SCT Barrel Sector Prototype Test Program- Short Term Aims

Harness Test.

•Installation and evaluation of a single harness & 6 modules.
•Urgent need to sign off the design for manufacture.

Thermal Tests- Repeat

•? T across inlet and exhaust with first configuration.
•Temperature profile along the stave - ’cooling loop’
•Detector temperature during operation.

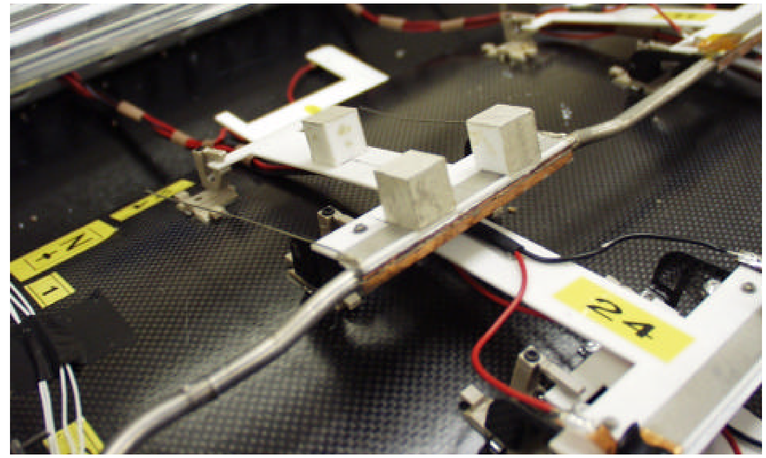
Mechanical Tests

•Distortion of ‘special dummy’ module when cooled.
•Distortion of the cooling loop when cooled.

Configuration 2: Barrel Features & C.D.S.

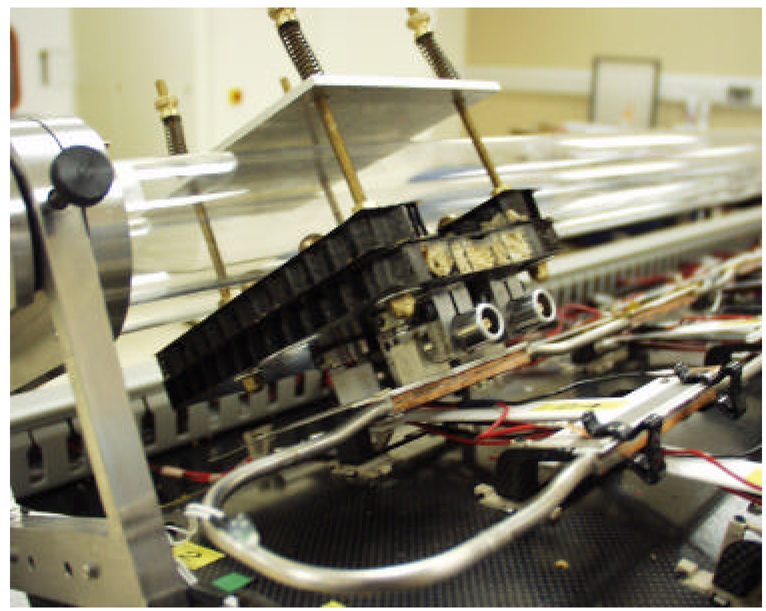
Barrel Sector Prototype

•10° tilt angle brackets.
•Alumina strip heater modules **without** clipped copper tab electrical connections – epoxy connections – see next slide
•Pre-production prototype 1 cooling loop.

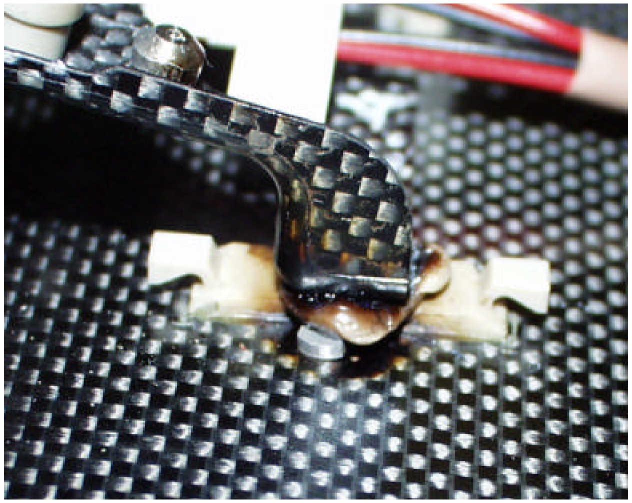


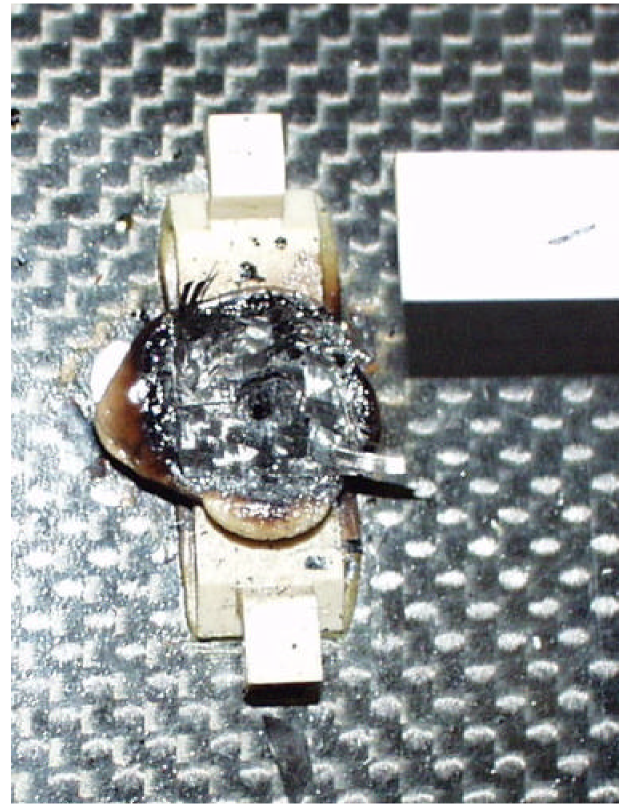
Capacitive Displacement System

•A trolley with capacitive sensors measures displacements in all axes on a special alumina dummy.
•7 sensor heads ‘see’ the cubic faces.
•Can be positioned anywhere on the sector.
•Accurate to 1µm.
•System traverses Z on fused silica rails.



Barrel Damage

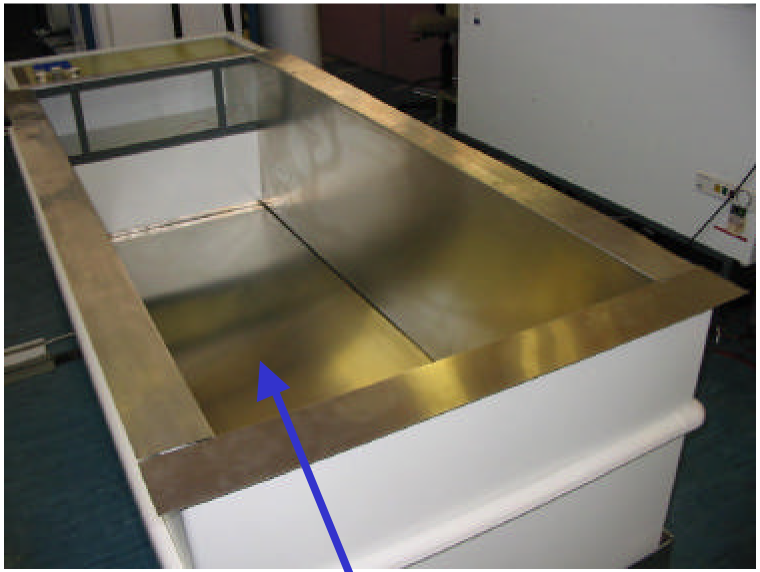




- At some point 2 pads have been damaged
- Most probably consistent with loss of 2 power supplies.
- Can rotate away from problem for remaining tests at RAL.
- Problem will be repaired before sector goes to Oxford.

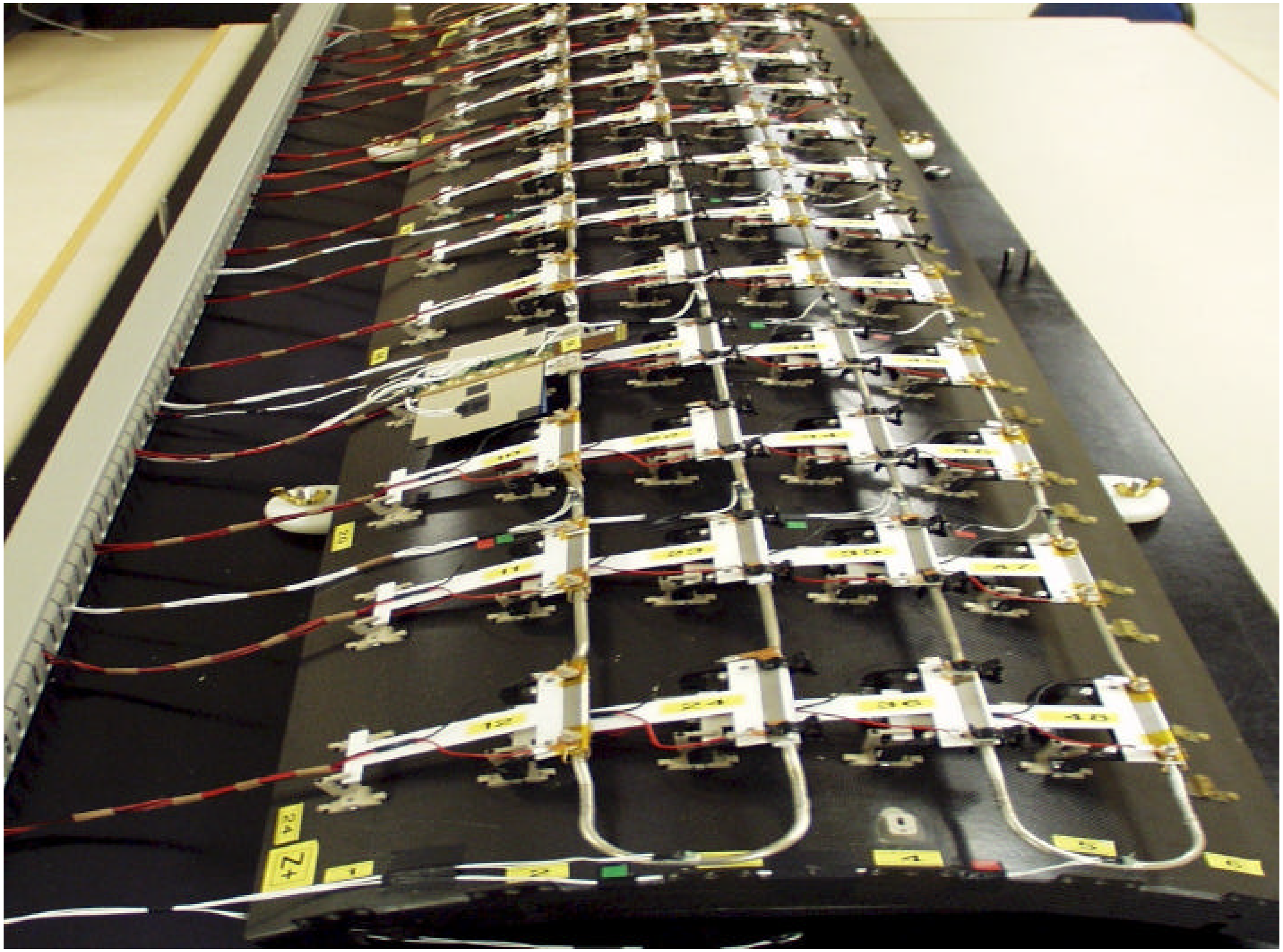
Configuration 2:
Environmental Chamber

- Large chest freezer equipped with Oxford's thermal Imaging camera and web-cams – see what is happening.
- Reduced humidity – NO frosted cooling pipes! Dew point thus far= -22°C with coolant flow at -20 °C
- Precise control and data-logging of chamber temperature. -25°C - 0 °C
- Aluminium/Copper faraday cage construction.
- Module DAQ interface.



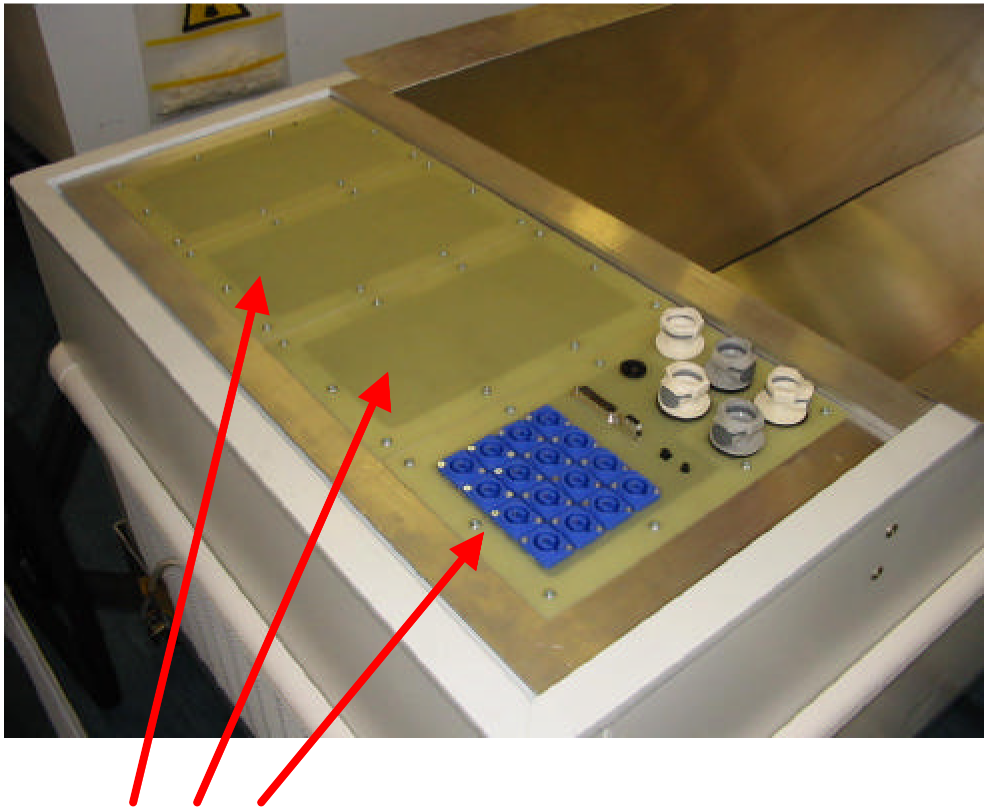
Faraday Cage in construction

Barrel Sector Prototype



Configuration 2: Environmental Chamber and Services

- Services entry via patch panel - future flexibility.
- Cooling loop is electrically isolated from evaporative rig pipework.
- Larger bore on evaporative rig exhaust – maximise compressor power.
- PT100 temperature sensors replaced with ‘one-wire’ system- time for a complete scan <10s



Patch Panels in construction

Completion of Configuration 2

•Brackets- no change

•Alumina Dummy Modules- change electrical connections- in progress.

•C.D.S. –Installed.

•New Test Chamber- in progress.

•Evaporative cooling plant – operational.

•One wire temperature sensor system – tested, installation in progress.

•Harness – awaiting cooling loop removal – in progress.

Estimate all the above will be complete by 13/10/2002

Configuration 3

Sector Prototype

•New 11° tilt angle brackets.

Cooling Loop

•Final design loop – pre-production prototype 2.
•Production shunt shields.
•1 half row of new cooling blocks for electrical modules.
•Final design clips.

Modules

•36 alumina dummies, 6 instrumented thermo-mechanical modules, and 6 real modules!

Evaporative Cooling: Sub-Cooling

The RAL Evaporative rig does not perform well without sub-cooling, i.e. the C3F8 is delivered to the capillary at room temperature.

- During preliminary tests peak mass flow =**1.45 g/s**
- inlet/exhaust **? T = 11°C** (120 Watt load)
- With sub-cooling operational mass flow = **2 - 6 g/s**.
- inlet/exhaust **? T < 1°C**

  1g/s ~ 100Watts cooling.

–Evaporation in cooling circuit prior to arrival at the capillary?

–See Lewis for more detail.

Evaporative Cooling:No Sub-Cooling and Active Heating

Non Sub-Cooled Operation

•An additional compressor in series with the current unit could enable the rig to achieve a high enough pressure to deliver liquid C3F8 to the stave capillaries. Installation is being considered jointly with the RAL Health and Safety department - Pressure specification on CuNi pipe/Evaporative Rig?

SCT Cooling Strategy- Exhaust 'Active Heating'

• Evaluation of heater design and control for the above. Installation in progress.

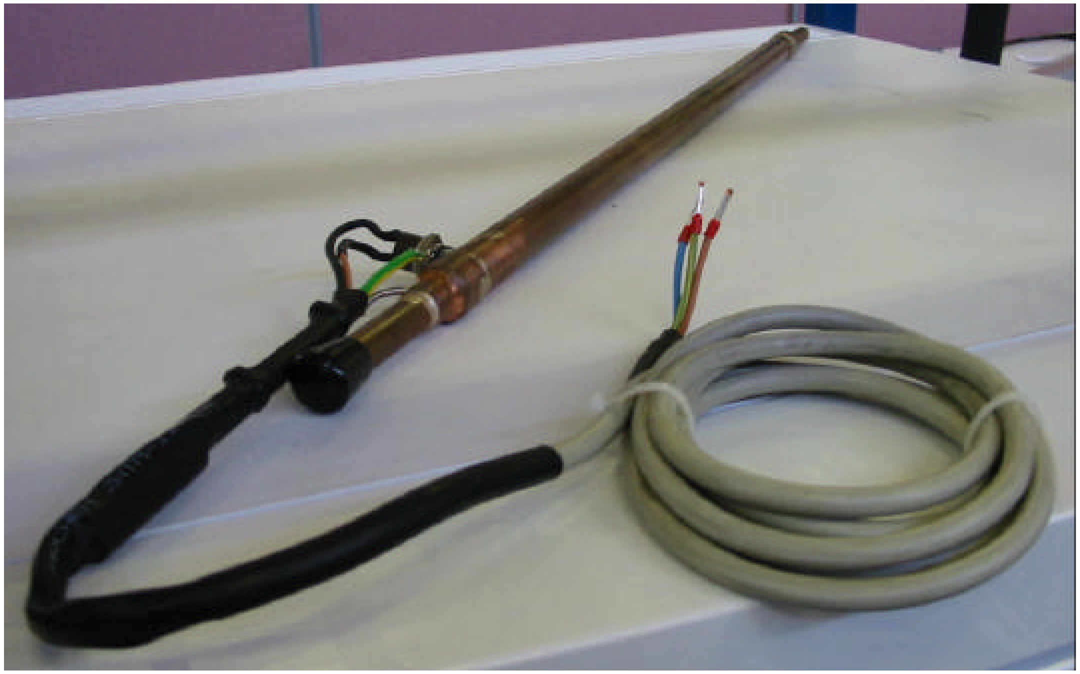
Additional Modifications

•Michel's group will produce a prototype heat exchanger with 2 inlets and one return tubes brazed along the length about 1.3 m long.

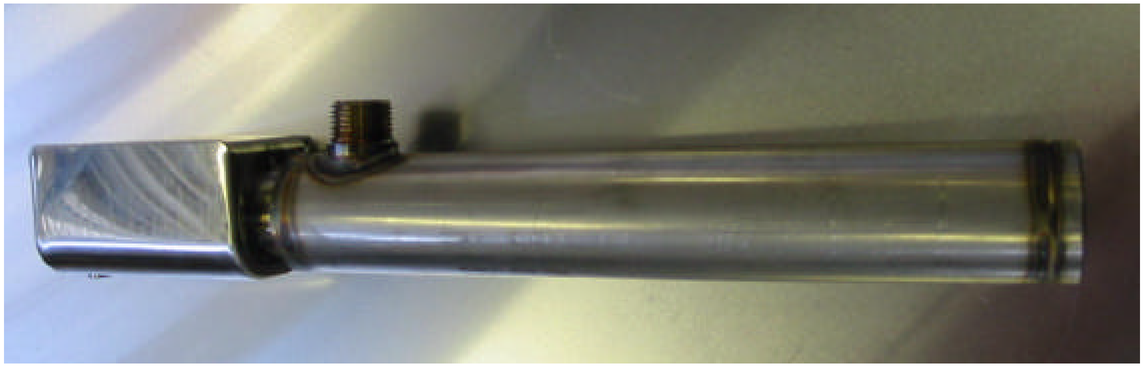
•Liquid flow meter, in addition to the current Gas meter- data-logging/monitoring. Calibration in progress.

Estimate completion of the necessary modifications by the end of October.

Active Heater Possibilities



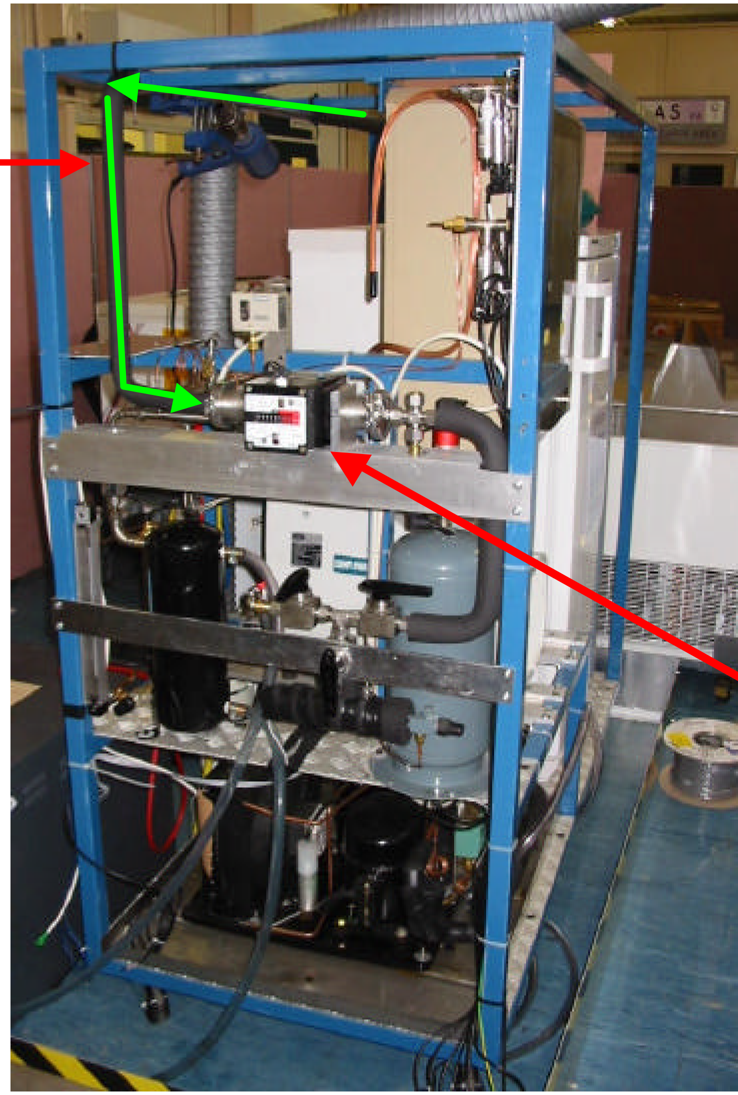
CERN supplied heater- 1m long, 18mm diameter



Commercially available- 25 cm long, 35mm diameter

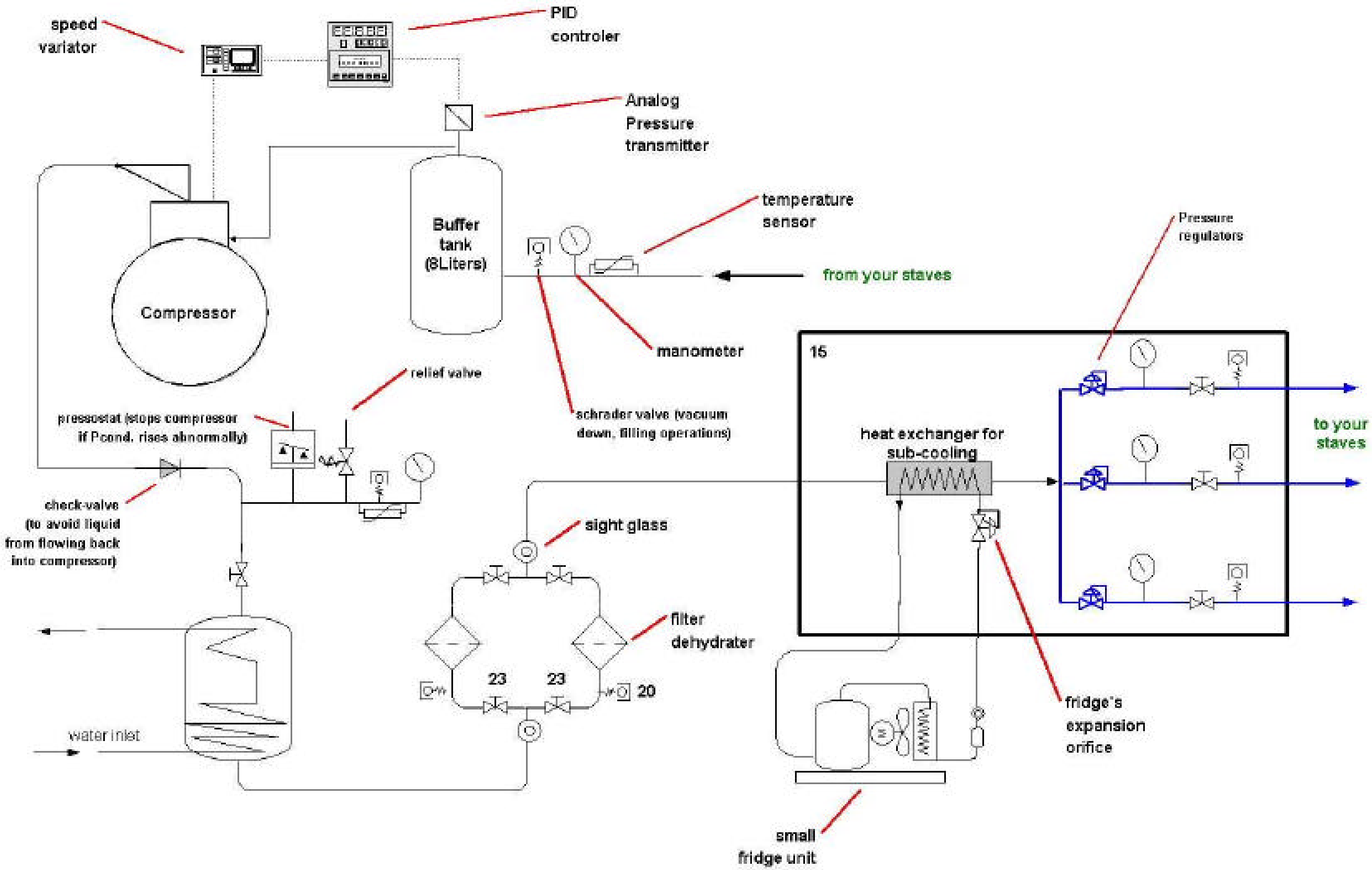
RAL Evaporative Rig

Exhaust Line

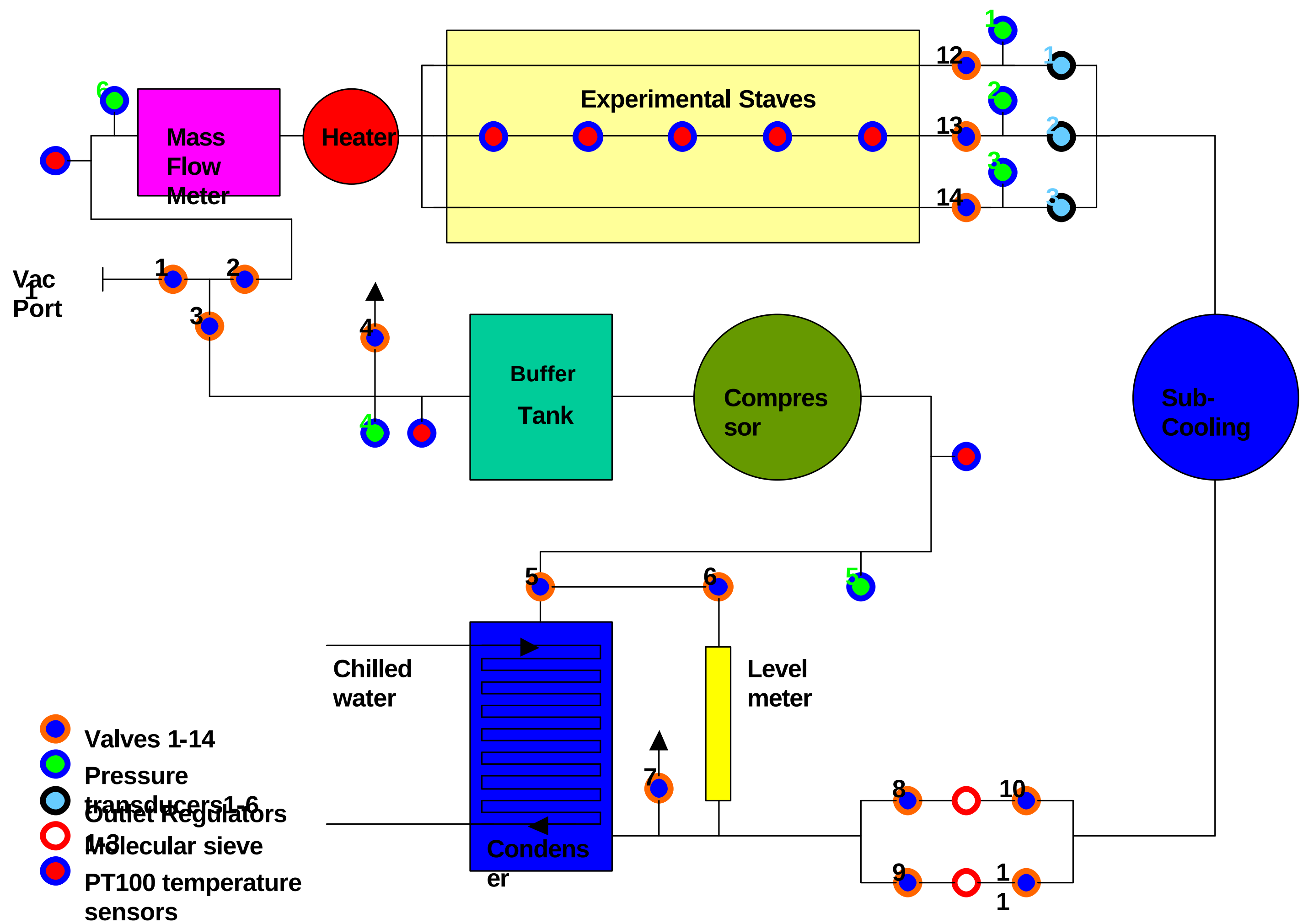


Gas Flow Meter

RAL Evaporative Rig - Schematic



RAL Evaporative Rig – Schematic II



Capillary Test

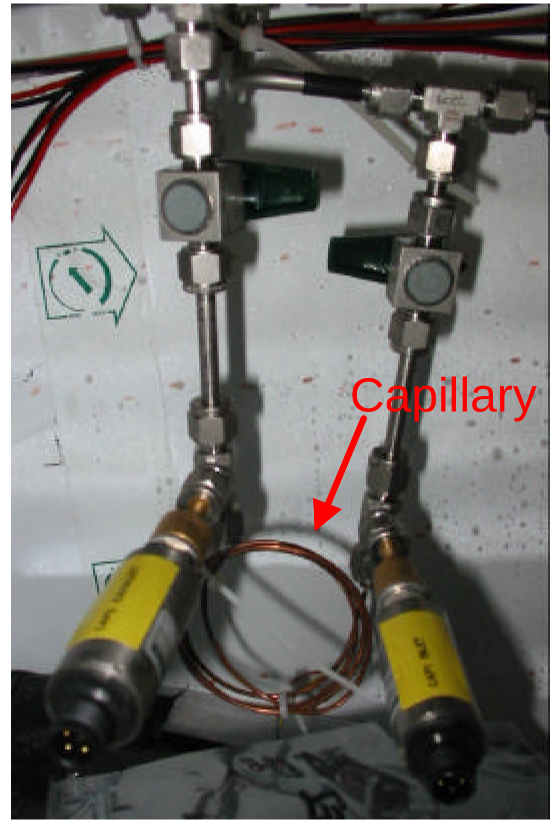
•Aim - Demonstrate the equation, determine the constant, **A**:

$$?P = A\left(\frac{dm}{dt}\right)^{\frac{7}{4}} \frac{L}{ID^{\frac{19}{4}}}$$

Where **?P** = pressure drop across the capillary,**dm/dt** = mass flow,**L**=capillary length and **ID**=Inner diameter of the capillary.

•Define the production capillary parameters for the final SCT cooling system.

•The Capillary test piece is operated when other users (Barrel&End Cap) are not running.

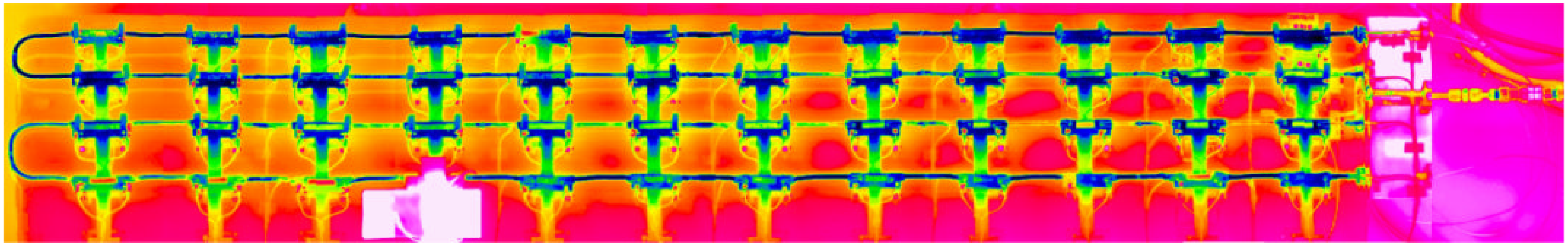


Capillary test piece in situ - ‘piggy-backing’ the End Cap stave.

Capillary Test ctd.

- A matrix of capillary IDs and Lengths to be tested.
- The first test capillary is ready – ID=0.8mm L=0.8m.
- 30m lengths of ID=0.7mm and ID=1.0mm have arrived so far.
- ? P Pressure transducers installed and operational.
- Labview Interface ready and operational.

RAL SCT Cooling Web Resource



For more detailed information relating to configurations 1,2 & 3 and any other RAL cooling activities:

http://hepwww.rl.ac.uk/atlas-sct/B3SectorPrototype/Main.htm