

CO₂ Cooling of PXD Endflange: Results from Karlsruhe

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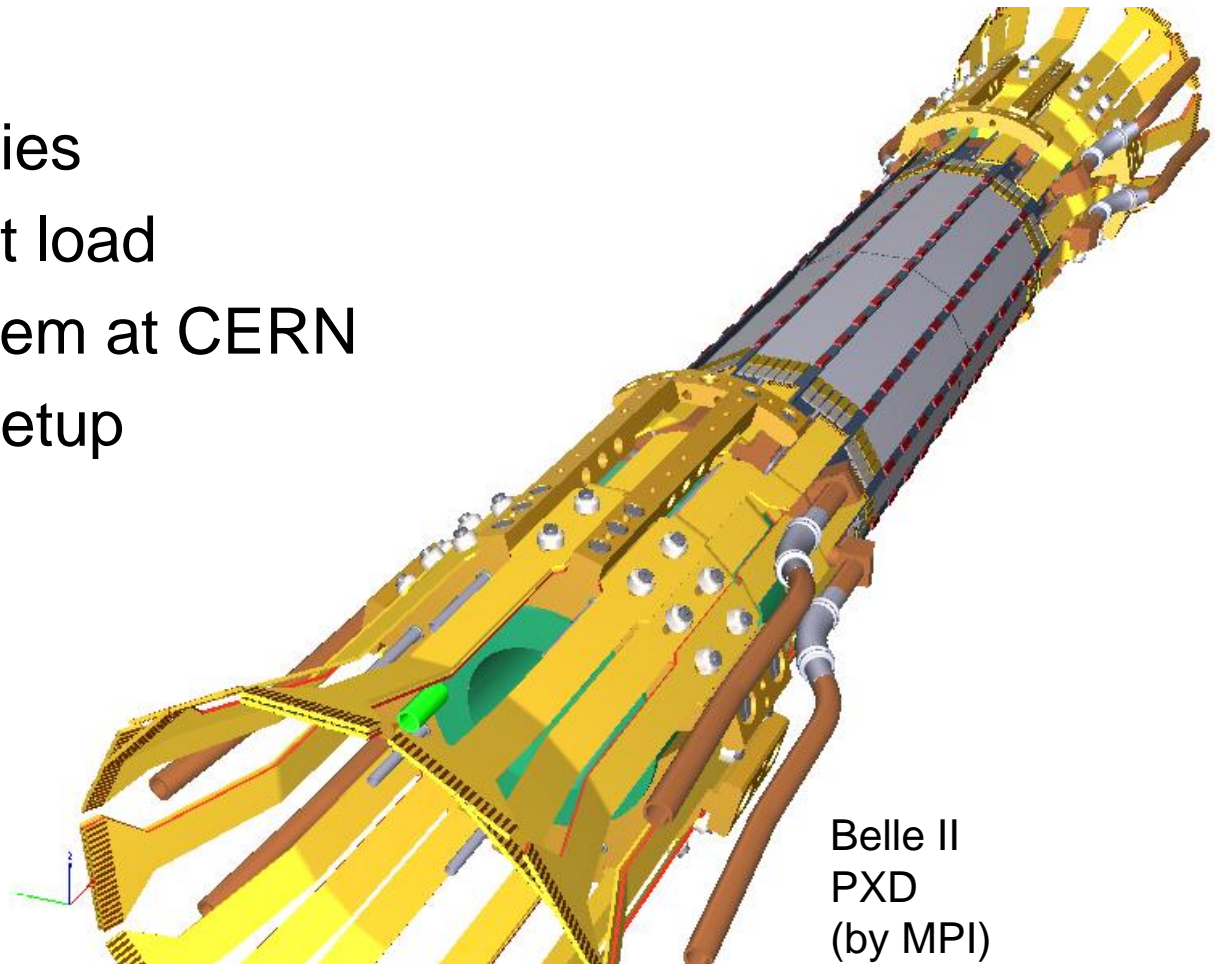
Belle II PXD Cooling Meeting, Karlsruhe, 13.01.2011

Institut für Experimentelle Kernphysik



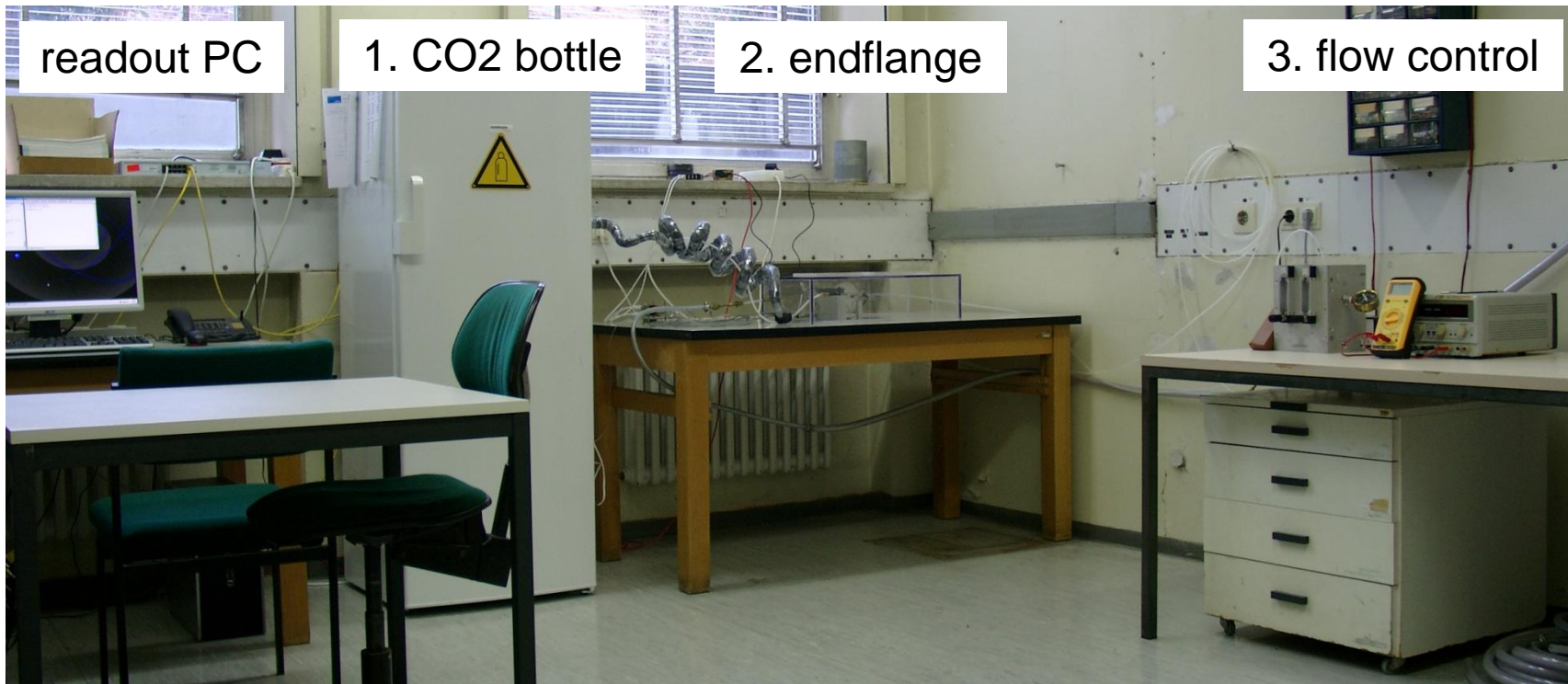
Overview

1. Open CO₂ system in Karlsruhe
2. First results
3. Heat load dummies
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6. Air cooling test setup
7. Schedule
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1. Open CO₂ system in Karlsruhe

- Built for CMS Tracker Upgrade
- Now used for Belle II PXD cooling tests
- Manual operation → limited runtime

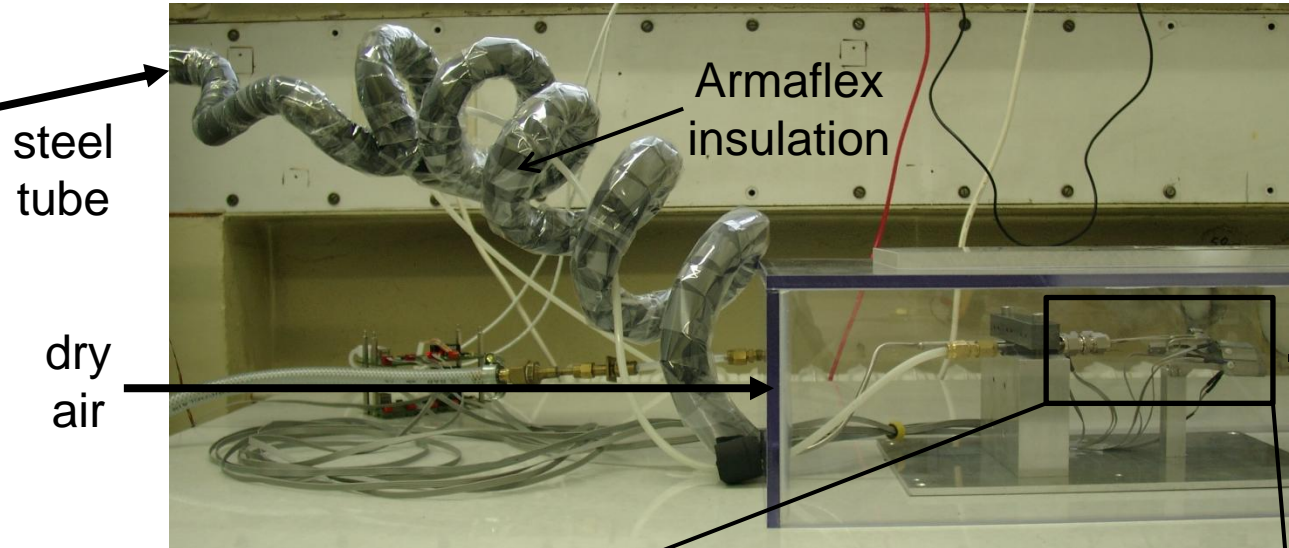


1. Open CO₂ system in Karlsruhe

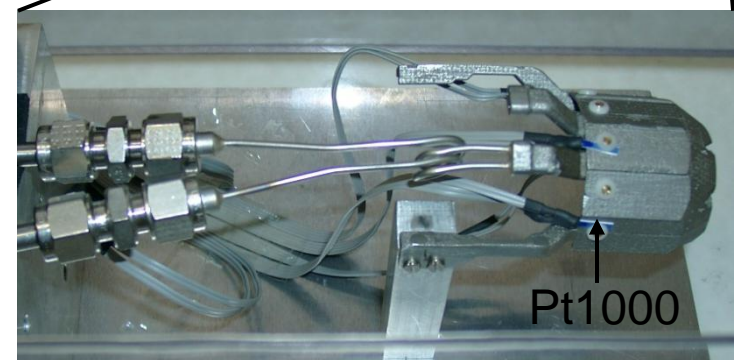
■ components of the system:



1. CO₂ bottle with pressure regulator, precooled to -32°C (saves CO₂)

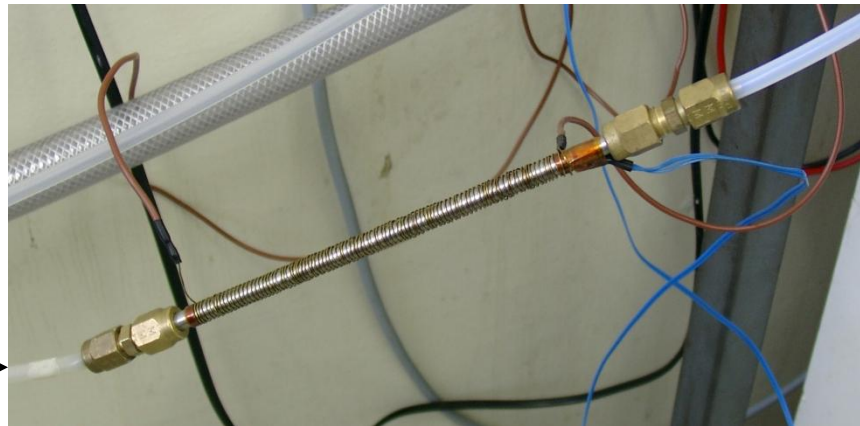


2. endflange prototype in air-flushed box to prevent condensation, Pt1000 for temperature readout

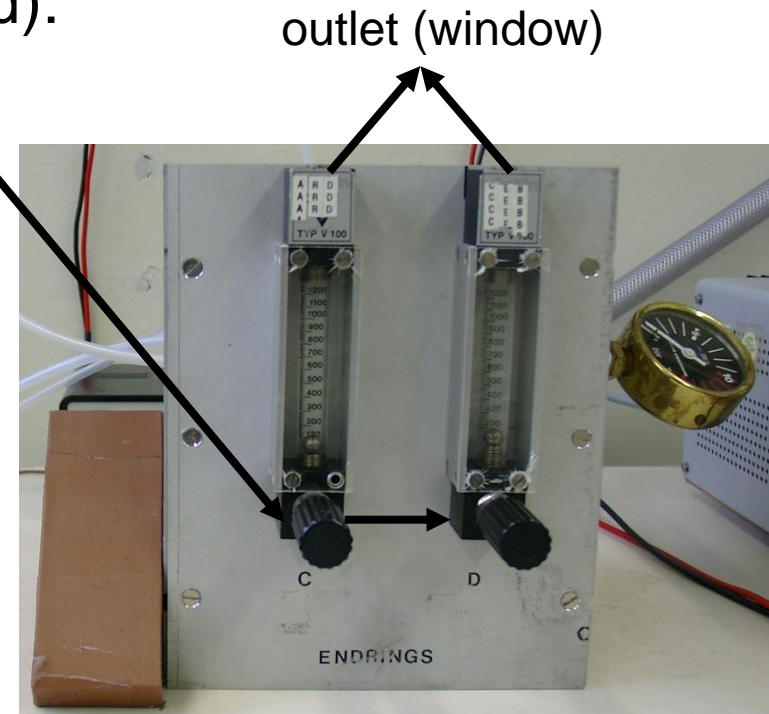


1. Open CO₂ system in Karlsruhe

- components of the system (cont'd):



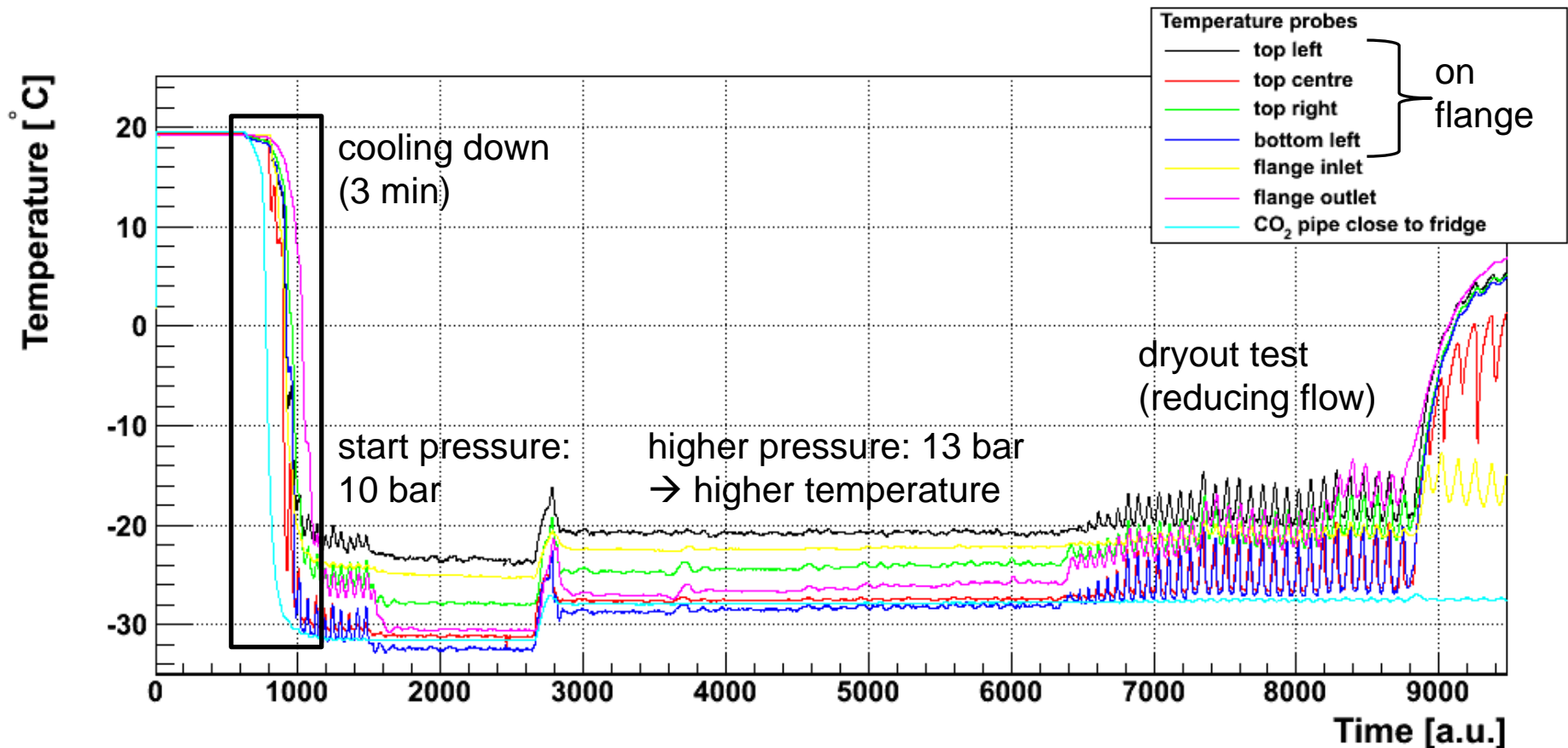
3. electric heater (temp. controlled) to prevent liquid CO₂ from reaching the gas flow meters



3. gas flow meters (combined) and pressure gauge for controlling operating values

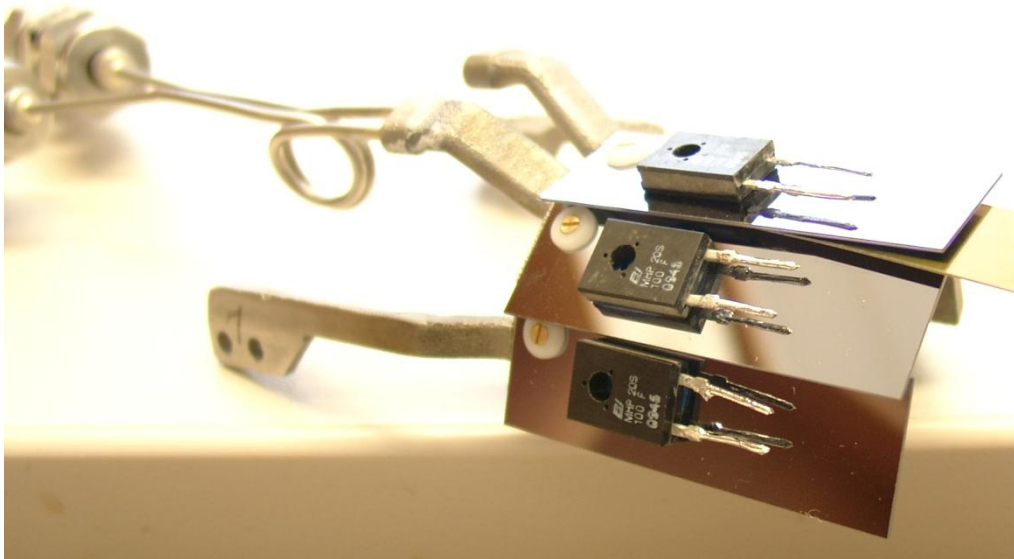
2. First results

- no heat load attached
- system is working as expected (max. pressure: 15 bar)

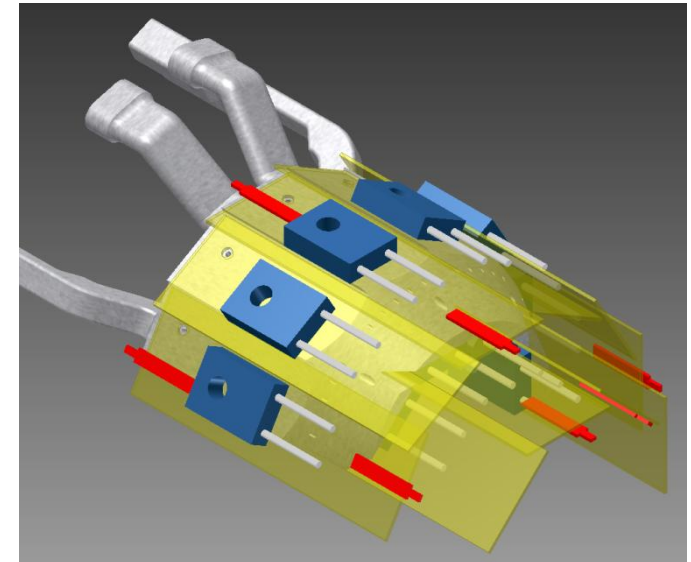


3. Heat load dummies

- silicon pieces made by HLL (length: 46 mm)
- resistor (max. power: 20 W)
- screwed to flange (with heat transfer compound)
- Pt1000 for temperature monitoring



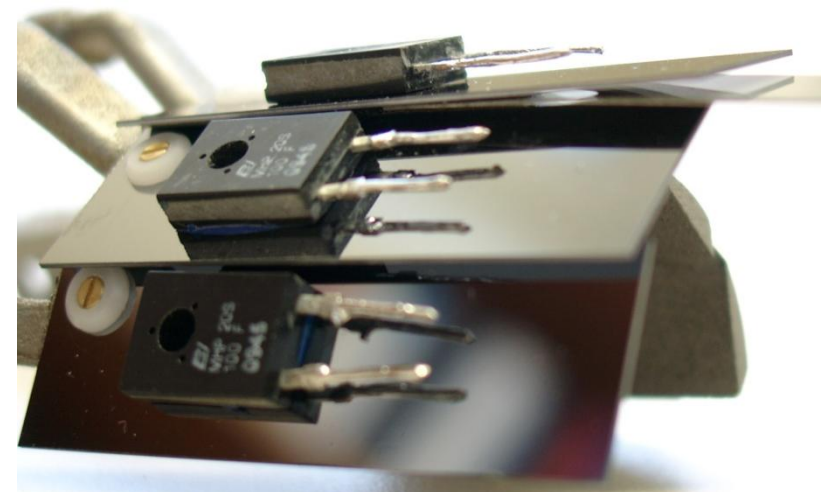
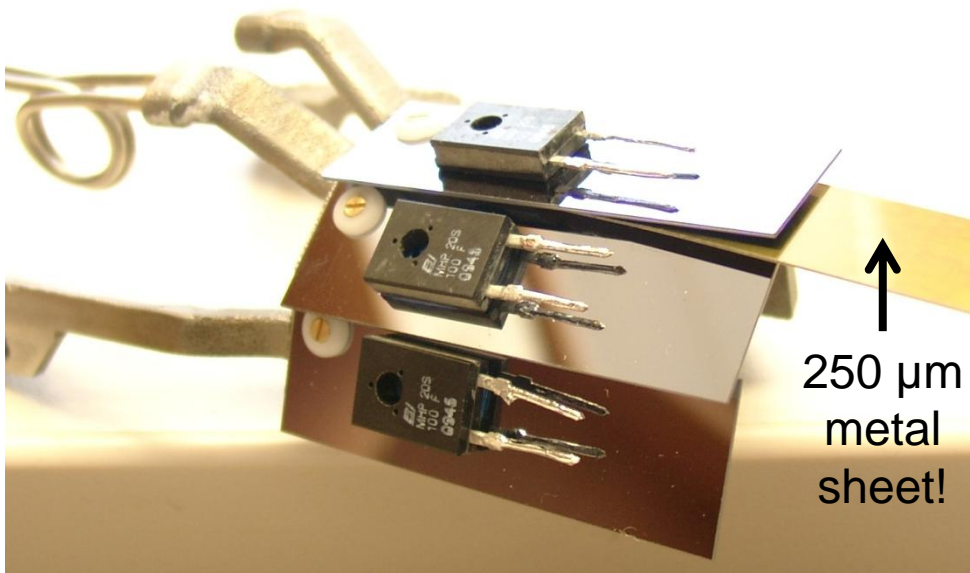
first dummies on flange to check positioning



drawing of the fully equipped flange (Pt1000 shown in red)

3. Heat load dummies

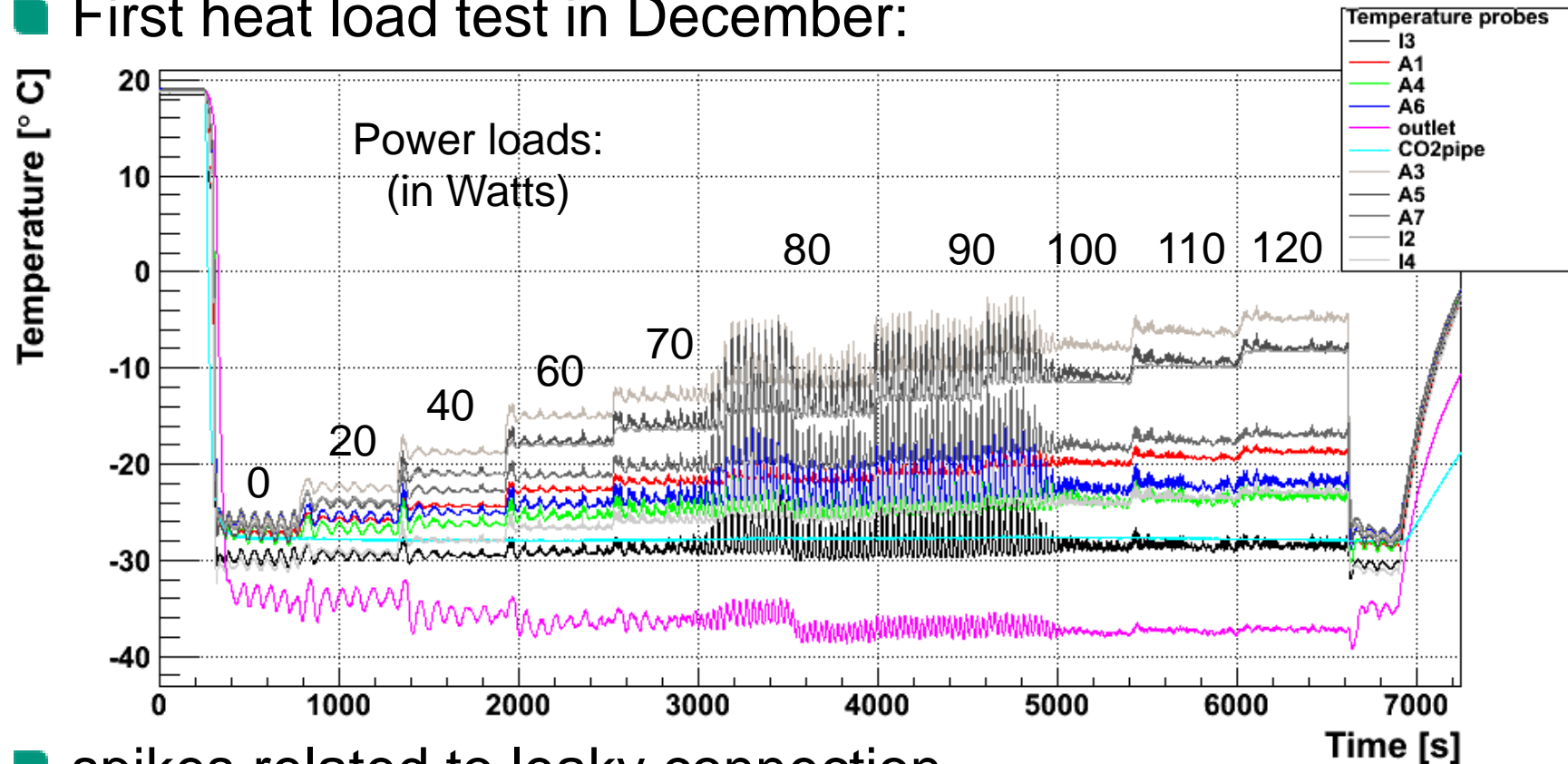
- problems during check:
surface of flange not flat, screw threads not perpendicular



- solution: polish surfaces by hand
→ OK for testing
- not suitable** for production version

4. Results with heat load

■ First heat load test in December:

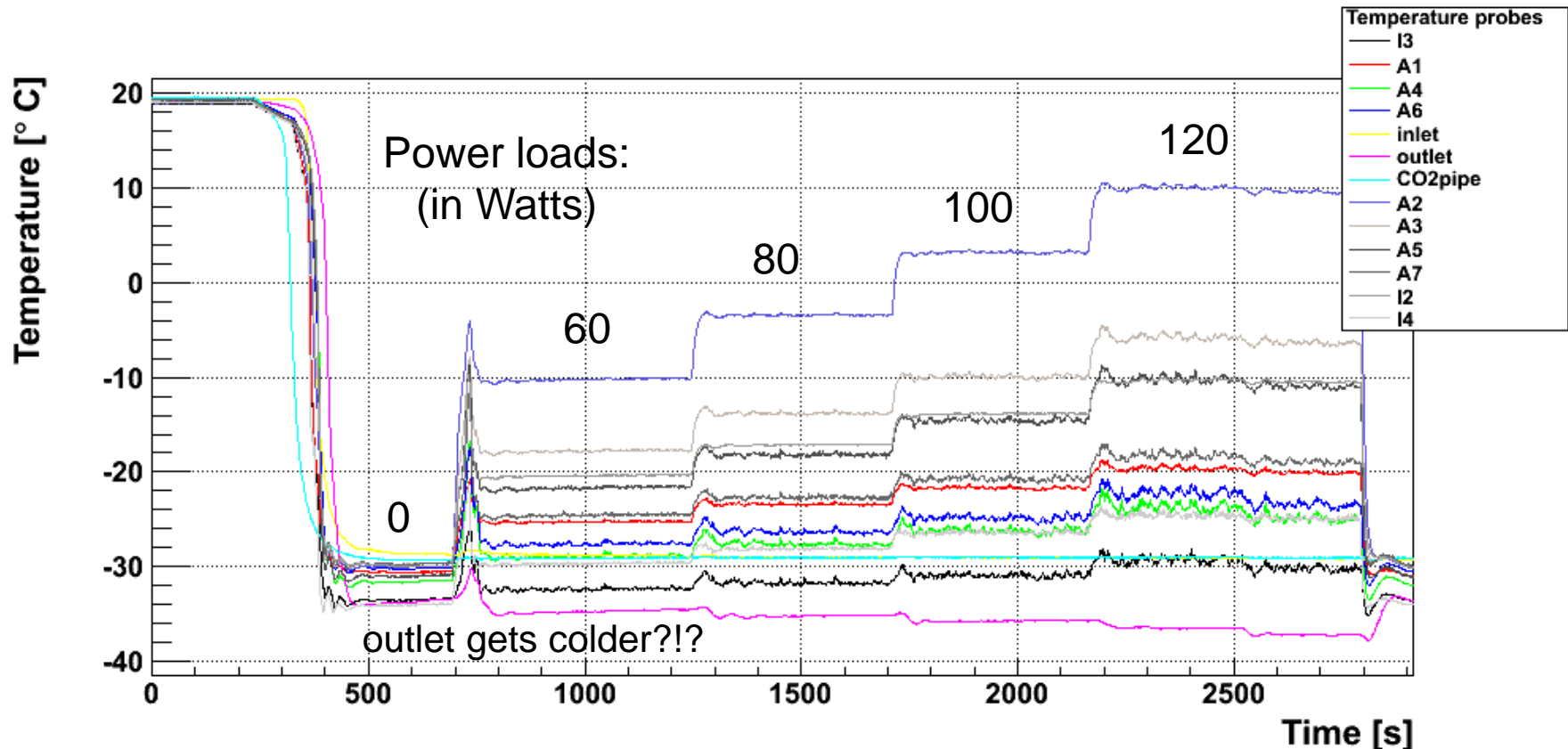


■ spikes related to leaky connection

■ temperature difference (@ 100 W): about **19°C**

4. Results with heat load

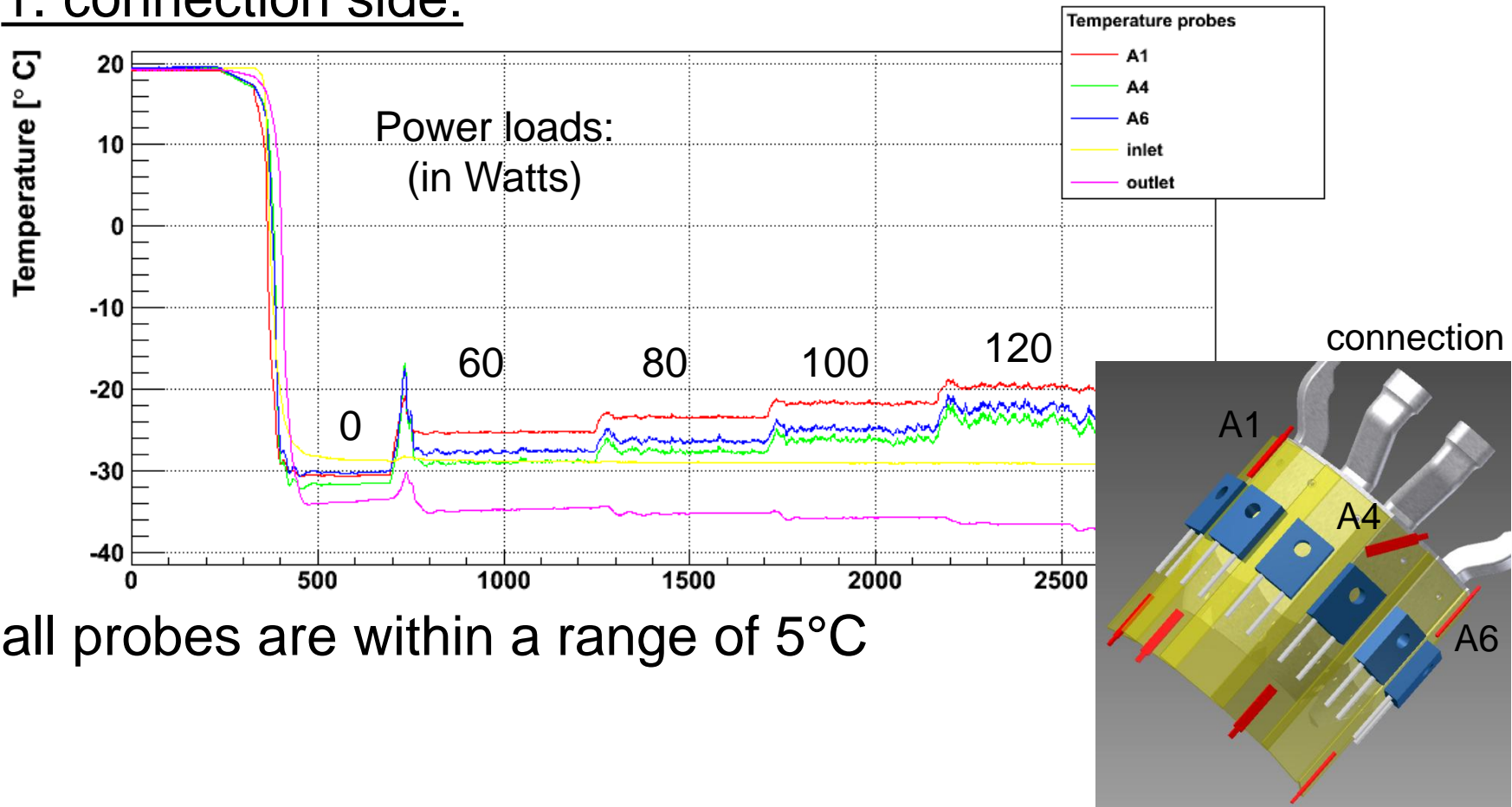
- Second test in January: leaky connection fixed



- temperature difference (@ 100 W): about **20°C**

4. Results with heat load

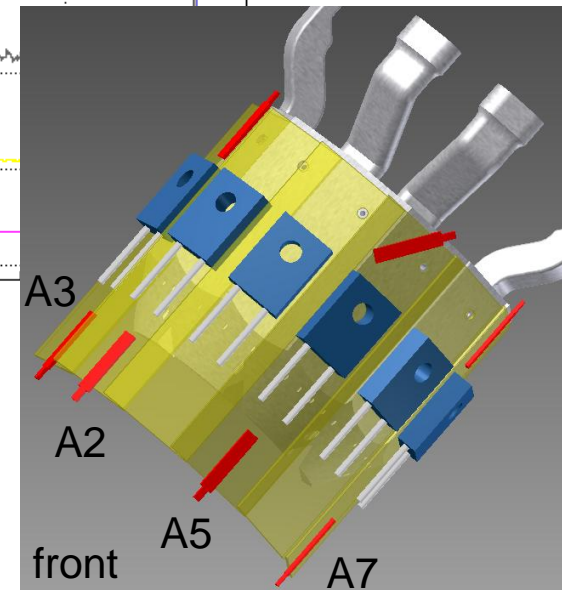
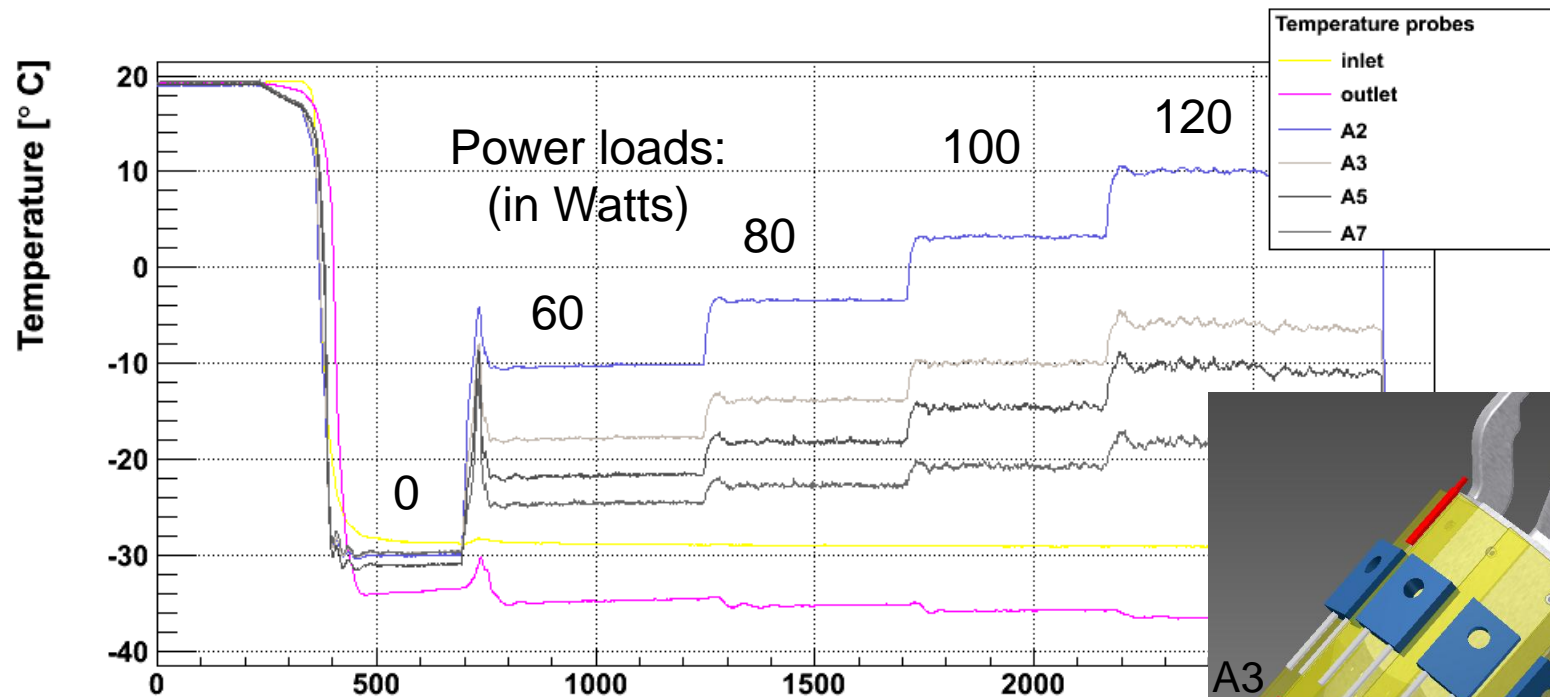
- now: closer look at different areas of flange
- 1. connection side:



- all probes are within a range of 5°C

4. Results with heat load

2. front side:

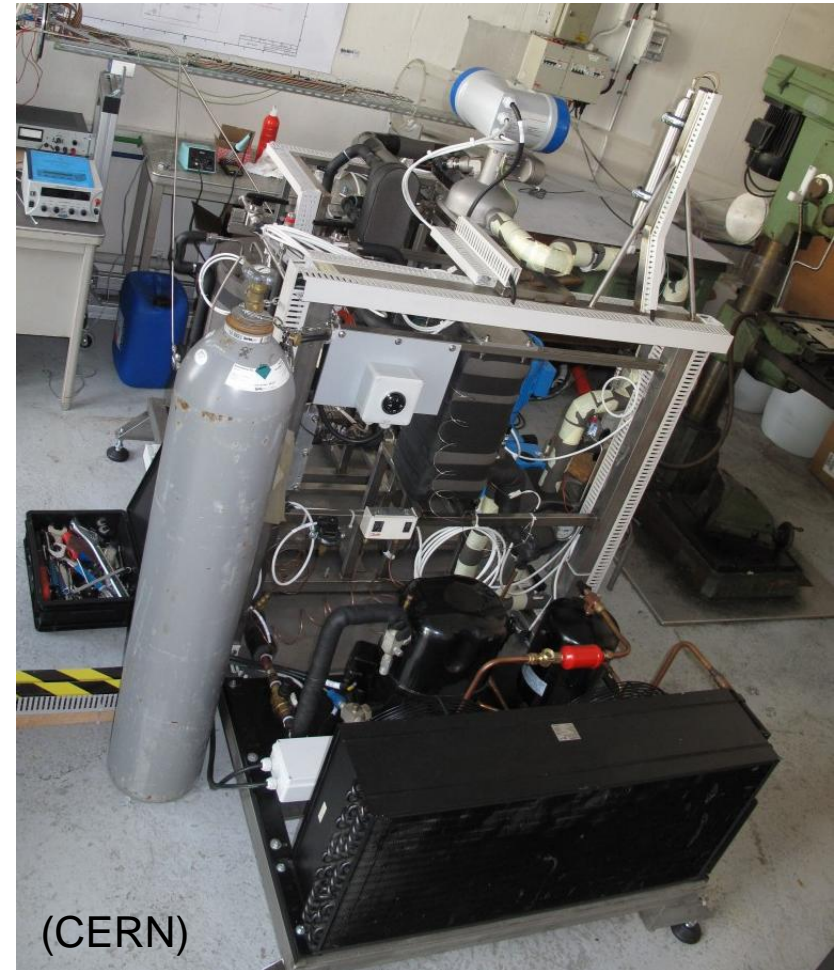


- much larger deviation of 24°C
- probe A2: bad contact (without A2: 11°C)

5. Closed CO₂ system at CERN

- Closed CO₂ system built by the group of Hans Postema, also for CMS Upgrade testing
- Finished in July 2010
- Available to IEKP Karlsruhe for tests, slot booked for **February 2011**

- Similar system supposed to be used for cooling of Belle II PXD and SVD



6. Air cooling test setup

- purpose-built cooling plant for CMS Tracker petal testing:
 - made by University of Louvain, Belgium
 - mono-phase, using FC-77
 - over pressure system, $P = 2.8 \text{ bar}$
 - $350 \text{ W @ } -20^\circ\text{C}$

- heat exchanger: designed to our specifications



Anlagenbau Böhmer



180x60x80 cm

Technische Daten	08.09.10	Seite A	Seite B
Wärmemenge <1 KW			
Menge	m ³ /h	Trockene Luft 0,6	Wasser/Gly.50% 0,1
Einlasstemperatur	°C	20	-25
Auslasstemperatur	°C	-20	-20
Druckverlust	kPa	5 (0,05 bar)	1 (0,01 bar)
PXD air volume: ~60 litres			

7. Schedule

- Open CO₂ system:
 - final results available for DEPFET meeting in Bonn

- Air cooling test:
 - check proposed method of cold air supply

- Closed CO₂ system:
 - time slot booked for February 2011
 - try to cool flange for a longer time
 - check stability of temperature control
 - become familiar with closed system and its components

8. Summary

- Results with heat load look promising
- Deviations related to mechanical problems
- Final analysis available for Bonn meeting

- Visit CERN in February to use closed system
- Similar system is foreseen to be used by Belle II PXD and SVD subdetectors

- Definition of future cooling work packages (**today**)

Thank you...