

# PANDA Barrel EMC Cooling Status

Thorsten Erlen

JLU Giessen

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## 1 Hydraulics Tests

- Setup
- Results

## 2 Temperature Tests

- Setup
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# Hydraulics Test

- Simulations suggest minimum flow of  $8 \text{ L min}^{-1}$  to achieve maximum of  $\Delta T_{out-in} = 1 \text{ K}$  for acceptable temperature gradient.
- Ethanol-Water mixture had to be used for safety reasons
- Ethanol/Water at  $-6^\circ\text{C}$  has similar dyn. viscosity to PANDA-Coolant of  $7,7 \text{ mPa s}$

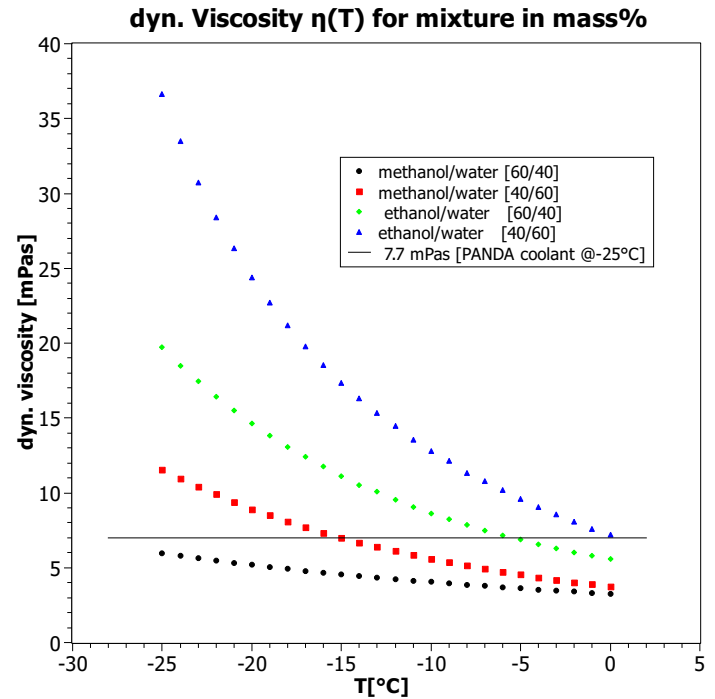
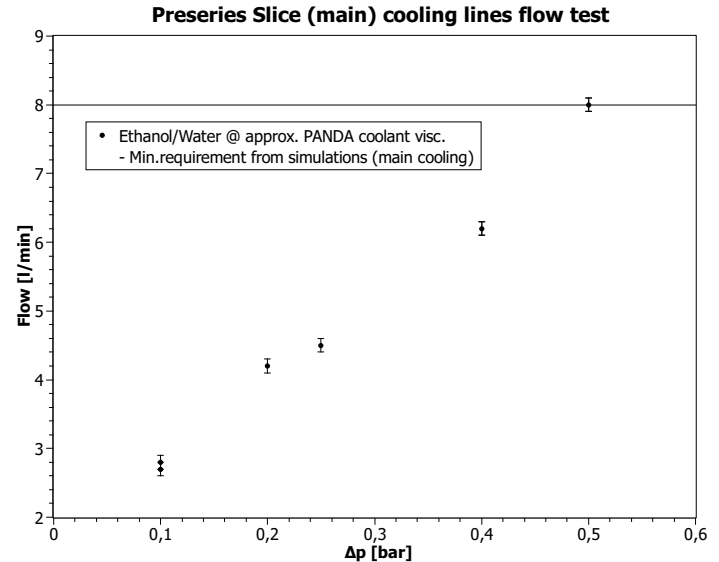


Figure 1: Literature values (via Grundfos.com)

- Cooler was set to  $-6\text{ }^{\circ}\text{C}$
- A bypass valve allowed to manipulate  $\Delta p$  between inlet and outlet of the slice
- Success for below-atmosphere pressure test,  $8\text{ L min}^{-1}$  achievable with setup



# Setup

- Main and front cooling installed (in parallel)
- Ethanol-water 60/40 (limiting flow)
- Set Temperature of cooler  $-28\text{ }^{\circ}\text{C}$  for 30 hours (not including cool down)
- 32 of 72 internal ThinPt100 sensors were used
- offset was measured at room temperature (against known good Pt100s)

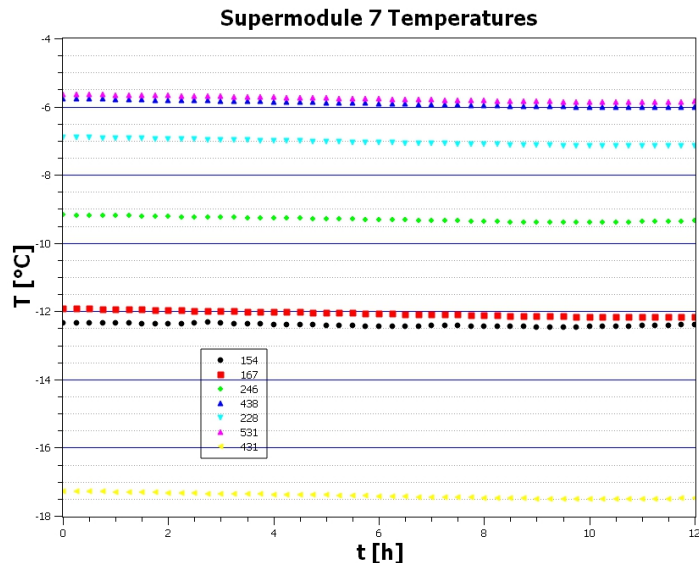


Figure 2: Absolute Temperatures readout without offset correction

# Data and Results

- $\Delta T$  between inlet and outlet stability, not ideal absolute values
- Temperatures show good variance for  $t=5..10$  [h]  $\leq 0,002 \text{ K}^2$

