Update of MARCO

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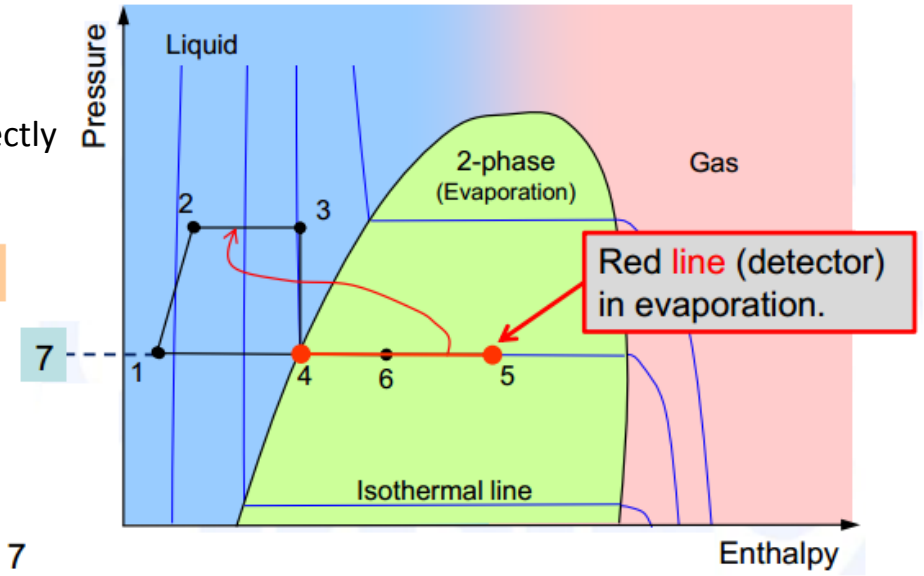
2PACL : The **2**-**P**hase **A**ccumulator **C**ontrolled **L**oop

- 2-phase CO_2 cooling : Effective low mass cooling concept。
- CO_2 in two-phase, heat removal by evaporating liquid CO_2 at the constant temperature and pressure.
- All control hardware in a distant accessible cooling plant.

The pressure drop in (4-5) should be small, therefore the accumulator directly controls the pressure in the detector.

Detector is on

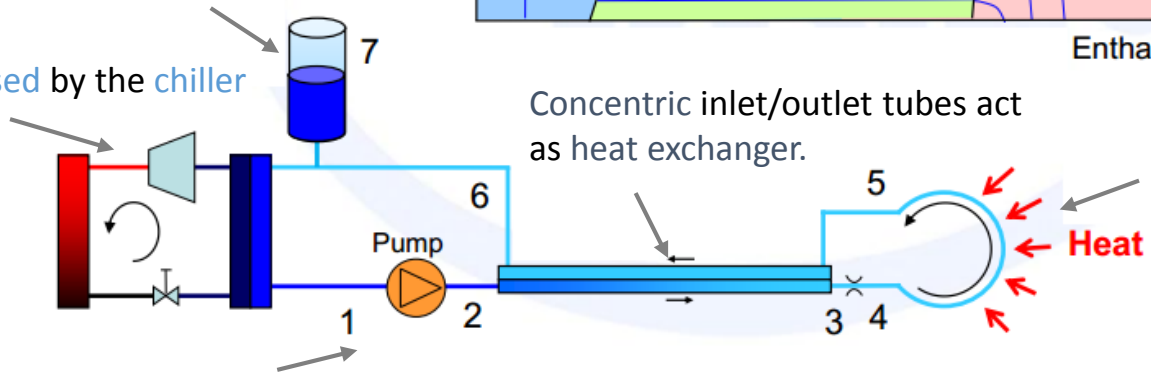
Controlling the **accumulator** pressure hence the condenser and evaporator pressure.



Vapor is condensed by the chiller

Concentric inlet/outlet tubes act as heat exchanger.

The detector acts as evaporator



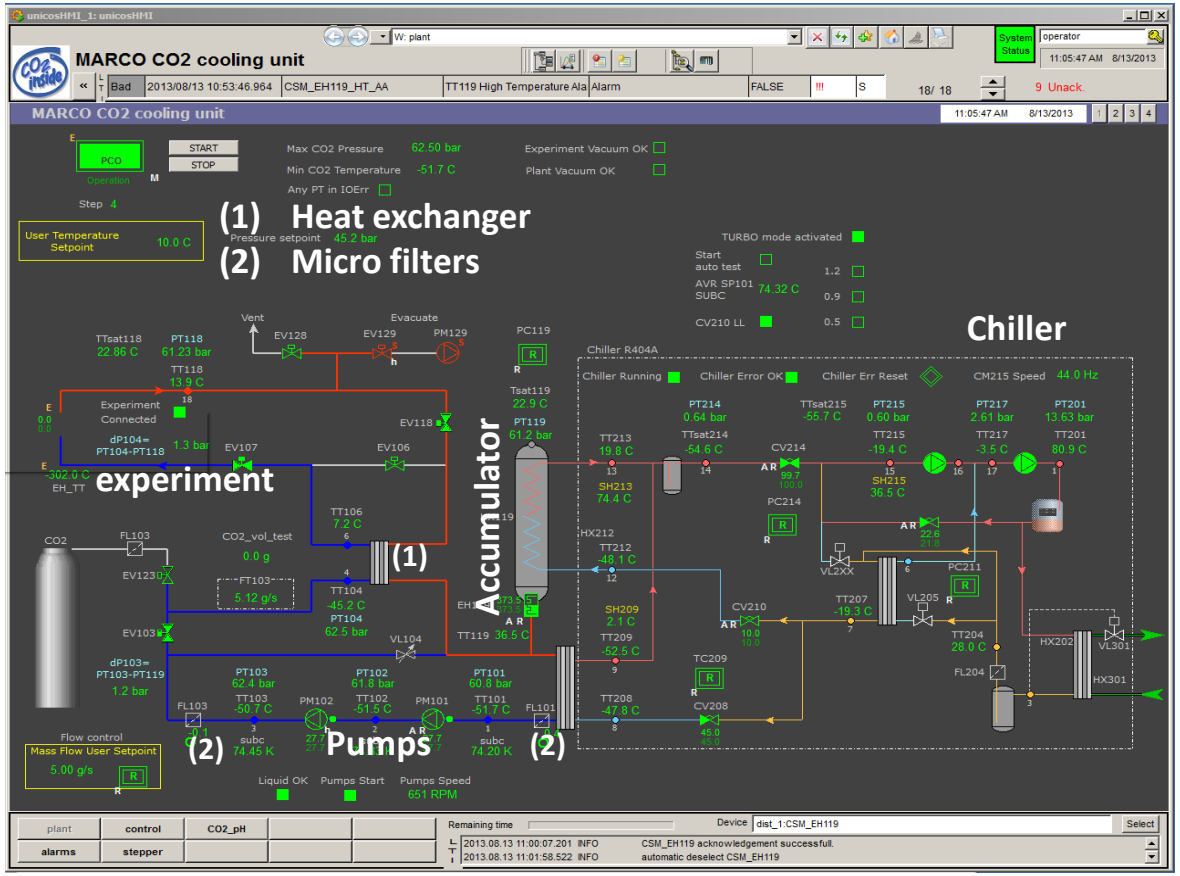
The sub-cooled CO_2 will prevent the pump from cavitation.

From Bart Verlaat (Nikhef/CERN)

MARCO CO_2 cooling unit

MARCO : ***M***ultipurpose ***A***pparatus for ***R***esearch on ***CO_2***

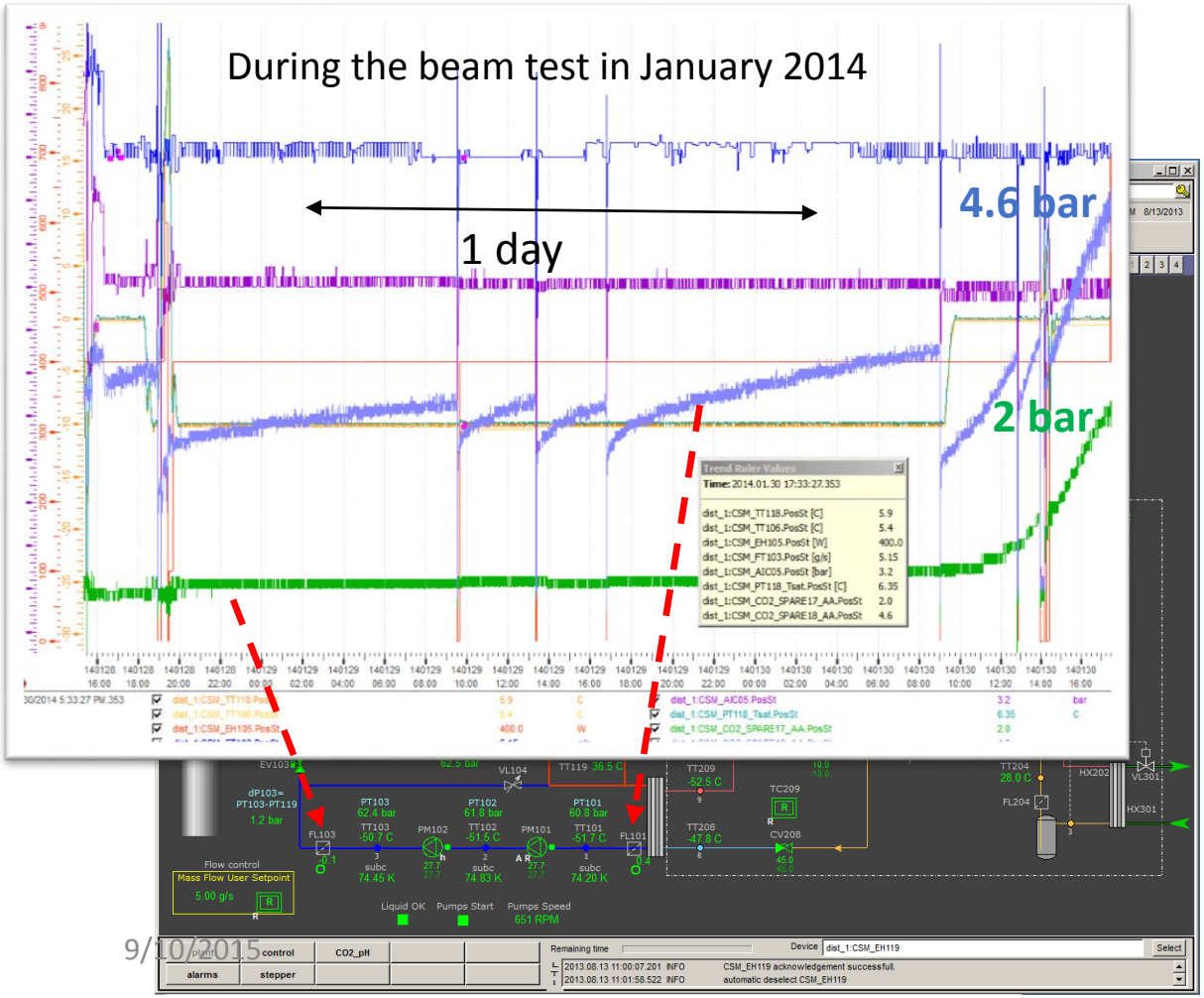
- Fully automatic (User friendly) CO_2 system for general use.
- Base design on detector cooling plants (Atlas IBL, BelleII)



Long term Operation of Marco

Weak point of MARCO is the reliability of CO_2 pumps,

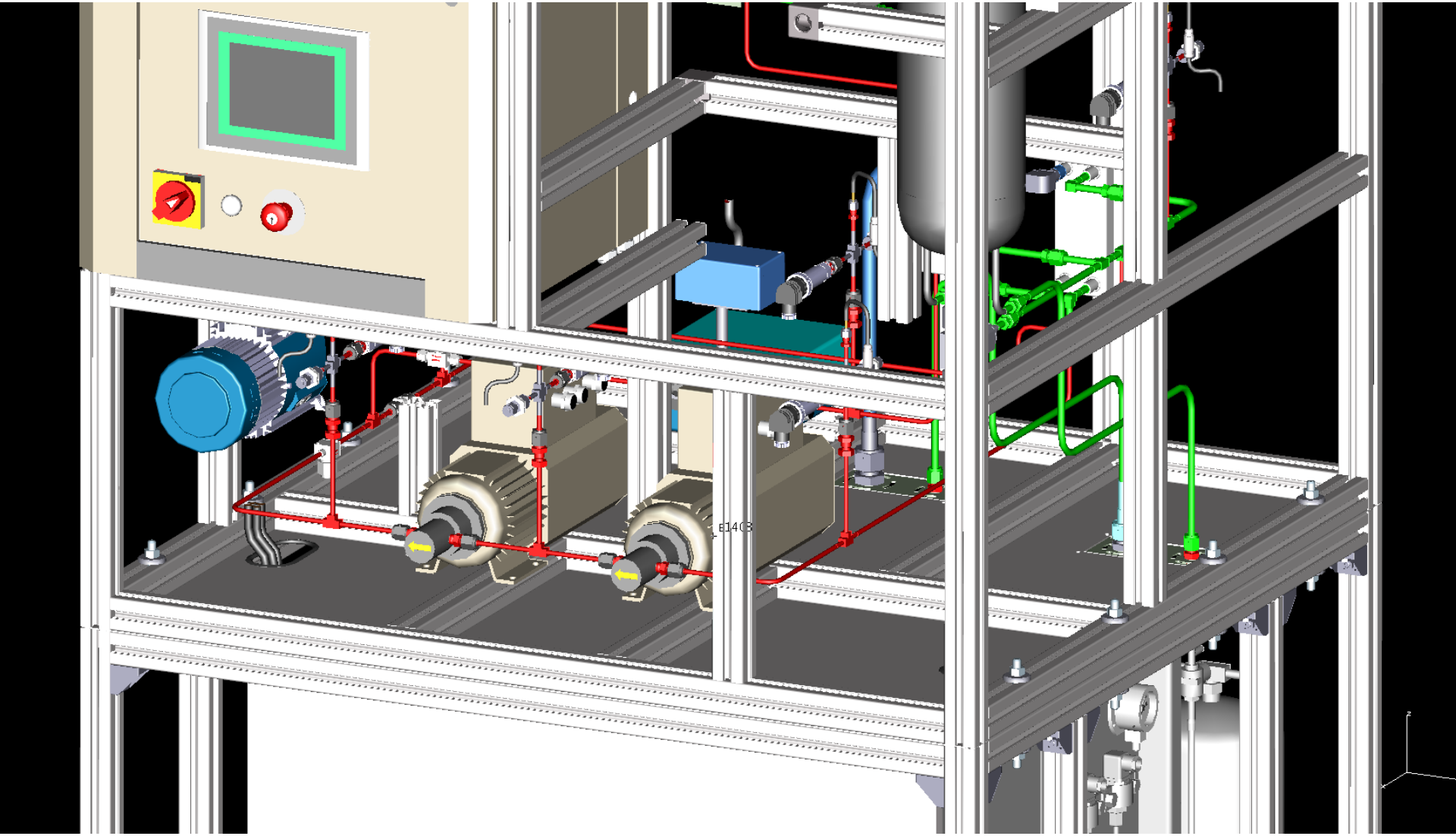
abrasive wear of gears cause clogging of micro filters.



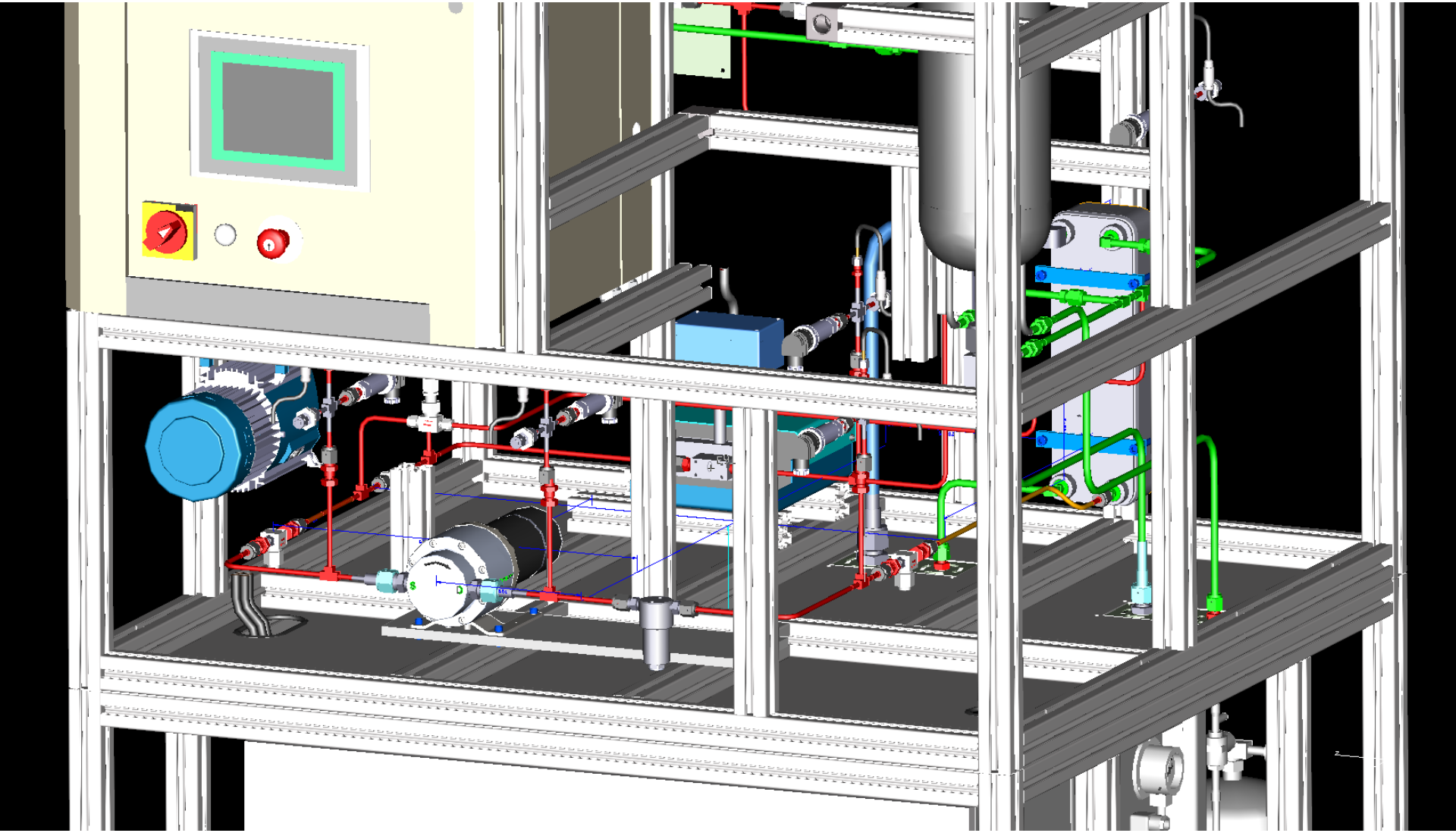
40 µm filter (mid march 2013)

After a continuously running for about 80 days, the pressure change before and after the filter rises to ~4bar, due to the dirt.

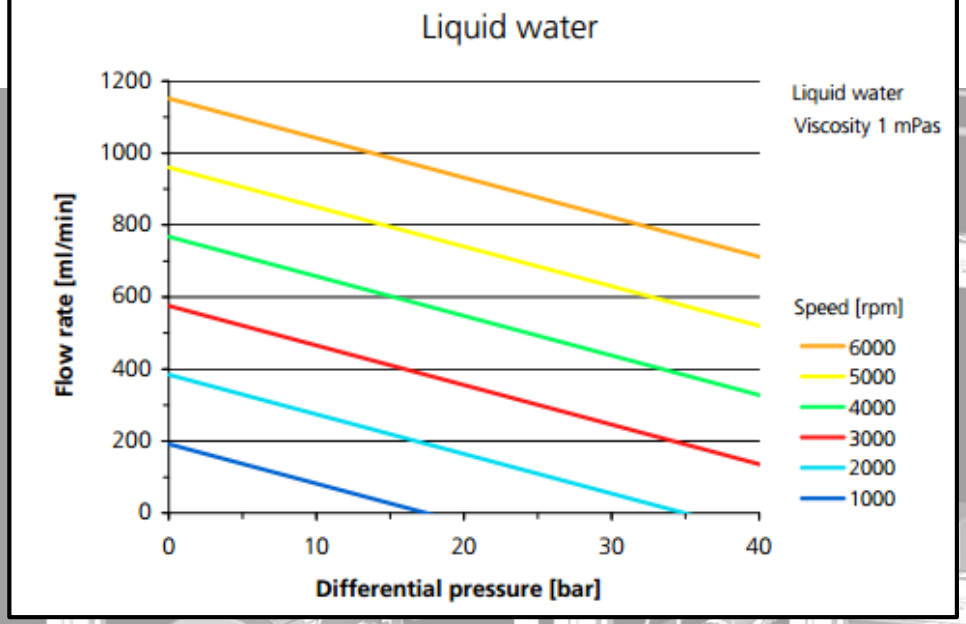
Replacement of pumps



NHP mzr-11558 pump refit



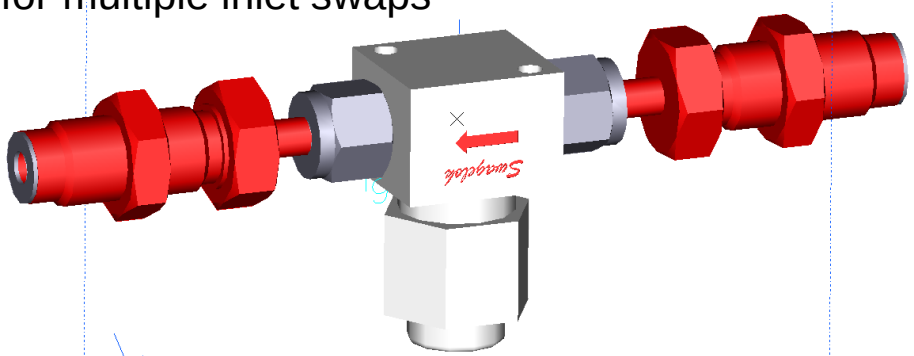
Flow charts



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

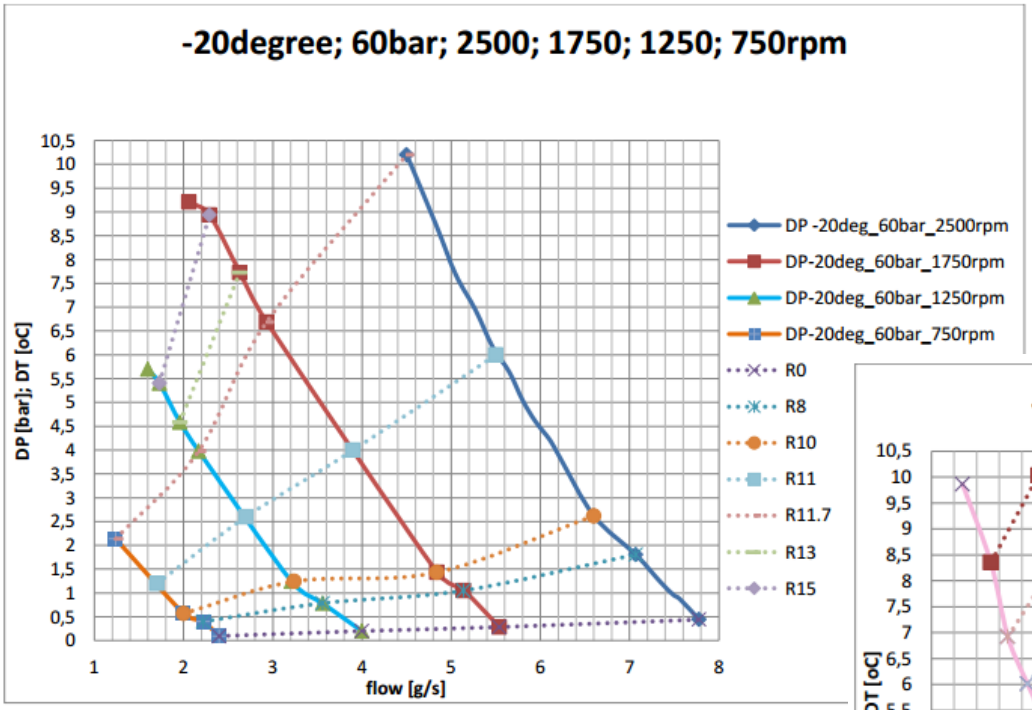
Filter with VCR

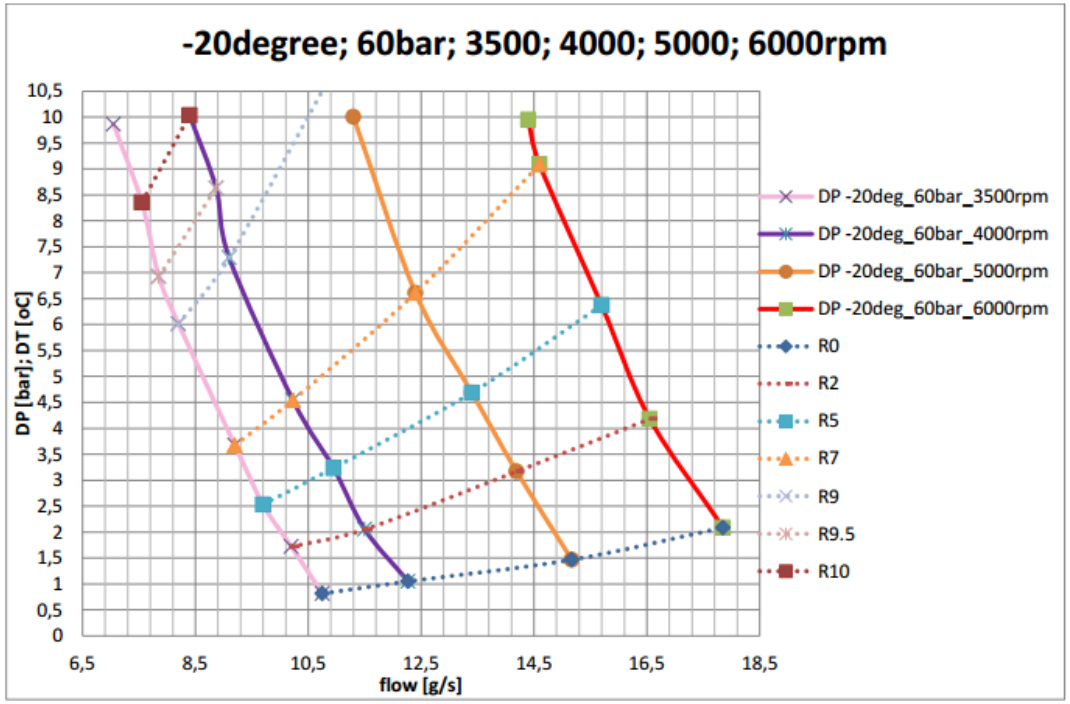
Filter fitted with VCR connectors
for multiple inlet swaps



Pump test at CERN

Cite from Piotr Dziurdzia's repot

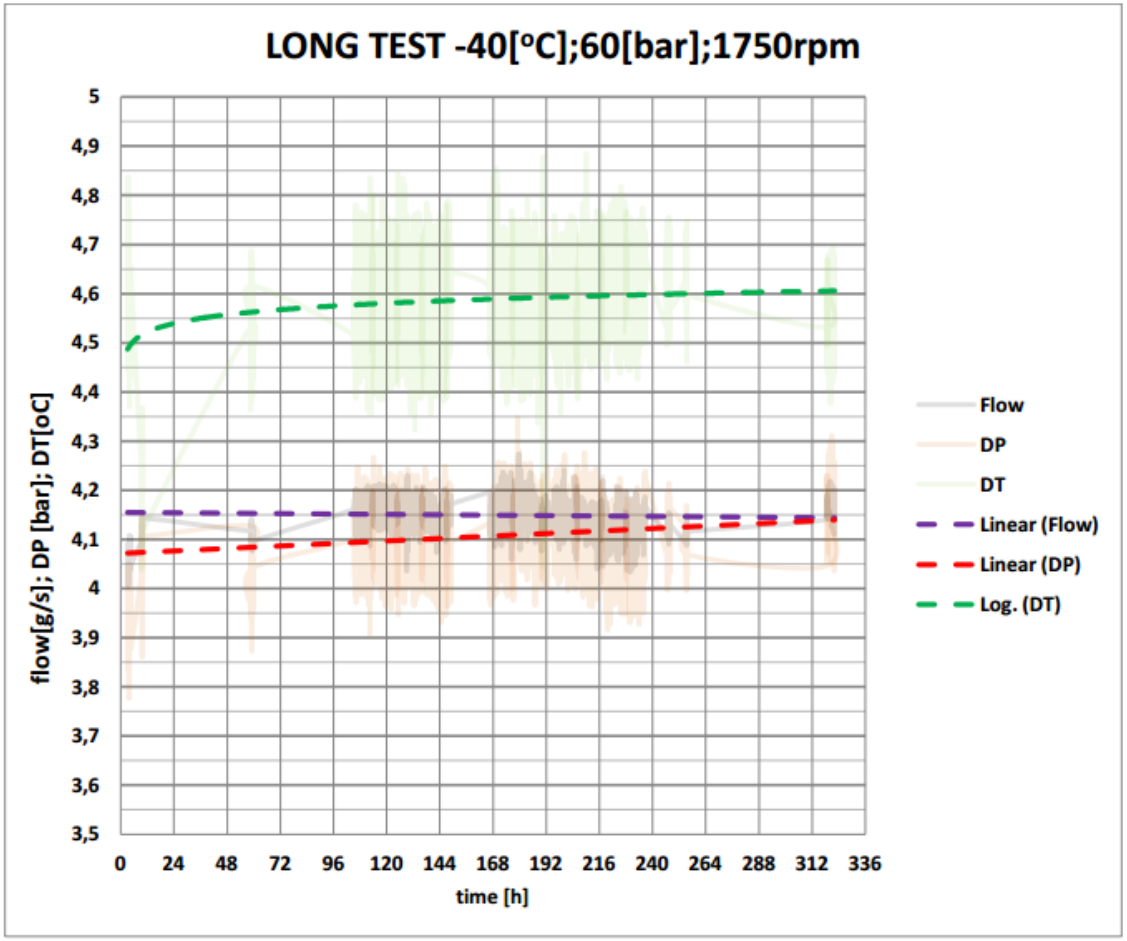




Maximum capacity can be reached is around ~1 L/min at 6000rpm, gives the mass flow ~ 16g/s.

Long-term Test

14 days test at set point of -40°C; 60bar; 1750rpm and pressure drop about 4bar.
Pressure drop rise up ~0.1bar, delta temperature increase ~0.1°C correspondingly



Summary

- MARCO works fine in our thermal mock-up tests.
- Weak point is the reliability of CO_2 pumps, abrasive wear of gears cause clogging of micro filters.
- The update design is done. The new pump and heat exchanger are on the list.
- The performance of new pump is good, according to the tests at CERN.