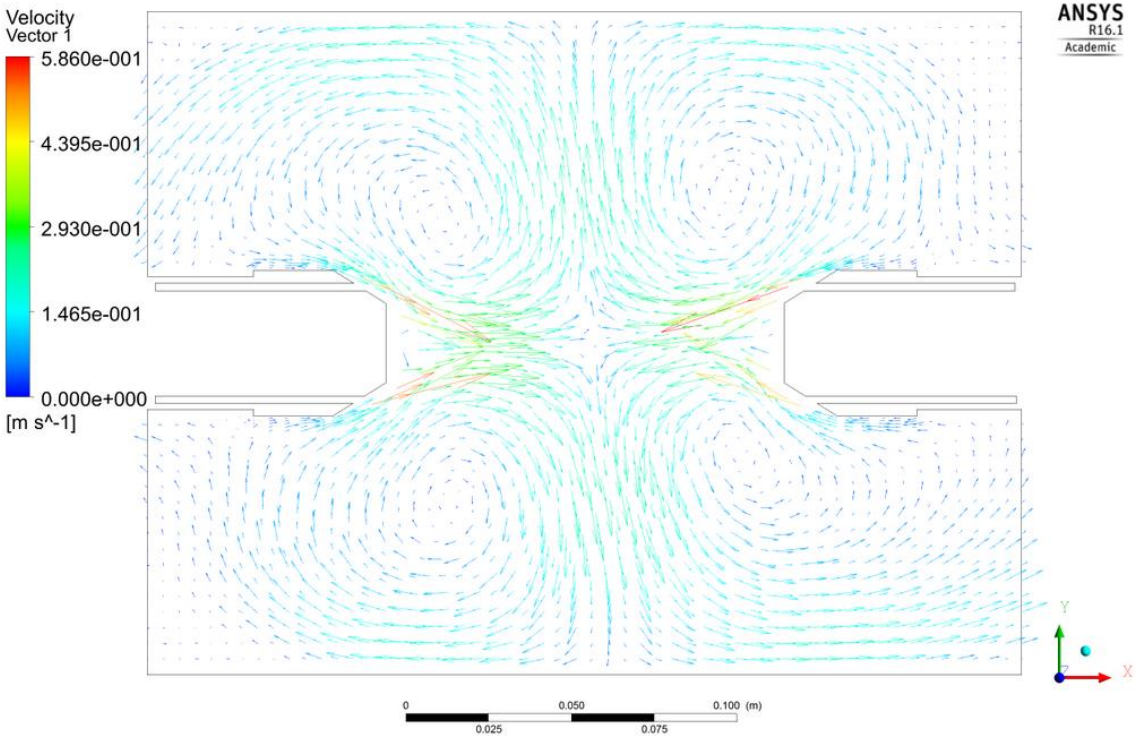
The thermal mock-up is built to study and optimize the cooling system for the BelleII vertex detector.

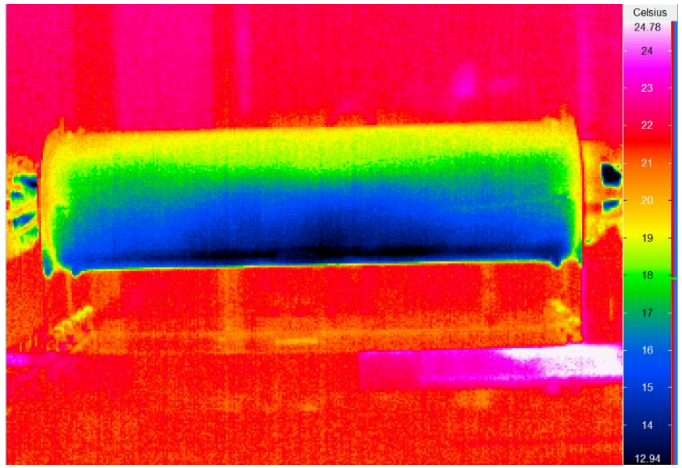
- Closed *CO*2 channel to cool the end of sensors;
- Nitrogen channels to provide air flow;
- Pt100s to monitor temperature on sensors;
- Fiber Sensors(FBGs) to monitor temperature and humidity around PXD.

Temperature in volume





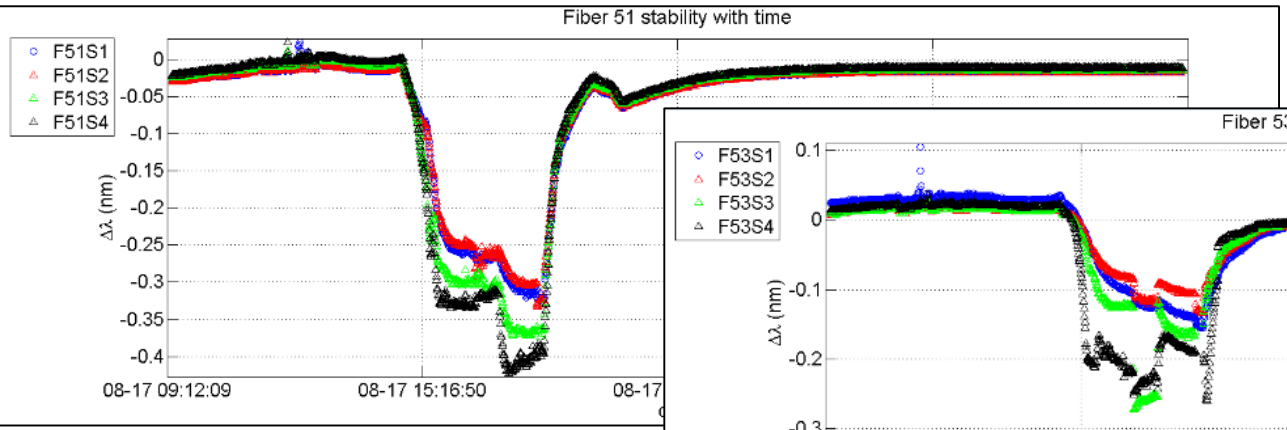


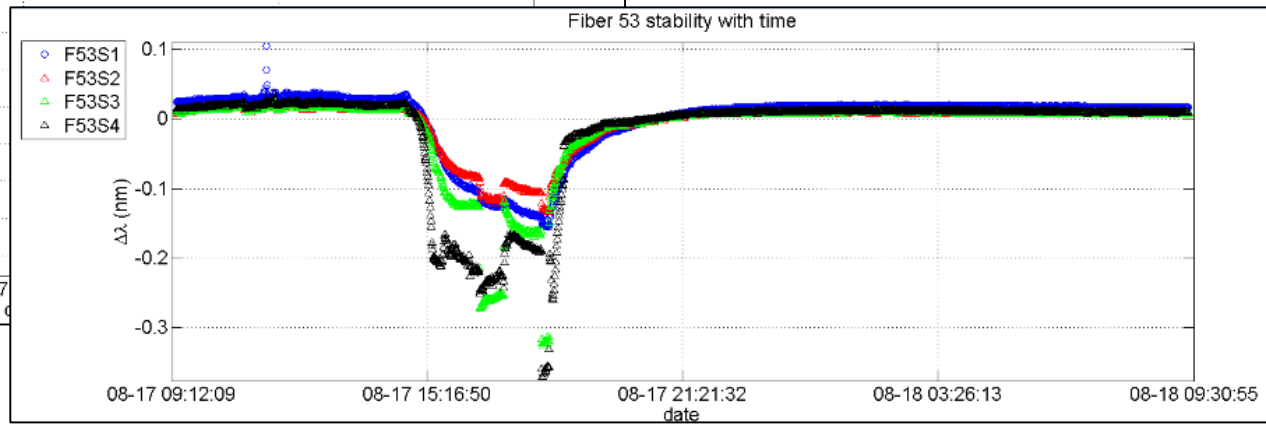


Cold gas goes to the bottom.

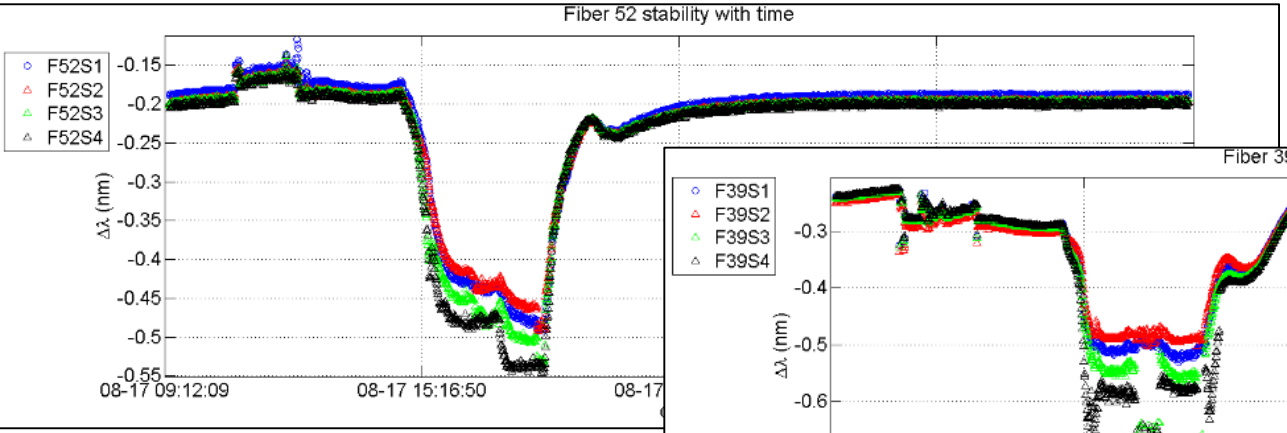
FBGs Results

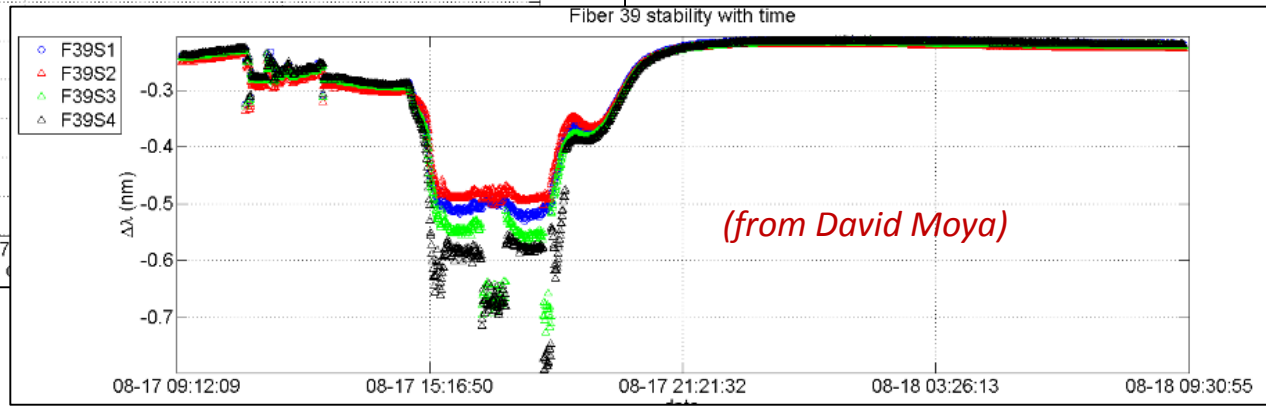
Layout: Fiber 51,52,53 sensitive to temperature; Fiber39 sensitive to temperature+humidity.
Fiber51,52 on top of PXD; Fiber 53,39 on bottom.
Each fiber has 4 sensors, sensor 4 is in the Backward, while sensor 1 is in forward side.





Lower temperature in the bottom.



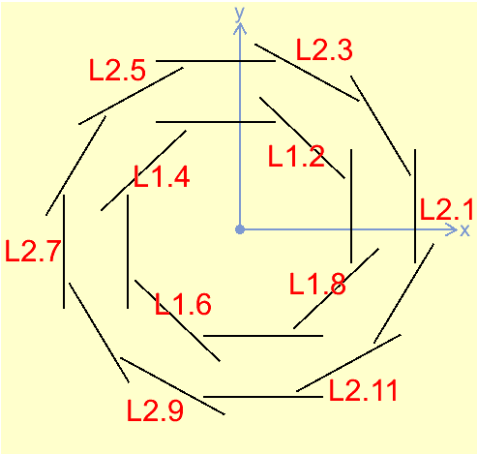


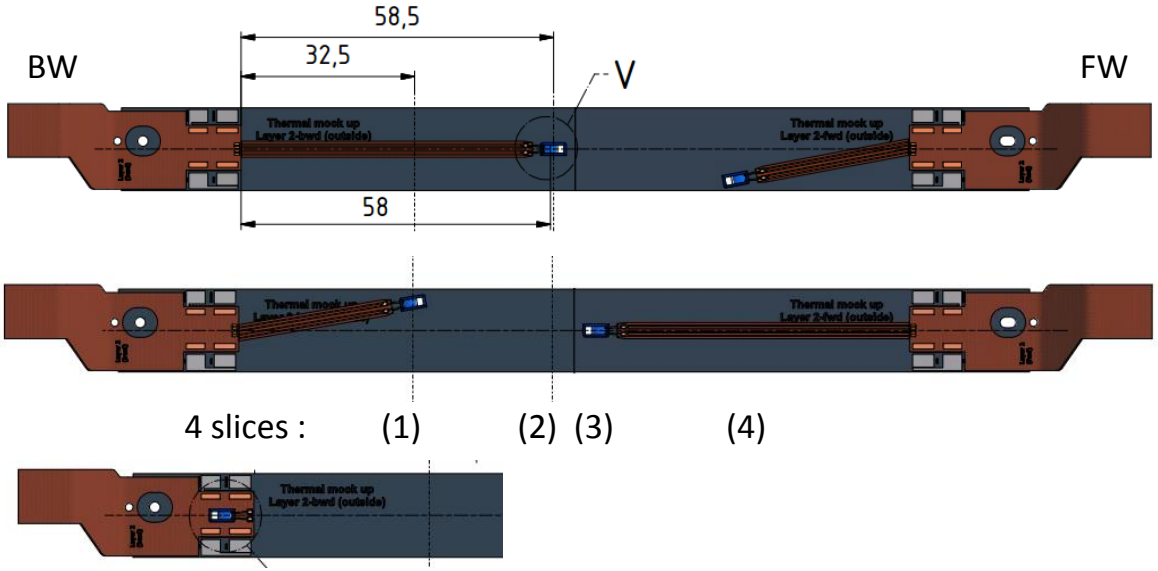
(from David Moya)

Pt100s on PXD

The Pt100s on sensitive area can be classified into 4 slices, and another one glued near DHP/DCD. FBGs locate above L2.5 and L2.11.

Detector Layout





Cooling system requirements

- ❑ Total heat of 360W
- ❑ Sensor < 25°C
- ❑ ASICs < 50°C

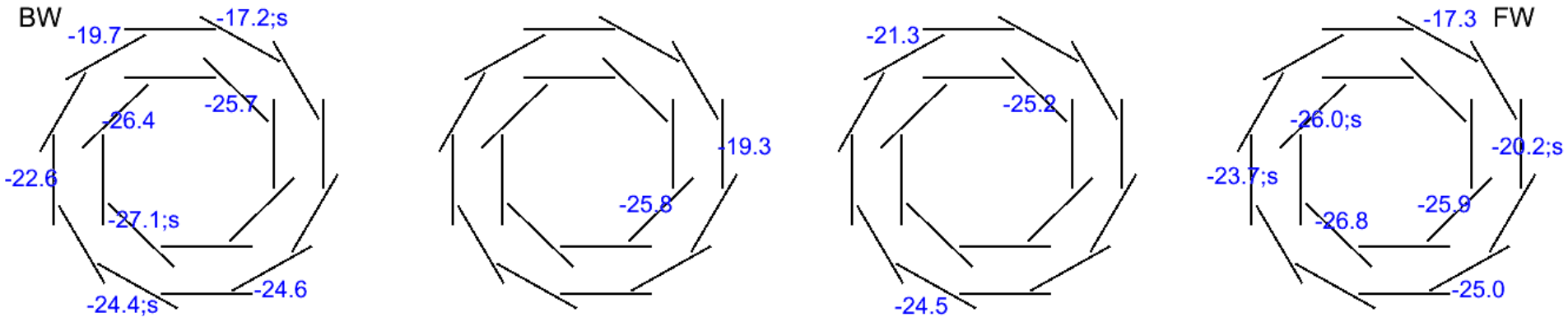
Power on PXD Mock-up

- ❑ DCD/DHP ~230W
- ❑ Switcher ~20W
- ❑ Sensor ~20W
- ❑ Kapton cable ~100W
- ❑ Total ~370W

Spare Pt100s.

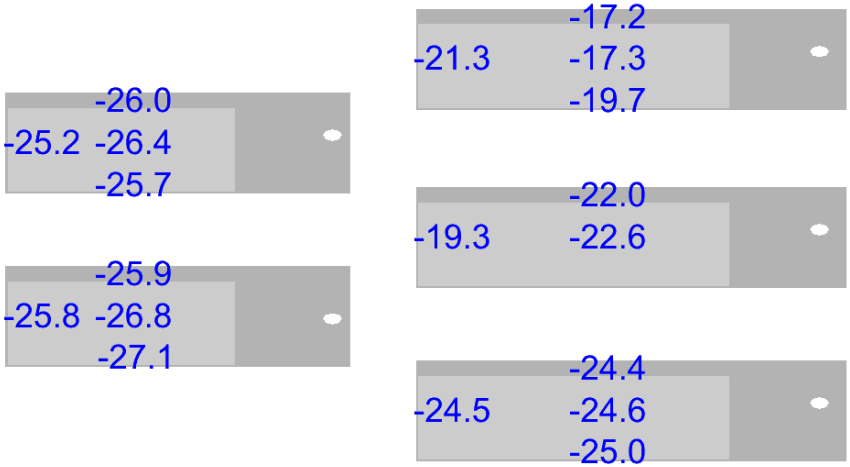
- ❑ 3 locate near DCD/DHP,
- ❑ …

Marco at -30C no heat N2: 6L/min; average : -21.4C

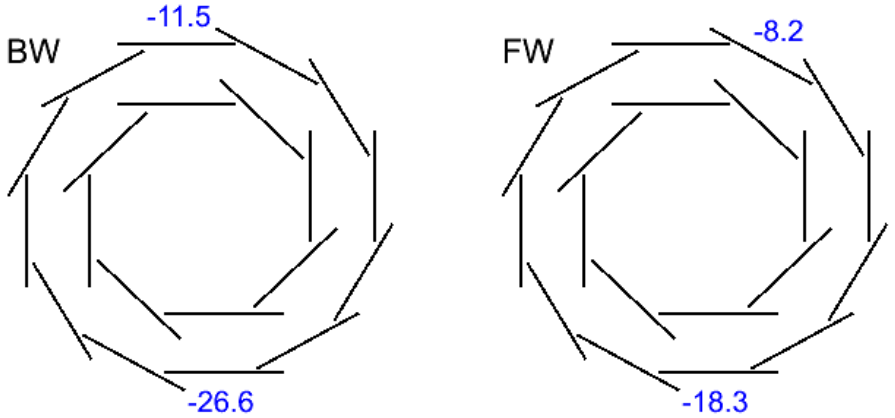


4 slices

Top

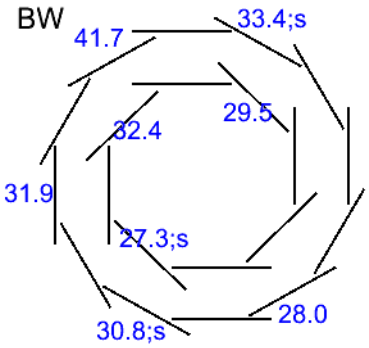


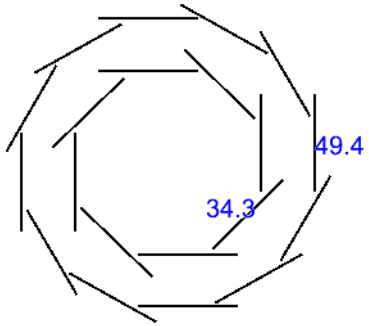
Bottom

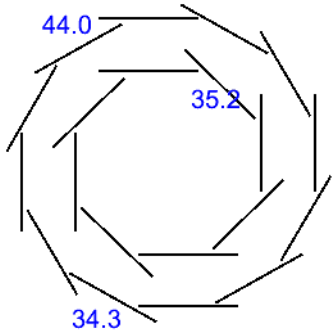


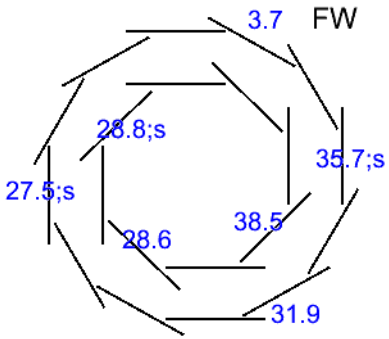
DCD/DHP

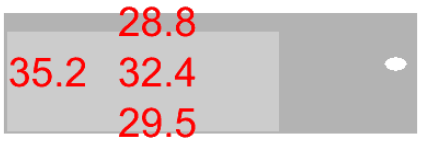
Marco at -30C; N2: 6L/min; DCD/DHP 3/3 on; Switcher + Sensor on

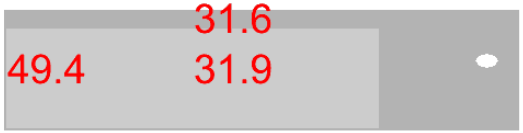


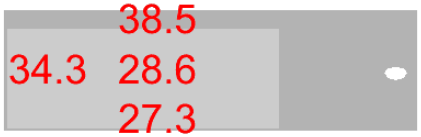


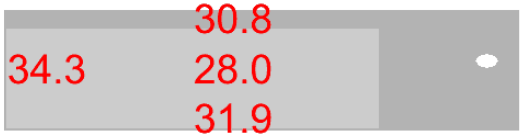


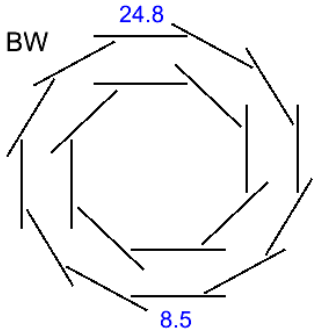


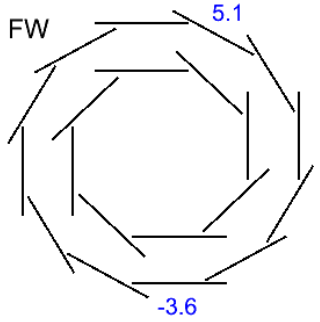








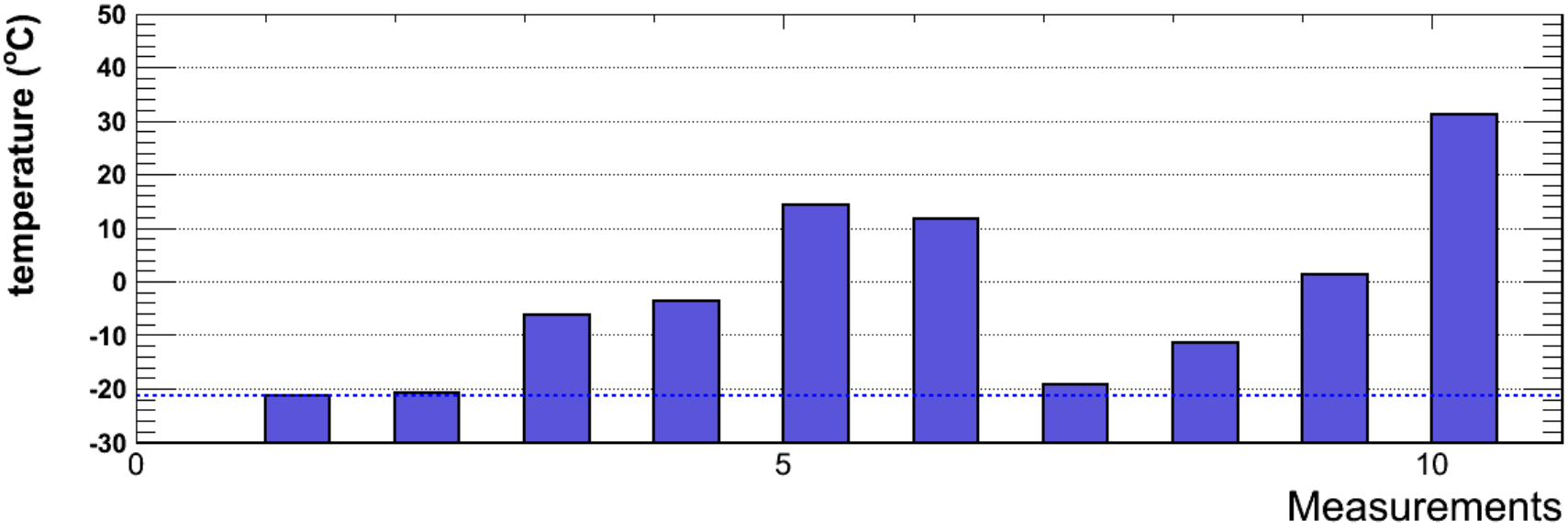




Summary of the temperature

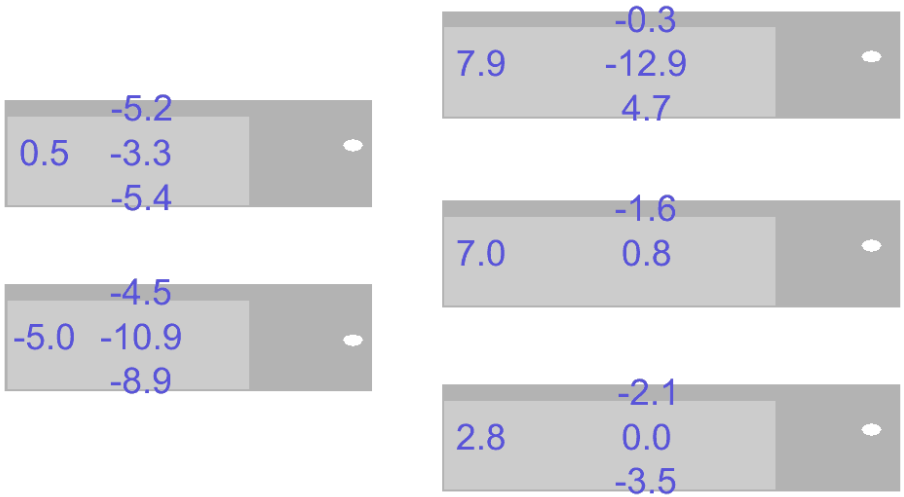
Marco at -30C

1. N2: 6L/min; no heat; average : -21.4C
2. N2: 4L/min; no heat; average: -20.9C
3. N2: 4L/min; Sensor on; average : -6.2C
4. N2: 4L/min; Switcher on; average : -3.7C
5. N2: 4L/min; Sensor+Switcher; average : 14.4C
6. N2: 6L/min; Sensor+Switcher; average : 11.7C
7. N2: 6L/min; 1/3 DCD/DHP on; average : -19.2C
8. N2: 6L/min; 2/3 DCD/DHP on; average : -11.5C
9. N2: 6L/min; 3/3 DCD/DHP on; average : 1.2C
10. N2: 6L/min; 3/3 DCD/DHP+Sensor+Switcher; average : 31.2C

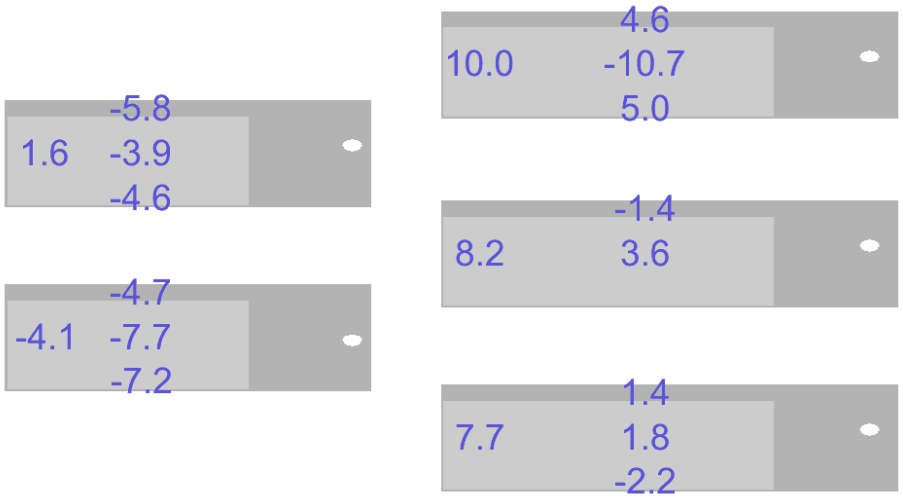


Compare different N2 cooling method

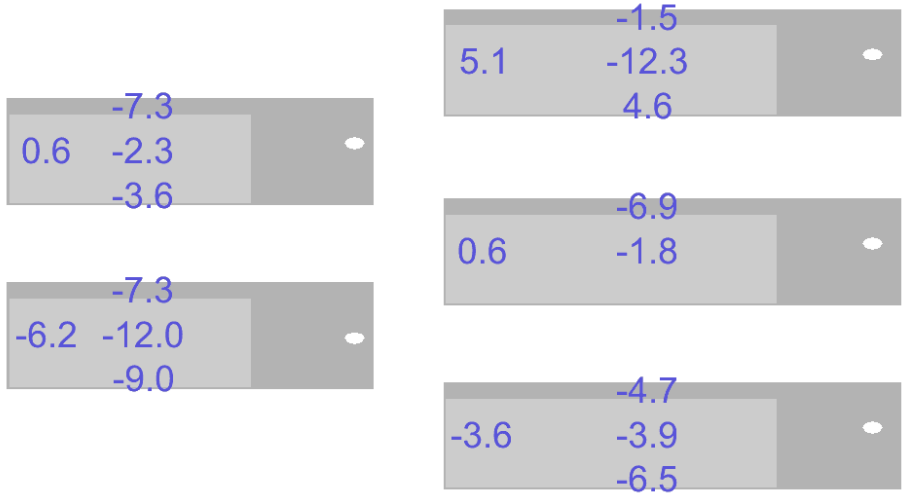
At -30C; N2: 6L/min;
1/3 DCD/DHP + sensor on; Average : -1.6C



At -30C; N2 only flushing, 6L/min;
1/3 DCD/DHP + sensor on; Average : -0.1C

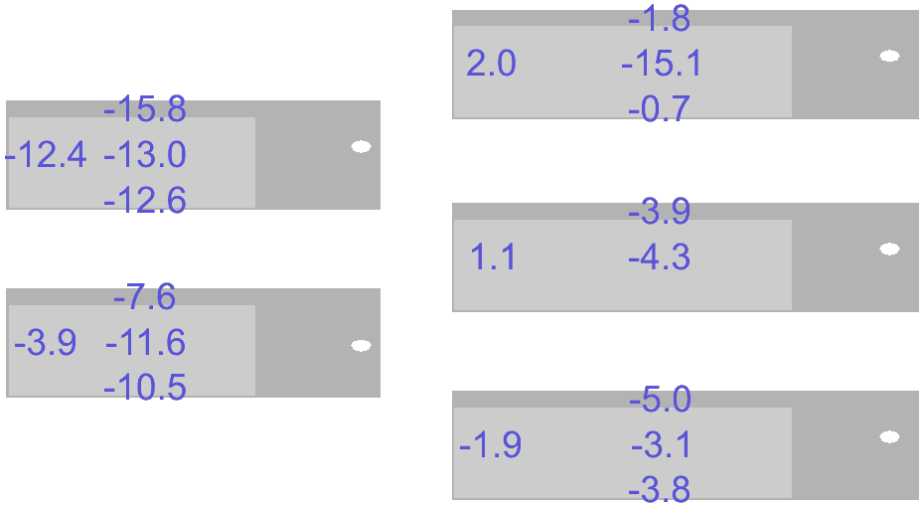


At -30C; N2 only tube, 6L/min;
1/3 DCD/DHP + sensor on; Average : -3.7C

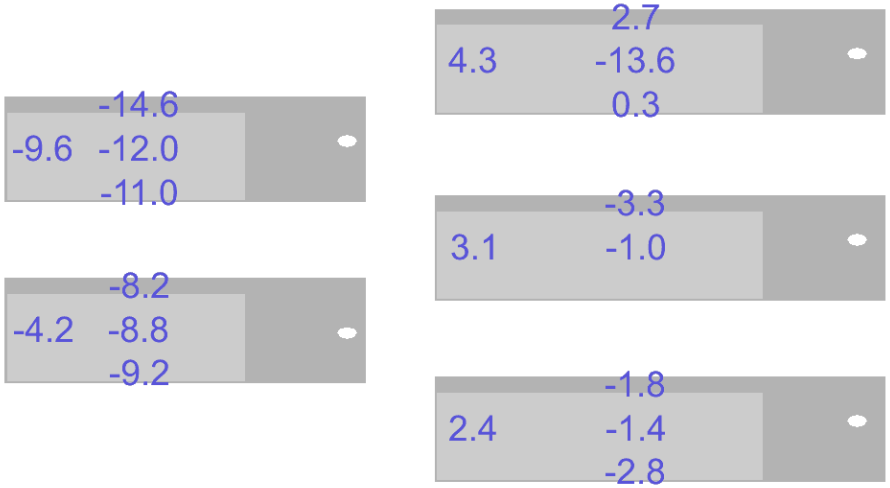


N2 tubes give better cooling performance at 6L/min.

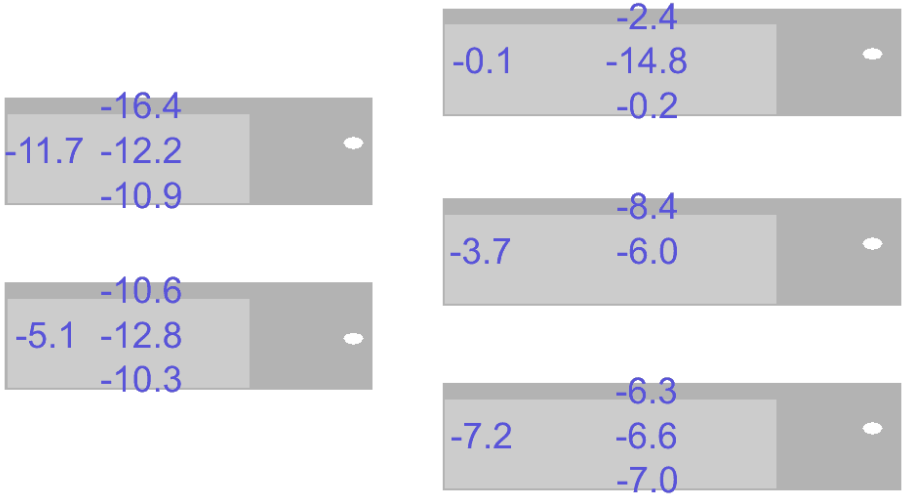
At -30C; N2: 6L/min;
Switcher on; Average : -5.7C



At -30C; N2 only flushing, 6L/min;
Switcher on; Average : -4.0C



At -30C; N2 only tube, 6L/min;
Switcher on; Average : -7.3C



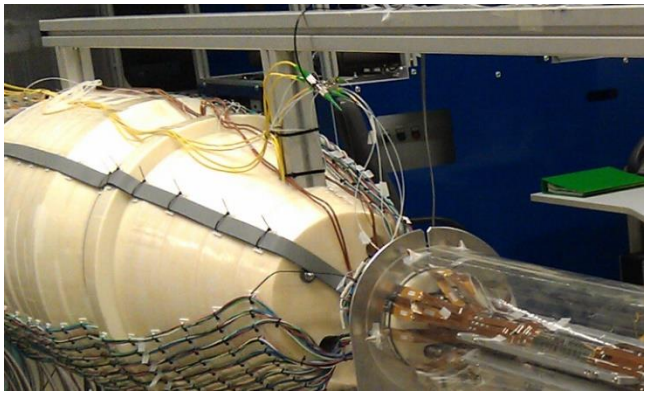
FBGs indicate the N2 temperature is >-10C.

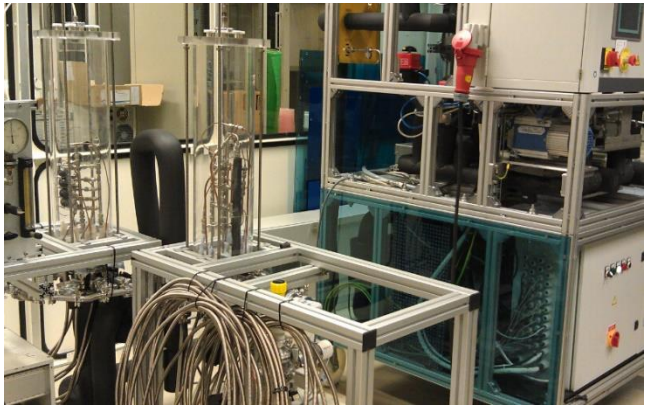
We want better cooled N2.

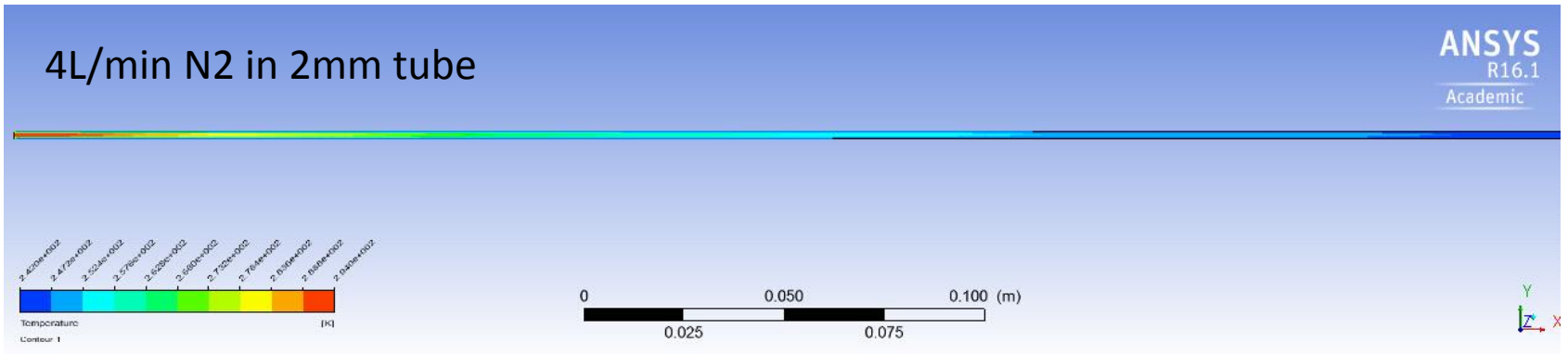
2 spare CO_2 line to cool N2: 12m long flex line.

Indicated form thermal simulation, N2 easily gets heat from environment.

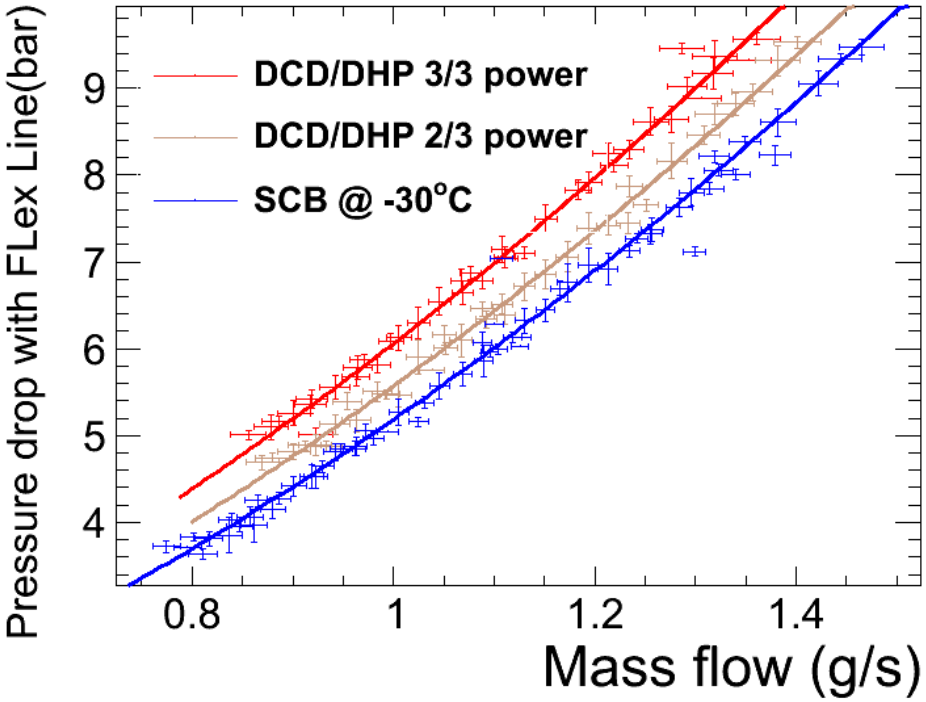
To do heat isolation.

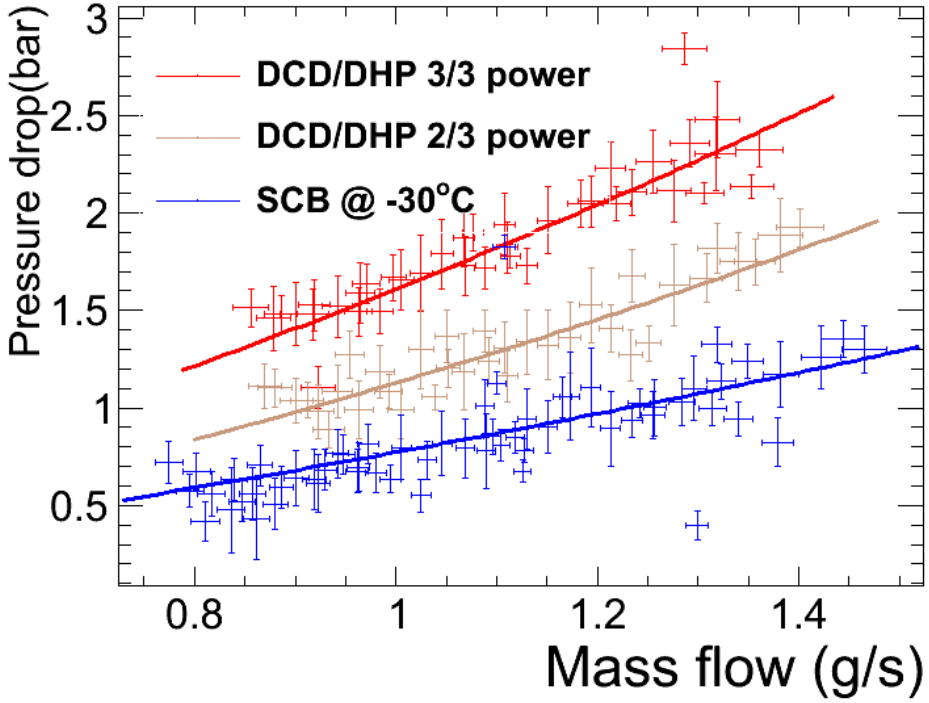




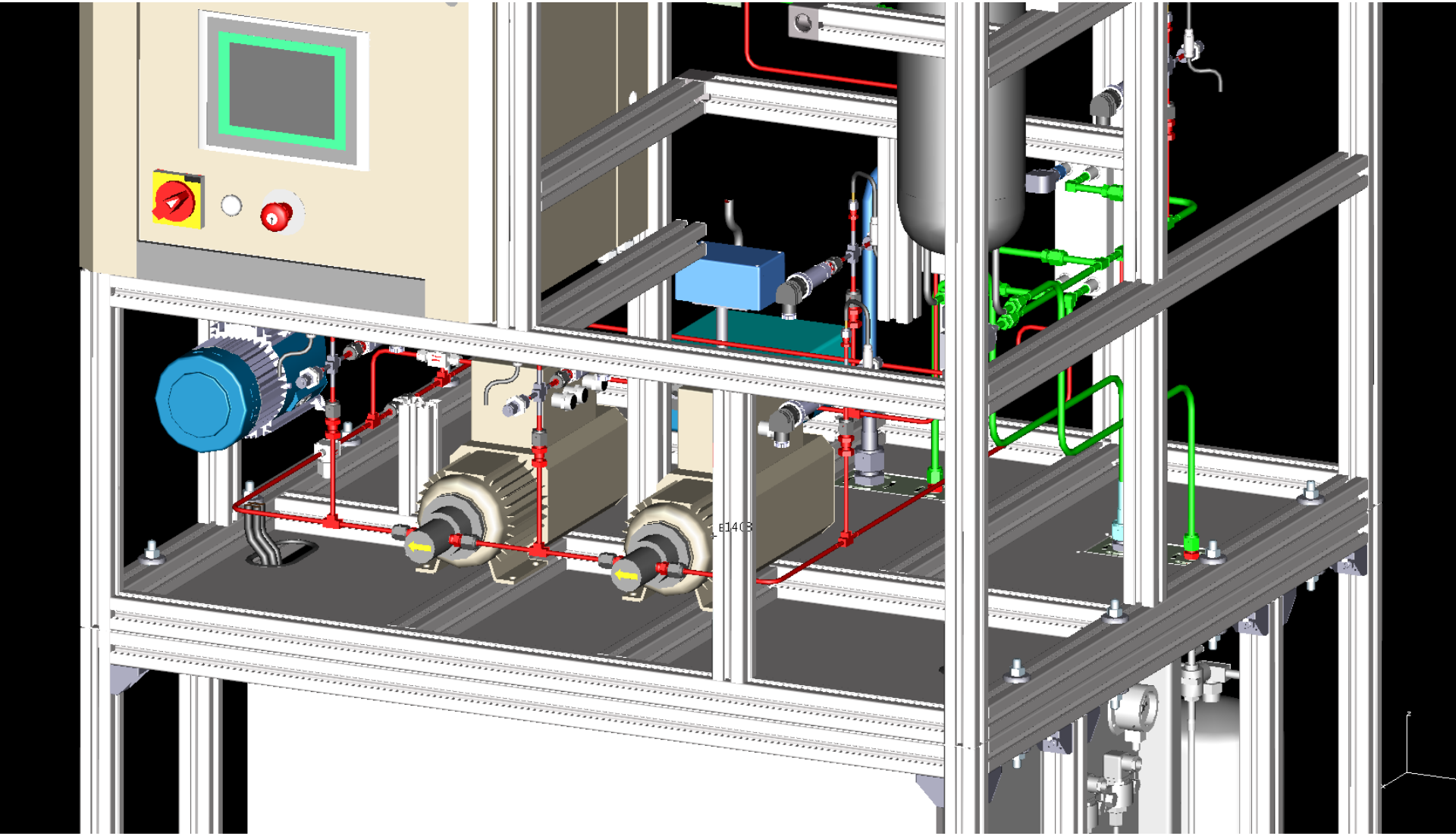


Mass flow v.s. Pressure drop

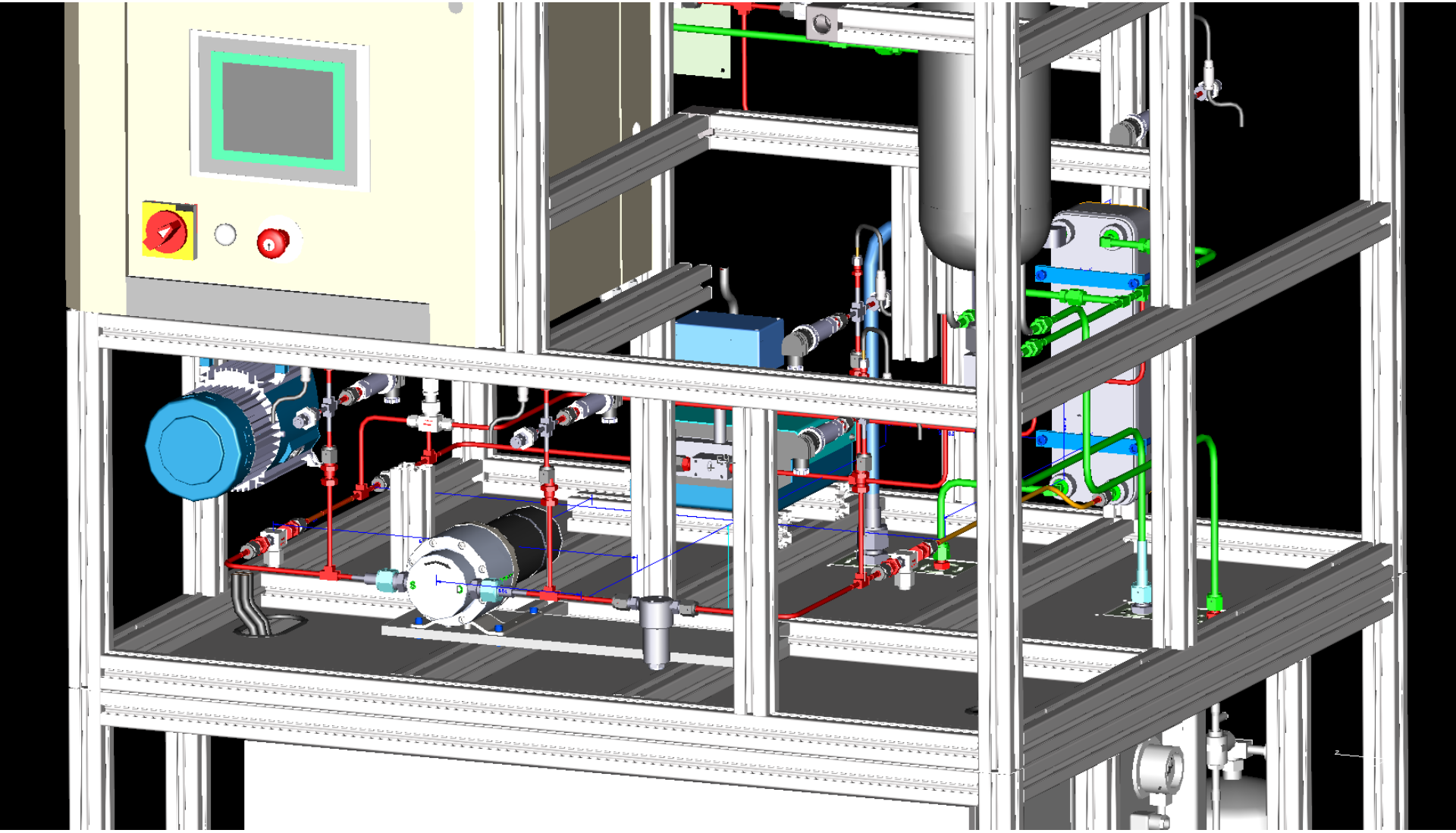




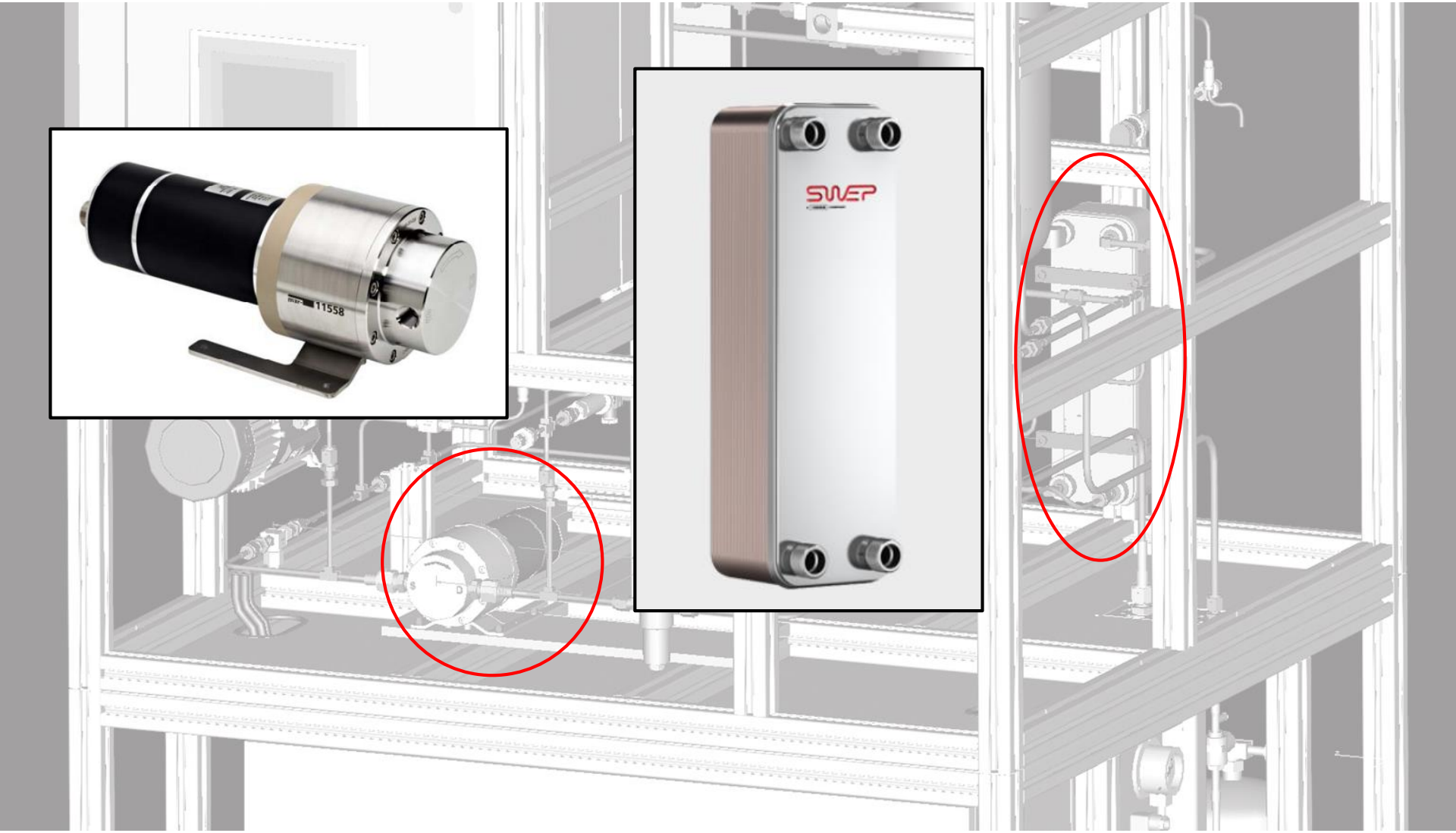
NHP pump refit

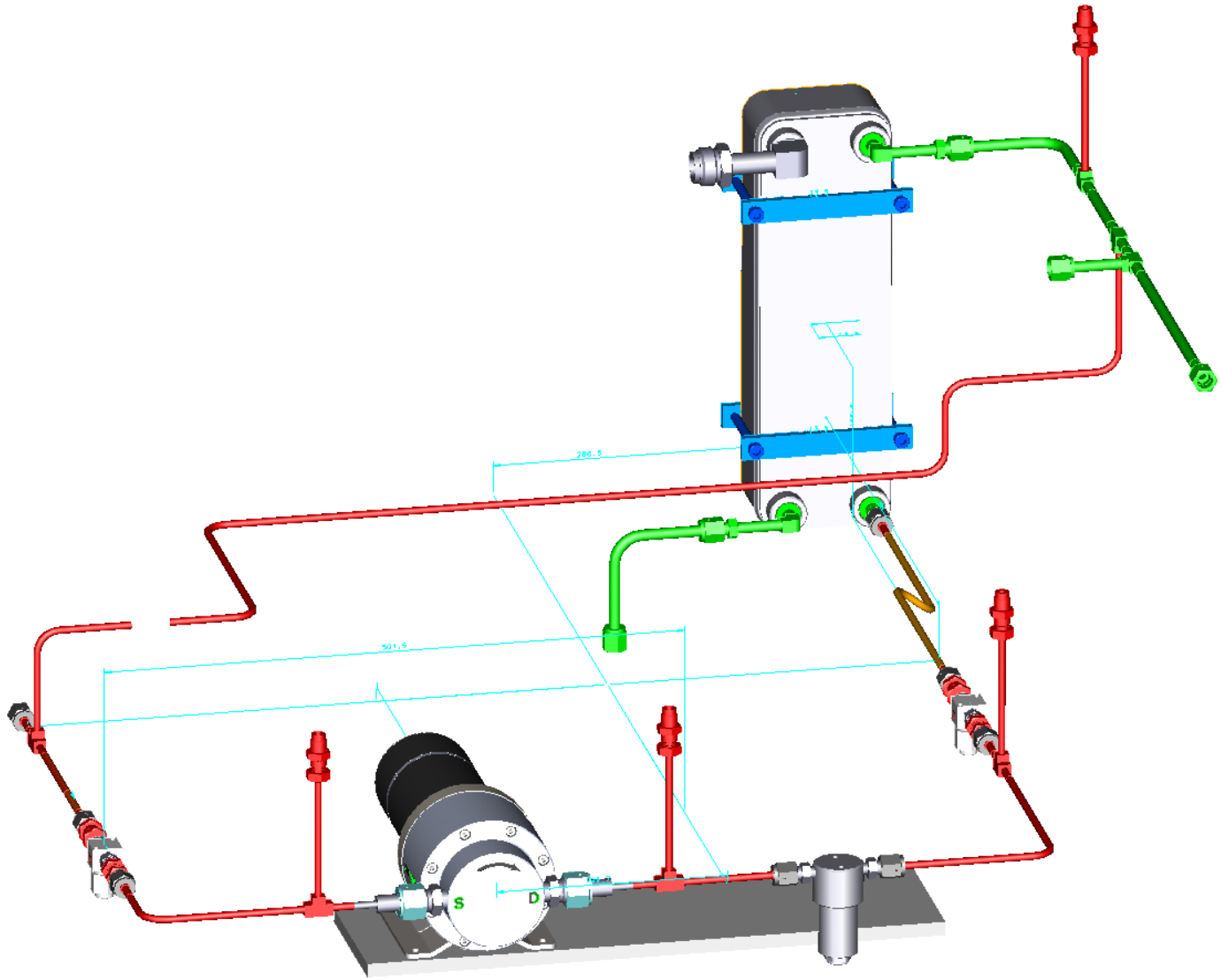


NHP pump refit



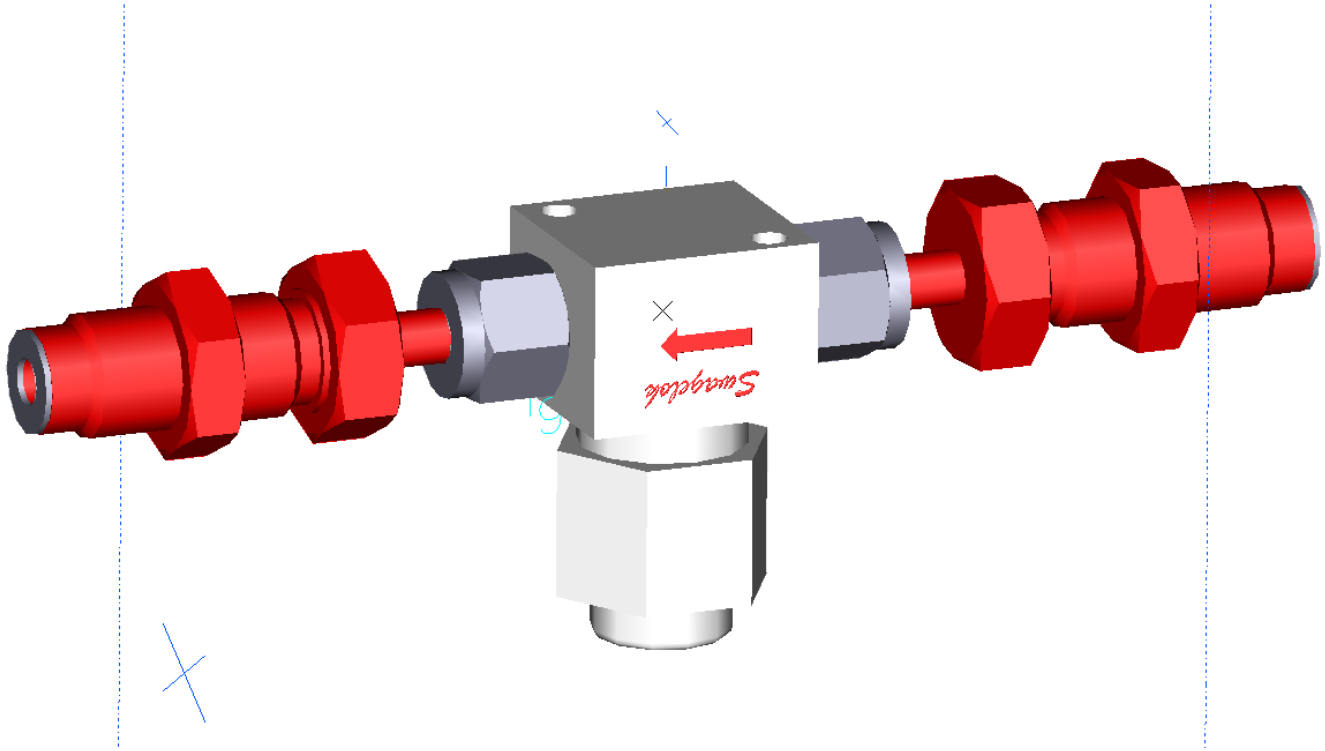
- Flow rate 0.19 – 1152 ml/min
- Speed range 1 – 6000 rpm



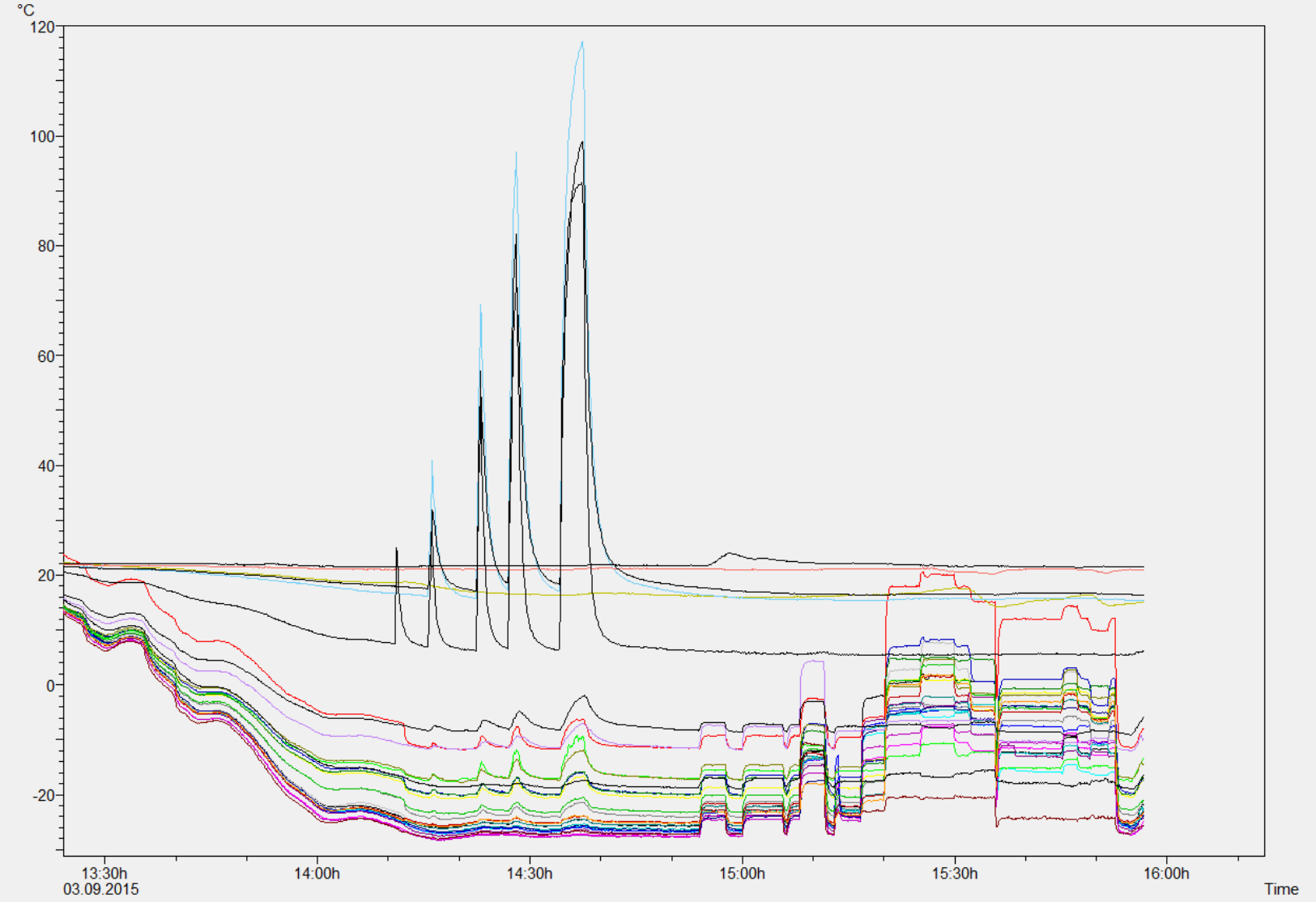

S
D

Filter with VCR

Filter fitted with VCR connectors
for multiple inlet swaps



Heaters on Kapton cable

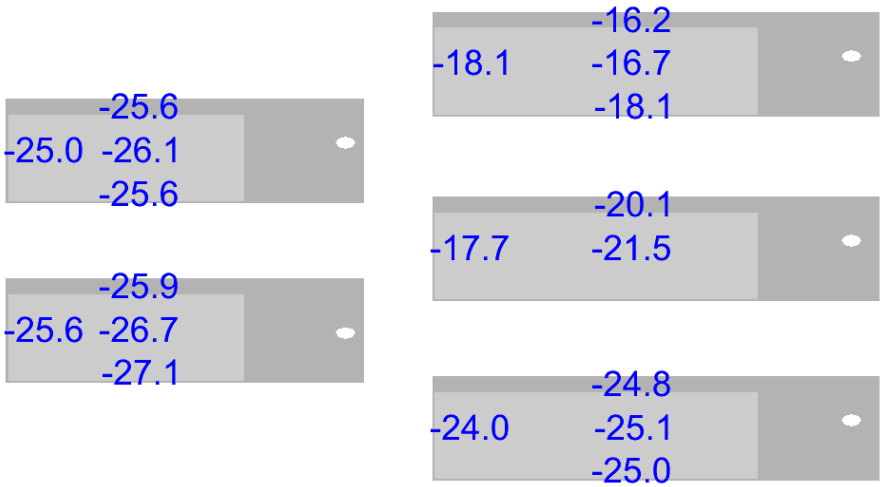


Summary

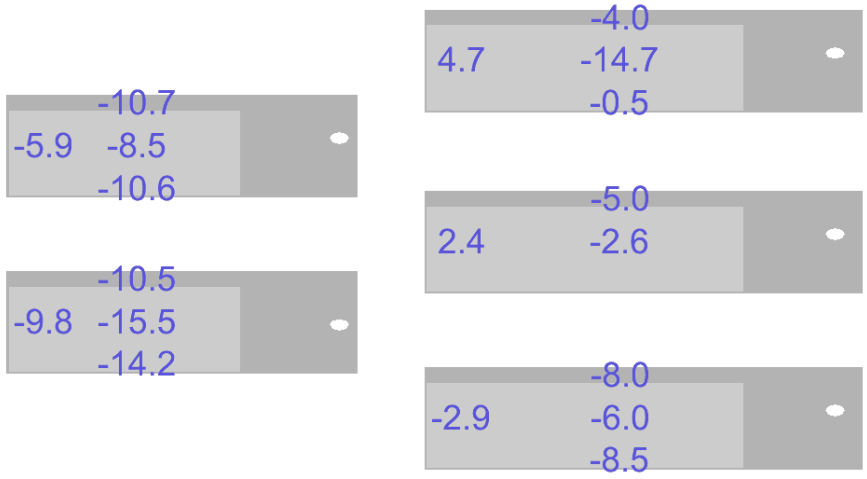
- First measurement is done, preliminary results are got.
- CO2 circuit gives good performance, DCD/DHPs are under 50^{o}C.
- Heat causes about 1 bar's pressure drop.
- The PXD sensitive area is hot, N2 plays a big rule in cooling, we want cold N2.

Backup

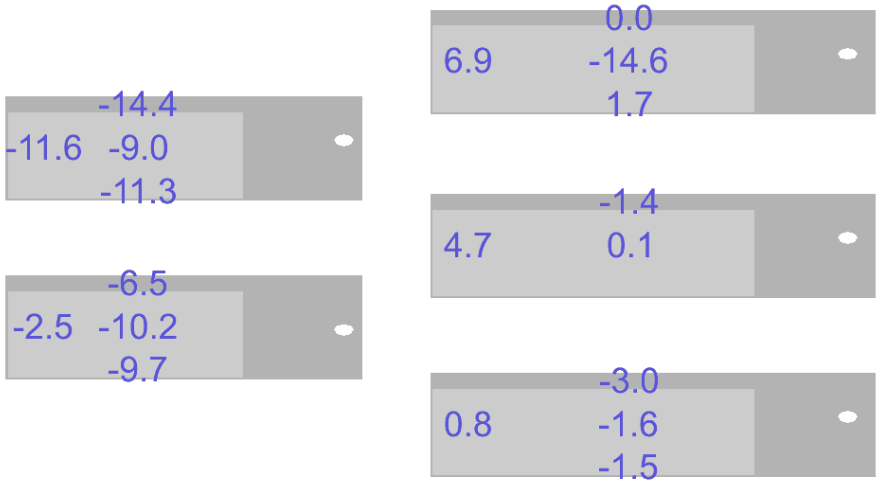
At -30C no heat N2: 4L/min;
Average: -20.9C



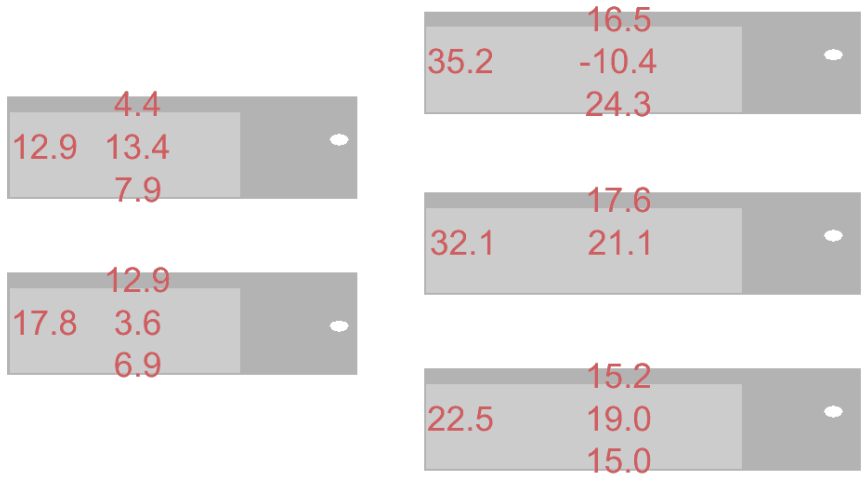
At -30C; N2: 4L/min; Sensor on;
Average : -6.2C



At -30C; N2: 4L/min; Switcher on;
Average : -3.7C

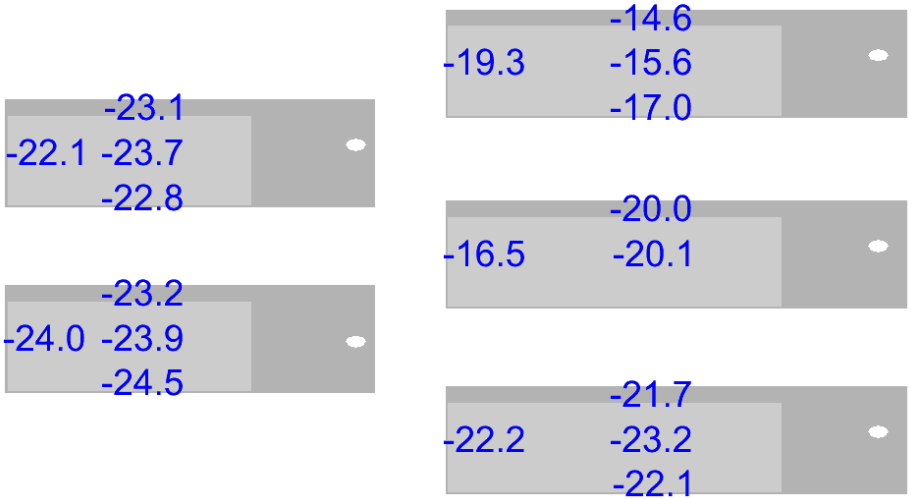


At -30C; N2: 4L/min; Sensor+Switcher on
Average : 14.4C

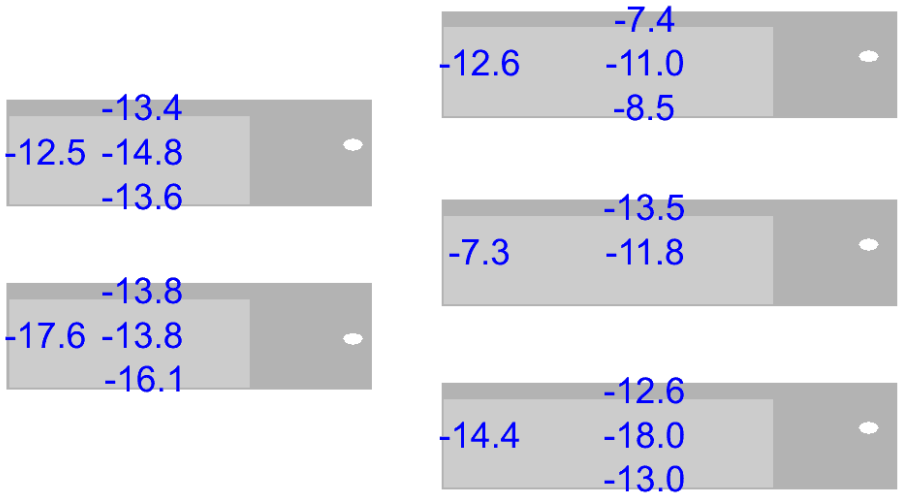


At -30C; N2: 6L/min; Sensor+Switcher on
Average : 11.7C

At -30C; N2: 6L/min; 1/3 DCD/DHP on
Average : -19.2C



At -30C; N2: 6L/min; 2/3 DCD/DHP on
Average : -11.5C



Status of MARCO