



LHCb COOLING MEETING
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Sezione di Milano

**Update on the UT evaporator
studies in Milano and cooling
requirements**

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Update on the cooling requirements for UT (presentation of the table circulated by Paola)

		UT
Accu Tmin	°C	-30
Accu Tmax [°C]	°C	15
Hot spot - pipe max T inside detector	°C	
CO2 max T – Evap T (=f(l, ID, flow))	°C	
Detector cooling loops	#	34x2
Parallel loops (each one of the 2 half-detectors)	#	2 planes 8 channel parallel + 2 planes 9 channel parallel
Power /central stave – HLLT (MAX)	W	76 ...+5%
Flow/central stave - HLLT @ -30	g/s	0,9 ...+5%
Dp central stave - HLLT@ -30	mbar	400 (measured)
Power / external stave – HLLT (MAX)	W	50 ...+5%
Flow/external stave - HLLT @ -30	g/s	0,6 ...+5%
Dp external stave - HLLT@ -30	mbar	measure in progress
Power /cooling loop - WARM @ 15 C	W	75
Flow/cooling loop - WARM @ 15 C	g/s	0,88
Dp central stave @ +15	mbar	32 (measured)
Dp cooling loop - WARM @ 15 C	bar	4 (using flow restrictor ID 0,25 mm)
Transfer lines CP to JB	#	1
JB to detector transfer lines	#	2
Manifold	#	4 inlet + 4 outlet each one of the 2 half-box
Max detector power	kW	5
Max detector flow	g/s	60
Max detector Dp	bar	5*

* including inlet pressure drop (t.b.d.)
(using flow restrictor ID 0,25 mm)

CP= Cooling plant (alcove)

JB=junction box (top of the magnet?)

Relevant comments

- Detector cooling power calculation is based on the power dissipated by the detector read-out «SALT» ASICs
- power dissipated by the detector read-out «SALT» ASIC is not available as a final figure
- Recent information is an increase of + 5% in this figure, and measurements are in progress
- This fact is consuming part of the margin taken on the cooling power calculation
- Detector box heat pick-up from ambient is included in the cooling power calculation as an estimation (I don't know the safety margin on this calculation), we need to leave sufficient safety margin on this

- central stave measured with dummy prototype
- it is confirmed that the stave pressure drop is ~ 400 mbar at «nominal power» of 75 w and the «nominal mass flow-rate» of 0,9 g/s to have 30 % outlet vapour fraction
- + 5 % more ASIC power dissipation could be accommodated easily in this numbers
- The stave circuit is dominated by the calibrated orifice (Swagelok 0,010" = 0,25mm ID flow restrictor) pressure drop ~ 4 bar in nominal condition
- Lateral staves are being measured in immediate future and differences between this and the central stave will be communicated asap
- The warm test at 50 bar evaporation pressure, 15 °C indicate a central stave pressure drop of ~ 30 mbar at \sim nominal massflowrate and power (we are in liquid mono-phase cooling)

* From the cooling requirements document

With 5000 W cooling power,

mean outlet vapour fraction estimated 30 %,

liquid-vapour enthalpy 280 J/g

total mass flow-rate $\Rightarrow 5000/280 \cdot 0.30 = 60$ g/s

splitting evenly in the two detector half-boxes