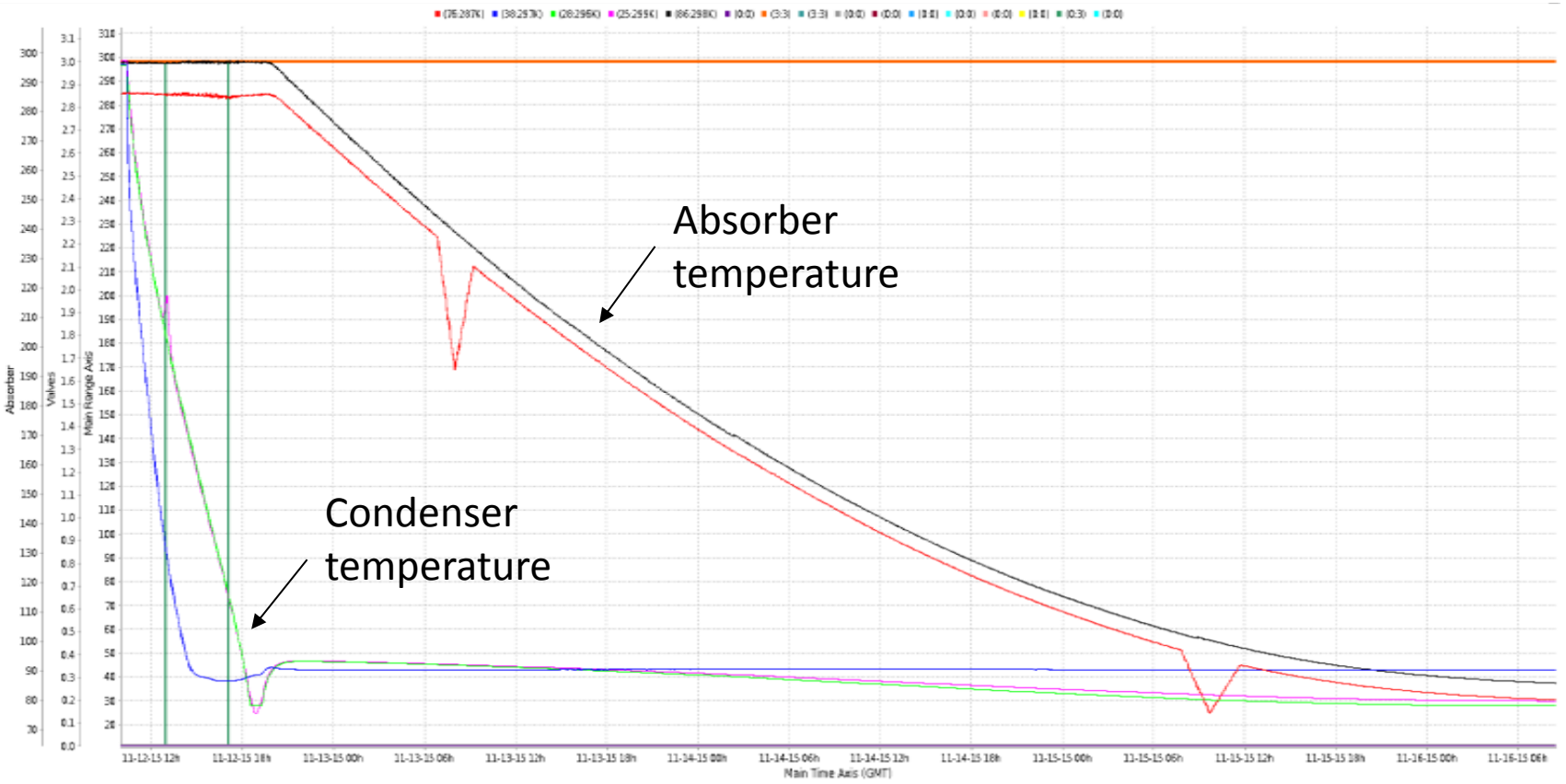
# CM 44
# Hydrogen System

31/03/16

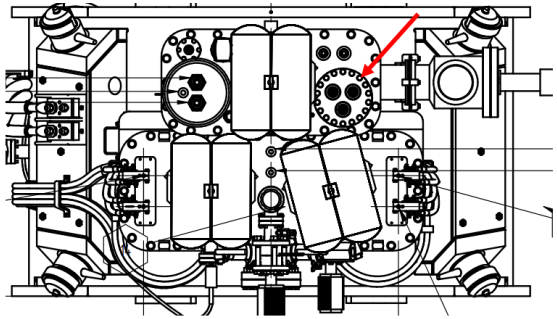
# Cooldown problem



# Diagnosis of leaks

Pressure rise as cryostat warmed up indicated $10^{-3}$ mbar.l/s leak

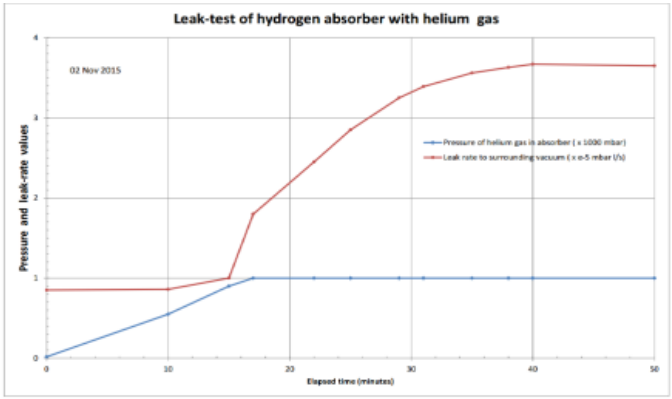
Using leak detector attached behind the turbo pump, leak checked from all neighbouring volumes – interspace volume, pre-cool circuit, absorber circuit and around turret



Two leaks invalidating the H2 safety case:

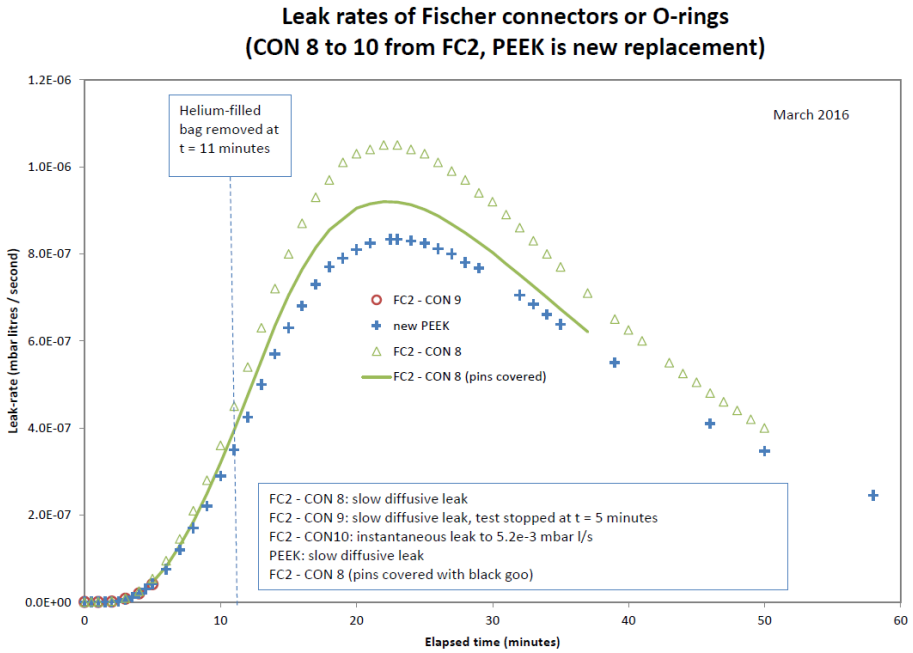
- Feedthrough on turret - 1 x $10^{-3}$mbar.l/s

- Absorber circuit – initially 3.6 x $10^{-5}$mbar.l/s, then after 2nd cooldown 1.2 x $10^{-3}$ mbar.l/s



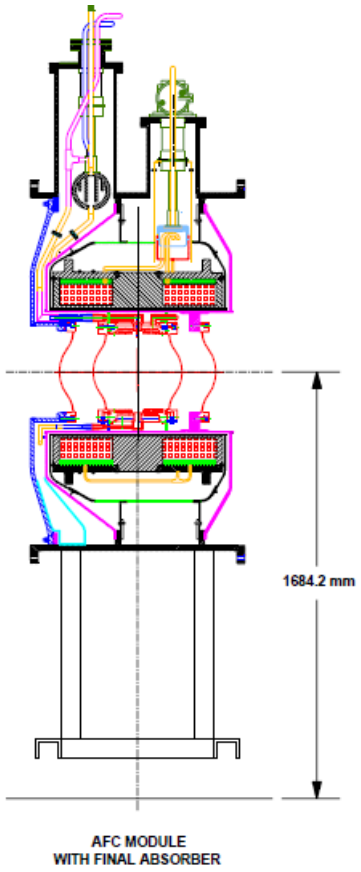
# R9

- FC#2 was put in R9
- The leaking feedthrough is being replaced.
  - All 3 feedthroughs now being soldered back in place were leak-checked - show $10^{-7}$mbar l/s
  - Prevent leaks developing again
    - preventing feedthroughs rotating in the top-plate
    - strain-relieving cables



# R9

- Working to improve the cooldown:
  - thermal model shows significant heat loads through radiation on absorber and conduction through cooling pipes (including LN2 pre-cooling pipes)
  - Glass fibre stand-off to prevent touch between top-hat and cooling pipes



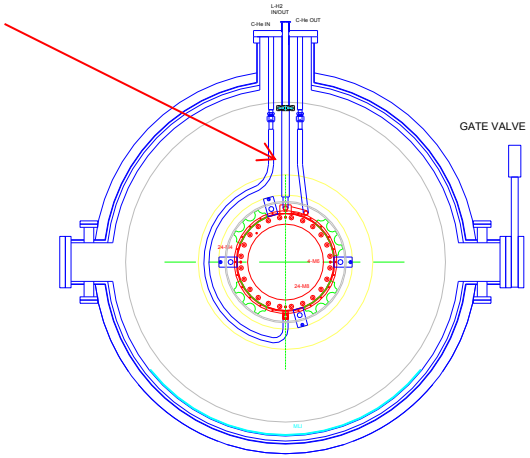
# R9

– Including heater on LH2 cooling pipework to drive flow around the circuit

- Watlow 25W heater identical

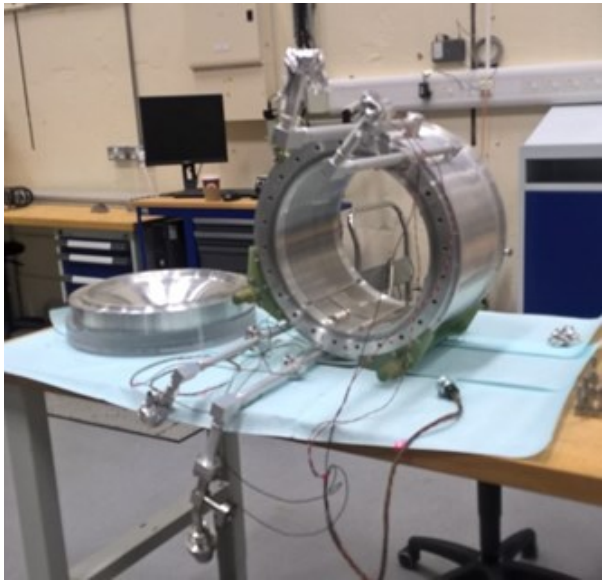
to existing heaters in the

insulation vacuum



# Fixing absorber leak

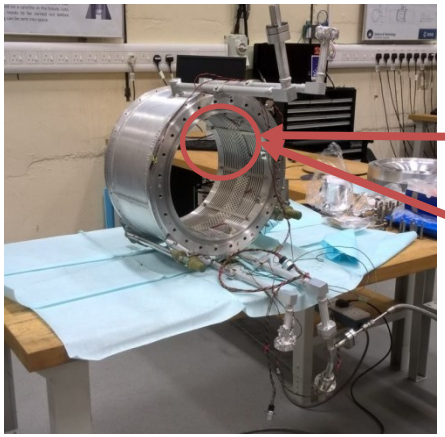
- Leak checked the absorber circuit with the cryostat open – identified leak location
- Removed windows to inspect the joint
- Leak check the windows themselves using rubber o-ring

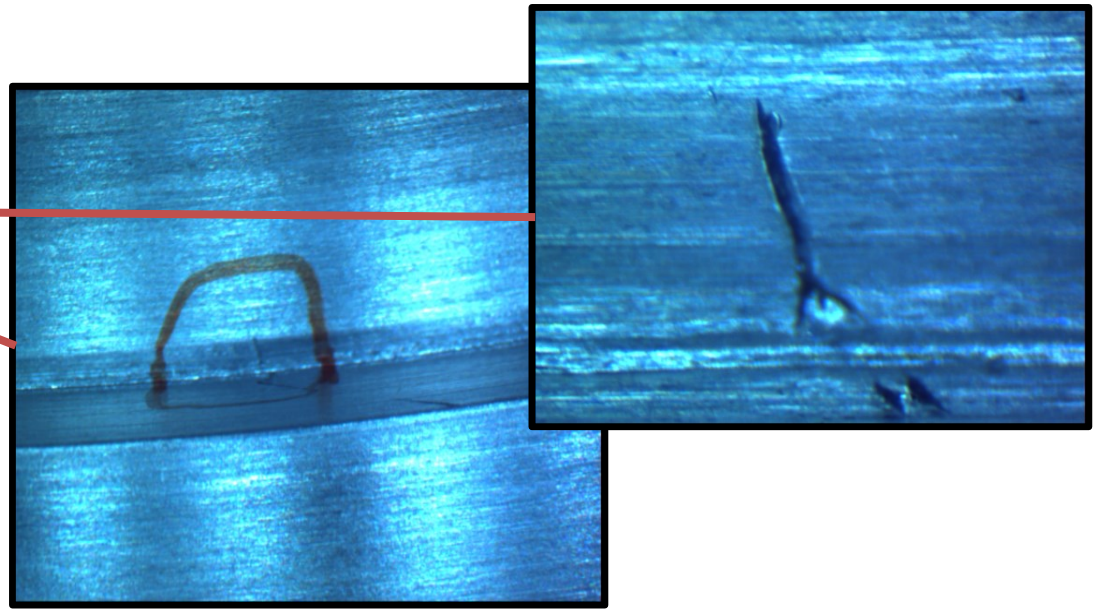


# Fixing absorber leak


- Repaired the surface

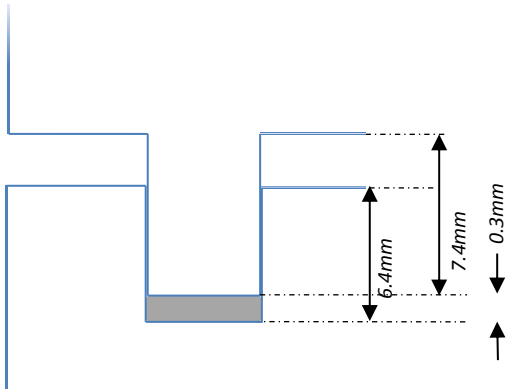
- Investigated surface defects





# Fixing absorber leak

The indium seal will now be reassembled following an agreed procedure:




1. The indium material was made to the appropriate dimensions such that the strip would compress to a thickness of 345µm±25.

2. The Aluminium (tongue and groove) and indium were cleaned using Acetone to remove any dirt, and then IPA to remove the Acetone residue.

3. The indium was layed in the groove

4. The bolts were tightened in a diamond pattern– replacing the previous spring washers with Belville washers. Belville washers should ensure sufficient force is maintained on the joint at low temperatures, when CTE mismatches between the Al flanges and the steel bolts will reduce the initial torque applied on the bolts.

The bolts were tightened such that the space around the perimeter of the flanges between the absorber and the window was constant, rather than a constant torque being applied. From the drawings, this would ideally be 1.3mm- since the surface of one of the inserts had been cleaned to remove a scratch it would be slightly higher on that side.

# Hydrogen system - paperwork

- Outstanding documentation:
  - Operating procedures – first draft in circulation for comment
  - Maintenance plan – first draft nearing completion
  - Pressure systems technical file – minor additions required
  - Risk assessments and system descriptions – final drafts in circulation for comment
  - Evacuation procedure
  - Split of responsibilities for MICE shifters, ISIS crew and hydrogen operators
  - Published instructions (one document or many?)

- Final sign-off will be after completion of hardware but a provisional ‘paperwork only’ sign-off will be sought at the earliest opportunity

# Work-plan

- Decide what, if any, remedial work is needed to deal with the defects in the groove, and carry out.
- Reattached the absorber windows
  - Repeatedly leak test and thermal cycle (complete mid-May)
- Install absorber in the FC in R9 with a vacuum end cap and prepare for testing (end-May)
- Test the cooldown with Helium in R9. (end - June)

If successful,

- Install the AFC back in the MICE hall (mid- July)
- Sign-off and operate the LH2 system (mid-August)