

Leakless-Cooling Operation for Electronic Racks

A Test Set-Up for Cooling with Water under sub-atmospheric pressure

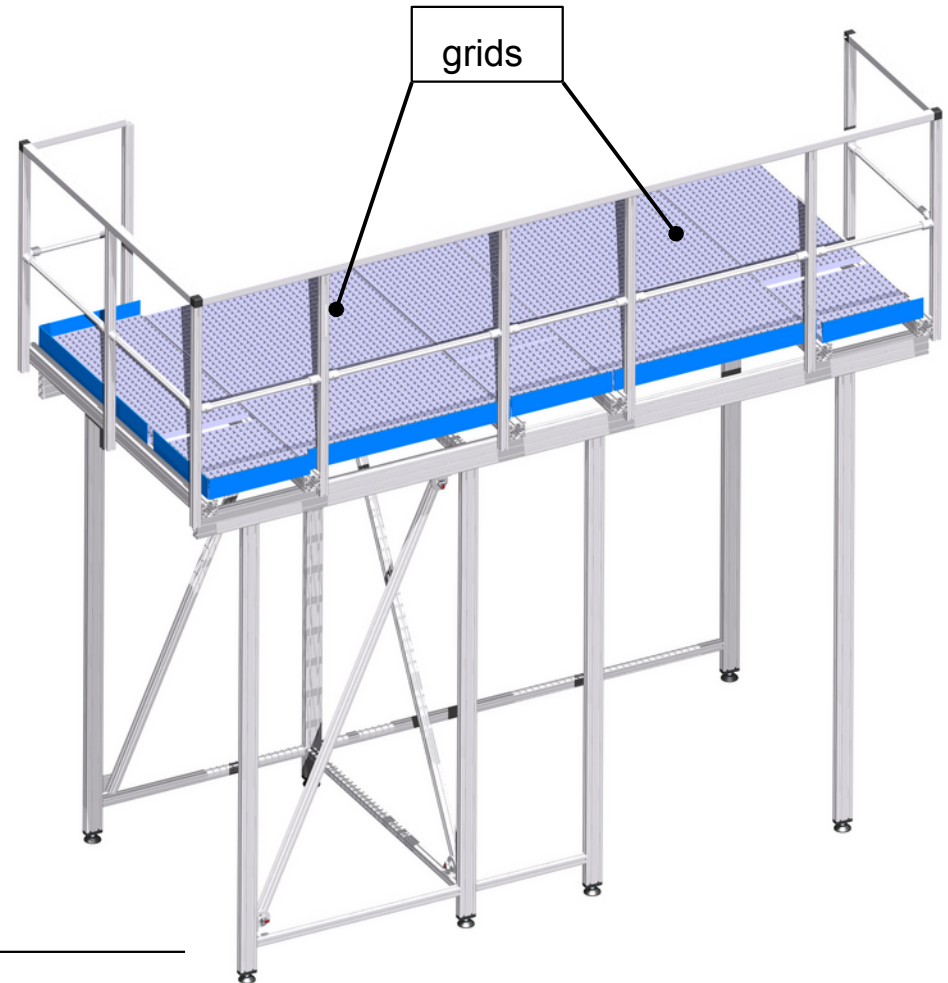
- Update -

Overview of current status - What has been done -

- Update (Hardware)
- Update (Software)

1. Platform designed, delivered and ready for built up

- Platform takes up two 42U racks.
- sustains up to 1400 kg with safety margin
- Built-up can begin soon in area of the Heckhalle
- Lattice grids ordered yesterday



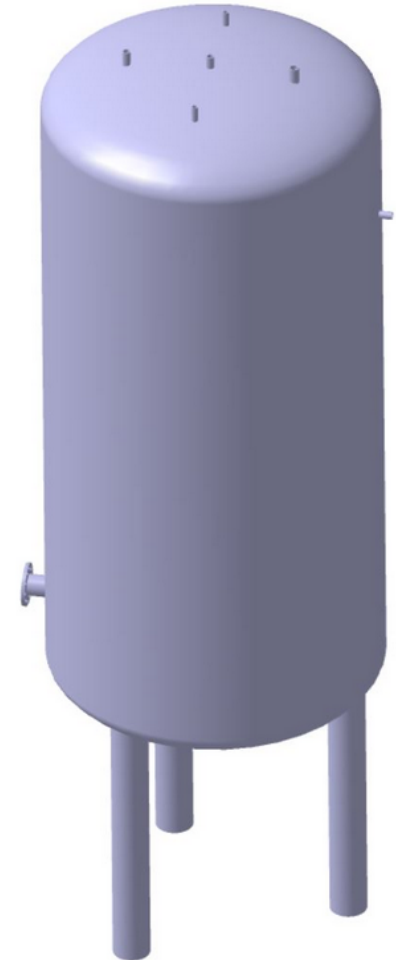
2. Water recipient available from GSI (free of charge)

taken from earlier experiment
 ~1000 litres capacity but usable for our purposes

Recent check for necessary outlet connections controlled by PLC shows:

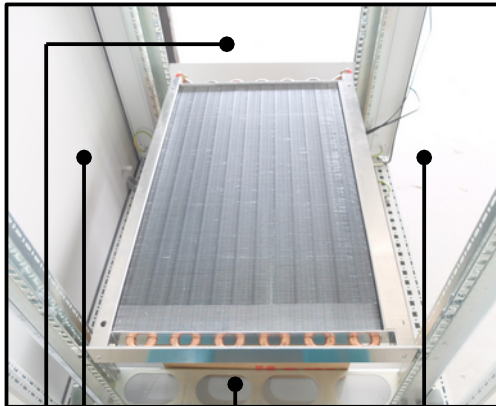
→ O.K. no adaptations needed.

Connection	1 x gas membrane pump	(controlled by PLC)	o.k
	1 x safety valve	(controlled by PLC)	o.k
	1 x pressure limiter	(controlled by PLC)	o.k
	1 x level gauge	(controlled by PLC)	o.k
	1 x ball valve for manual air relieve	(manually operated)	o.k



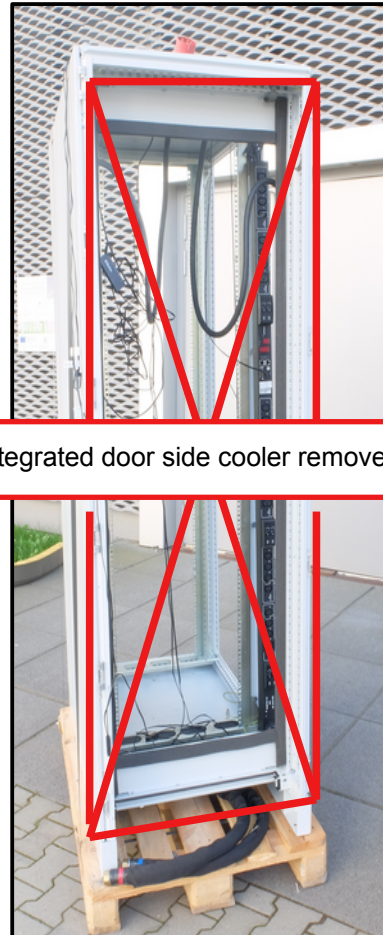
3. 42U Racks available from Green IT Cube (free of charge)

Properties: (H: 2m, W: 700mm, L: 1m)

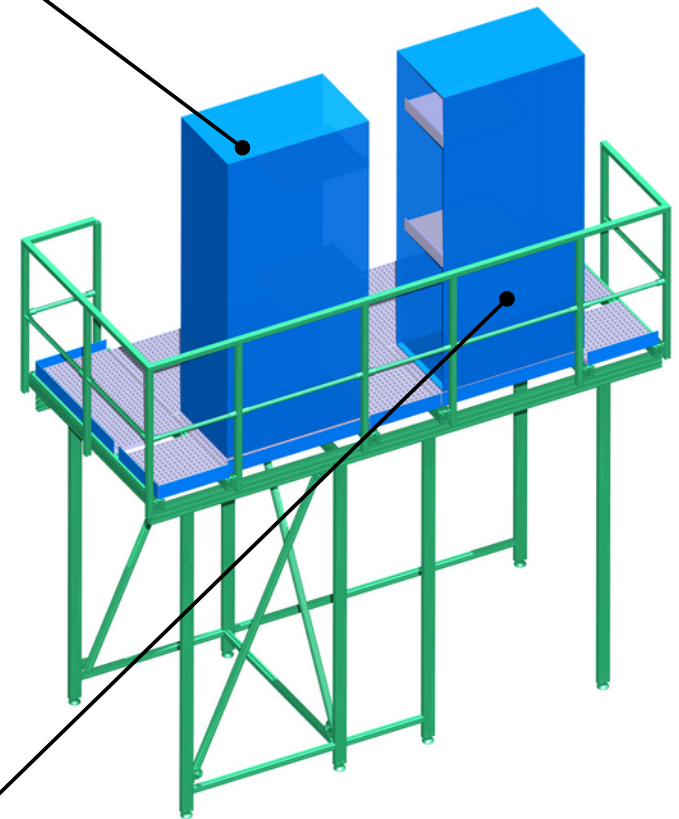


covers needed for openings at front,
back and inner rim

.... to keep ventilation airtight ...

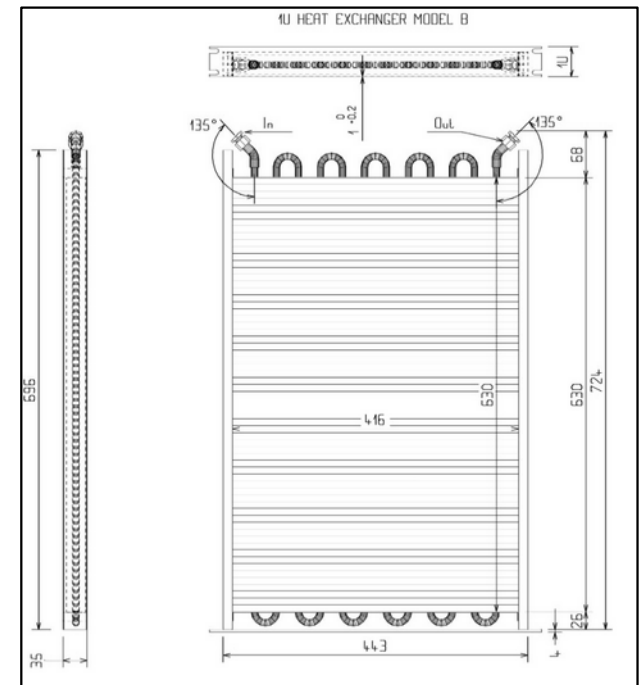
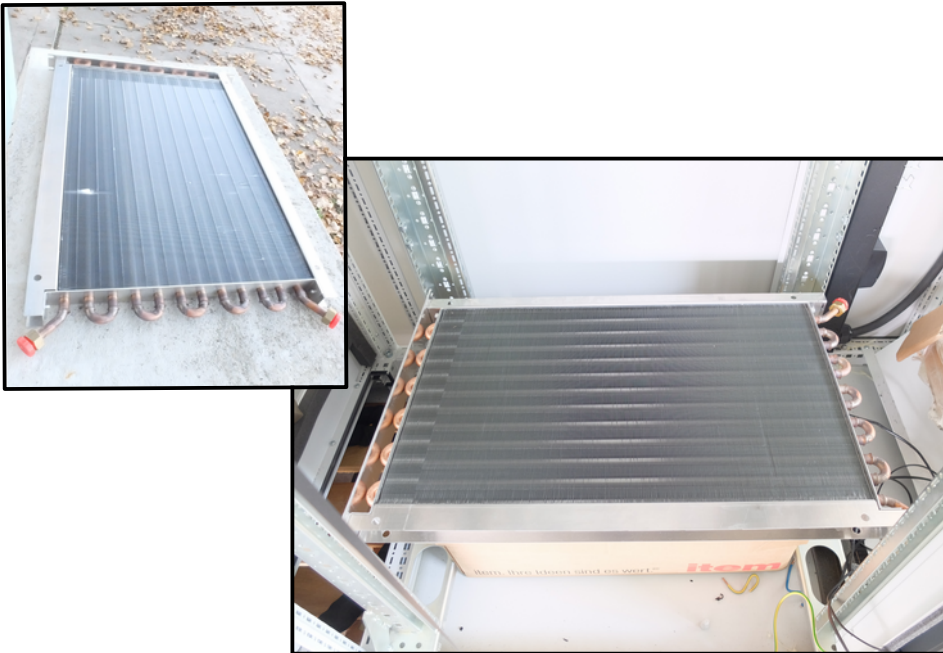


Integrated door side cooler removed



4. LHCb type Air to water Heat exchangers from CERN

- 1U height
- 10,8 mm inner coil \varnothing seem usable (the bigger the better, **focus on low pressure losses**)
- long LHCb version (630 mm depth) \rightarrow presents good coverage of usable area
- To do: set up connection in parallel fashion; allows to diminish pressure losses



5. Software set up for testing the hydraulics

Start version by Jost Lühning suitable for reading out 6 signals

- can be controlled with ArduinoMega 2560 or UNO μ C
- 4 analog INPUT signals to PLC (use of pressure gauges 4 - 20 mA)
- 2 digital OUTPUT (Relay: Vacuum pump; Relay: Water pump)

· Needs further attention:

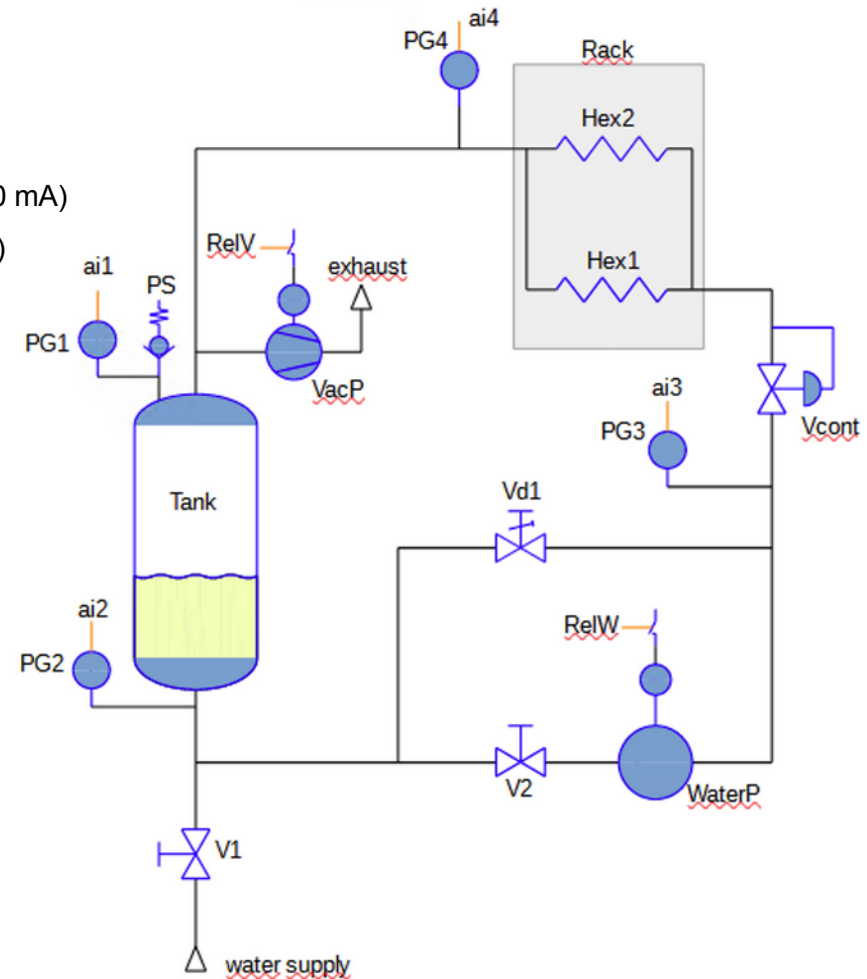
1 digital INPUT Switch on -> start main pump

1 digital OUTPUT Switch off -> stop main pump

+ 4 digital OUTPUTS for status of

“VacP”, &
“WaterP”
“Alarm”,
“Reset“

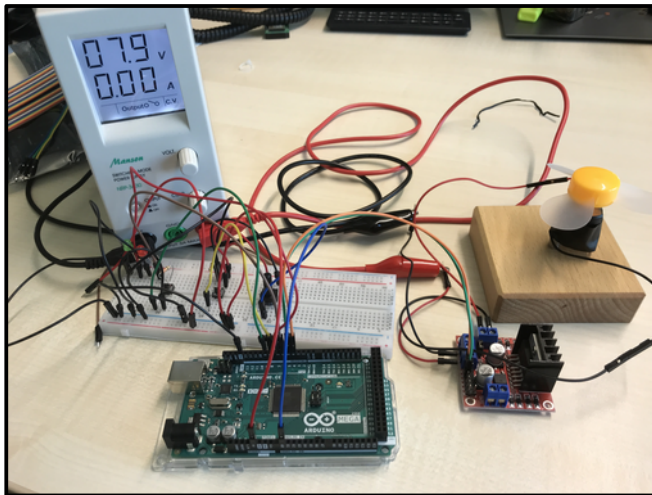
<https://panda-repo.gsi.de/infrastructure/leakless-cooling.git>



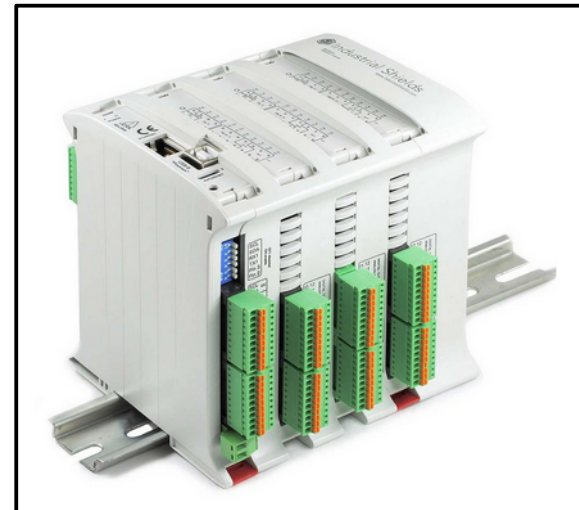
6. Breadbord setup incl. start/stop buttons, L298N driver board, Poti and 5V DC motor

Circuit for testing variable motor speed in first step ... is working

- Can be controlled with ArduinoMega 2560 or UNO μ C
- Operation with driver board (L298N) allows operation with up to 35 V \rightarrow but later 230V or 400V DC motor needed.
- External voltage supply for μ C crucial
- further iterations needed with higher voltage
- Next step: including setup in PLC DIN rail enclosure



Standalone ArduinoMEGA 2560 μ C with LH295 Driver board
DC motor & buttons and Potentiometer



Example: M-DUINO PLC Arduino Ethernet 54ARA I/Os Analog
/Digital PLUS (based on ArduinoMEGA μ C 2560)

Open points / To do:

- connection (tubing) of LHCb heat exchangers in parallel mode
- adding status signals for "Reset", "alarm" "VacP" and "WaterP" to the hydraulic start version
- controlling bigger motors with the bread board setup & Poti
- implementing a gas membrane (vaccum) pump

Thank you for your attention