

Testing and Check Notes of Protea FTIR System 6

Initial Inspection

HIB

- No silicone lagging on filter element holder – will need to add - done



- SDC connection tubing was inside and not cut down
- Air inlet tubing is bent (although not needed)



- No filter element inside – although see below there are 6 in the drawer

Suggest that pipe is not left inside with bubble wrap round it – what if someone had just heated it up!

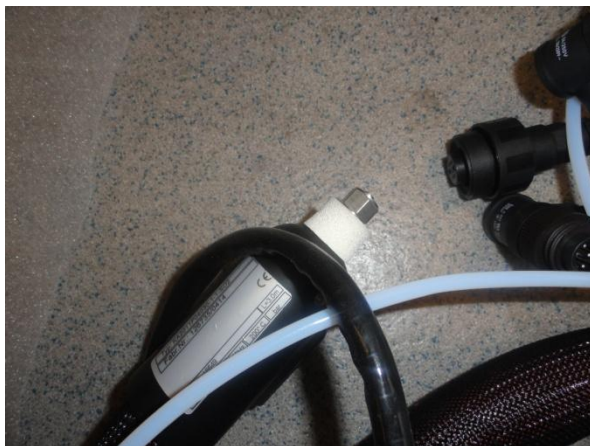
M+C filter

- It's now white!!



Heated line 1: SDC (extra electrical connections)

- Both ends have small doughnuts already fitted – correct



- M6 nuts on both ends of heated line – correct
- M6 nuts on both ends of span gas PTFE tubing – correct
- HIB end does not have labels on the Filter and Valve electrical connectors – need labelling - done

Heated line 2: Cone (for connection to M & C filter)

- Only one end has small doughnut already fitted – correct
- M6 nuts on both ends of heated line – correct
- M6 nuts on both ends of span gas PTFE tubing – correct

FTIR unit

- Packaged well in split foam
- I have marked "Front" on both halves, so I know how to pack the FTIR after testing it



Paperwork

- Calibration for FTT6rev2 in wallet
- Manuals for AtmosFIR, PAS, FTT FT-IR Analysis, HIB and PSP4000 are present

FTIR Rack

- Packed in wooden crate



- Neil and Gary removes it for me

- Front and rear door handles have changed, so they can only be opened with a key – not so keen on this since the operator needs to access the inside of the rack continuously to turn parts on and off.



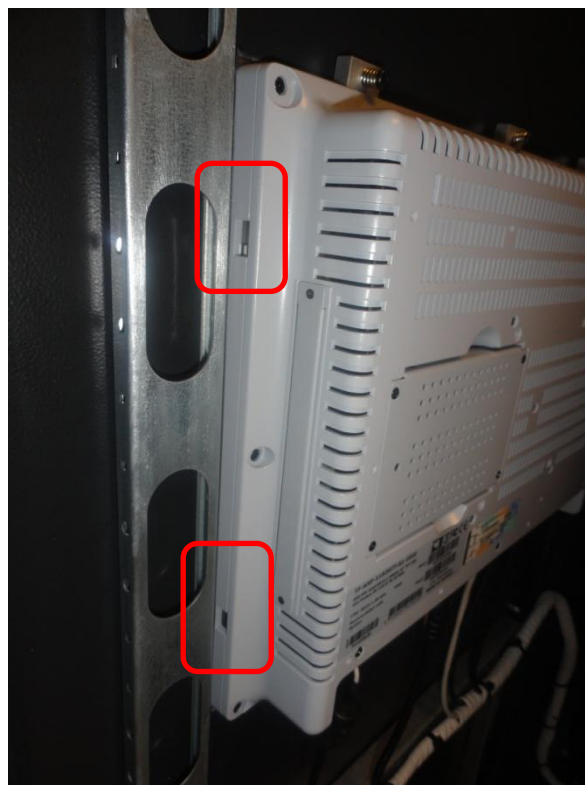
- Drawer opens and closes OK and can be locked
- Remove bubble wrap from screen – one of the fixing brackets is on the top of the screen



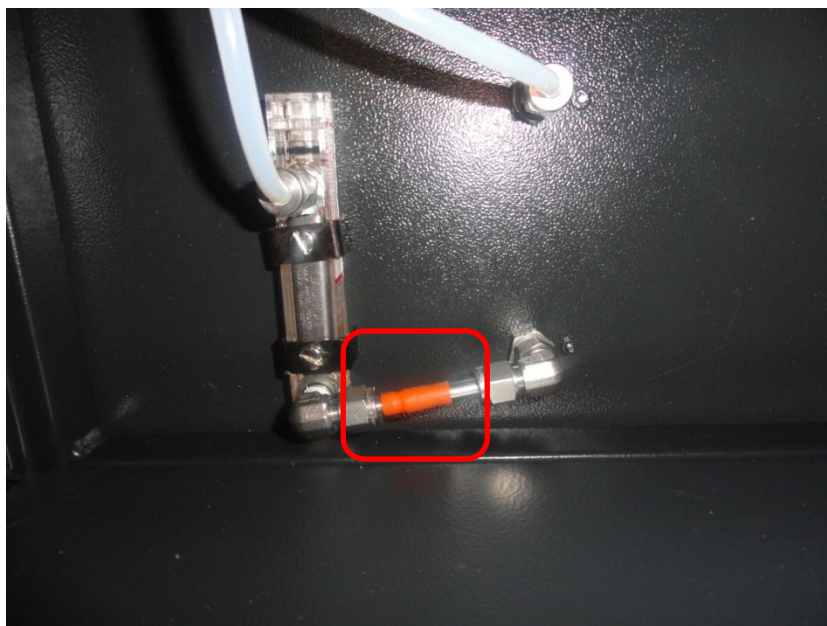
- Some of the PC connections are labelled. But neither the dongle nor the FTIR serial cable are labelled. The FTIR serial cable is more critical since it is at a location where there are two identical COM ports – **FTT to add labels - done**



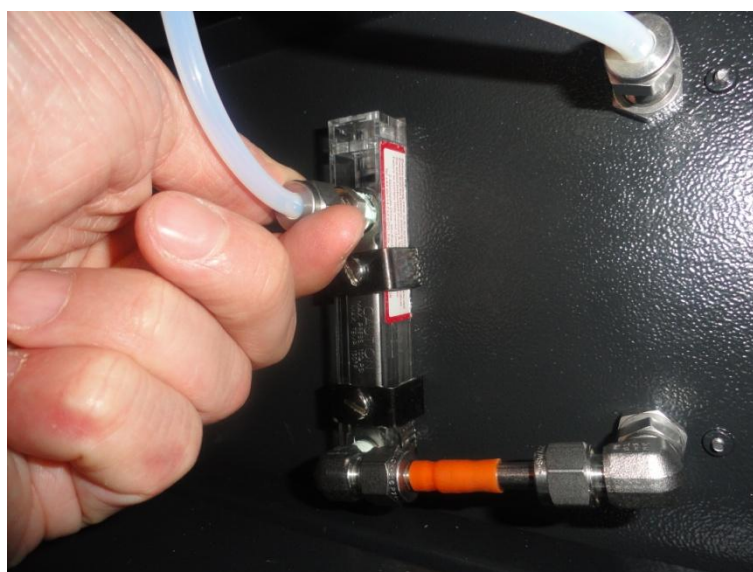
- There are no fittings to secure the screen down the side of the computer near the hinge mechanism – **were there any in previous system? – no – not with the three point locking mechanism**



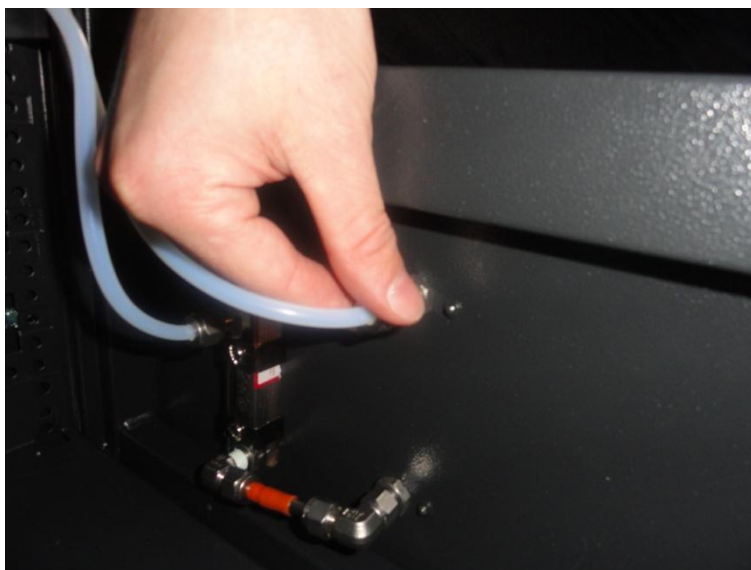
- Optics purge flowmeter – plumbed with something under the orange sleeving – what is it? Is there a plumbing diagram for the FTIR system? This is the flow orifice



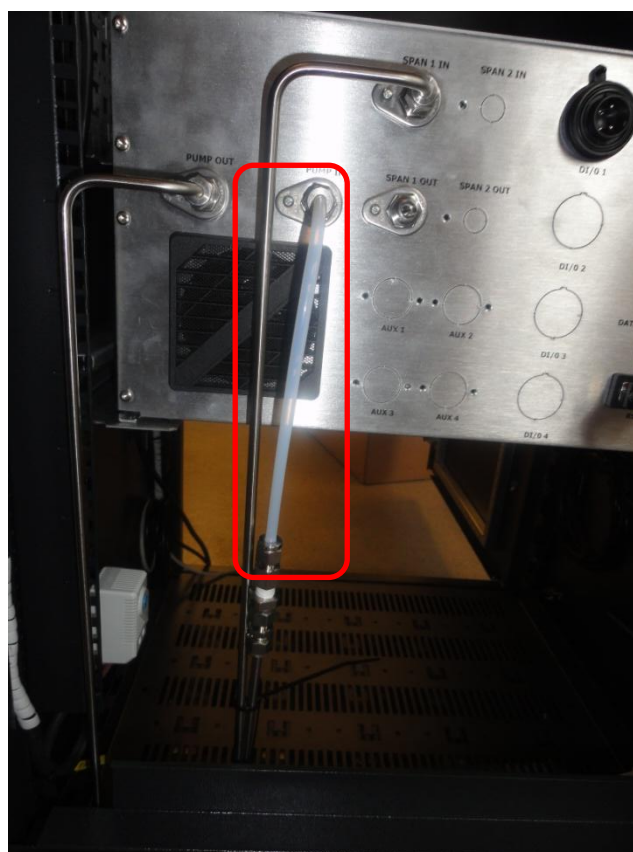
- Optics purge flowmeter – top fitting is only finger tight – I can undo it with my hand



- Loose M6 fitting on N2 in and loose lock nut



- “Pump in” connector is plumbed in PTFE now – used to be SS – at the advice from Charles Austen



Parts In drawer

- 6 x PTFE elements
- 2 x type A doughnuts
- 8 x type B doughnuts
- 7 x type C/D doughnuts (note there are 3 on the ends of the heated lines supplied – total of 10)
- 10 x FTIR unit inlet filters – **is there one in the FTIR unit?**
- 1 x Protea software CD with dongle
- 1 x Protea dongle (red) cap

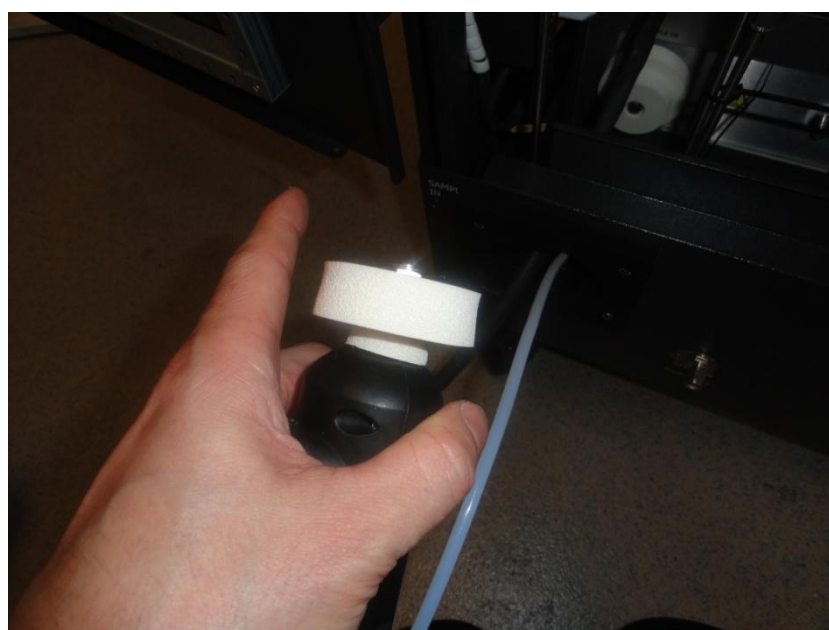


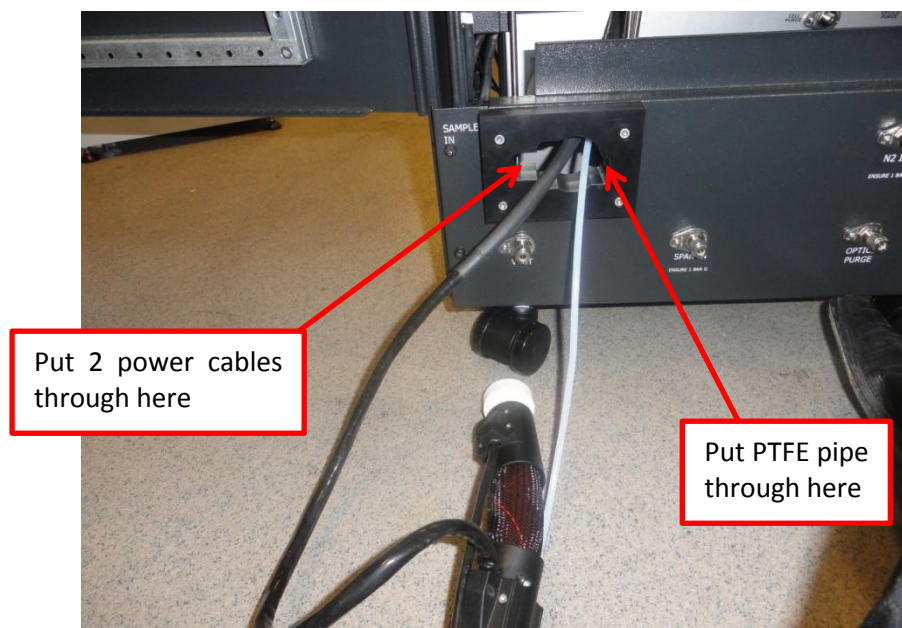
Setup and Testing

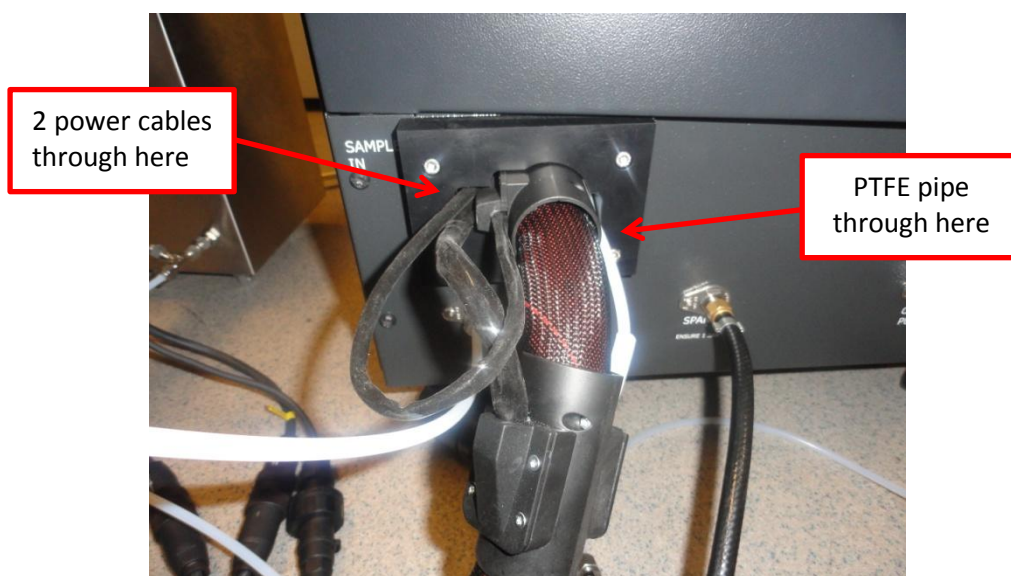
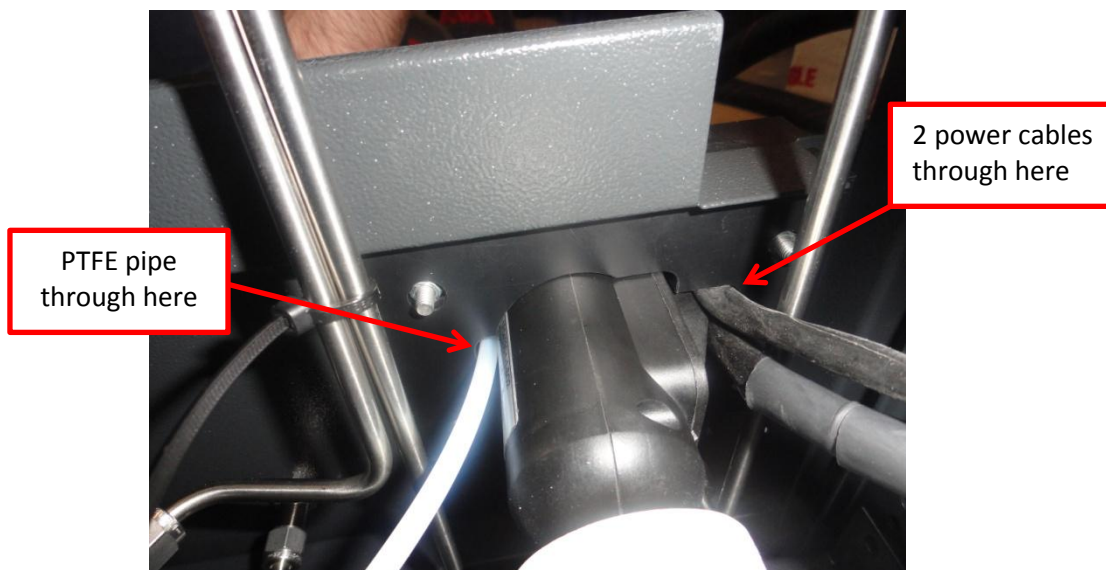
27 May 2014

I tighten the loose M6 nuts and lock nut

When putting SDC heated line into the FTIR put type A doughnut on FTIR and type A doughnut over the type C doughnut already on the end. Half put the FTIR unit in and then pass the SDC heated line connections through the hole on the back of the rack FIRST and let them hang down (note that there are TWO power cables with 4 plugs – put these on the left hand side of the slot, and put the PTFE tube in the right hand side of the slot). Then connect the heated line to the rear of the FTIR – you have a bit more room to play with, compared with where the FTIR unit sits in the rack in its final place.



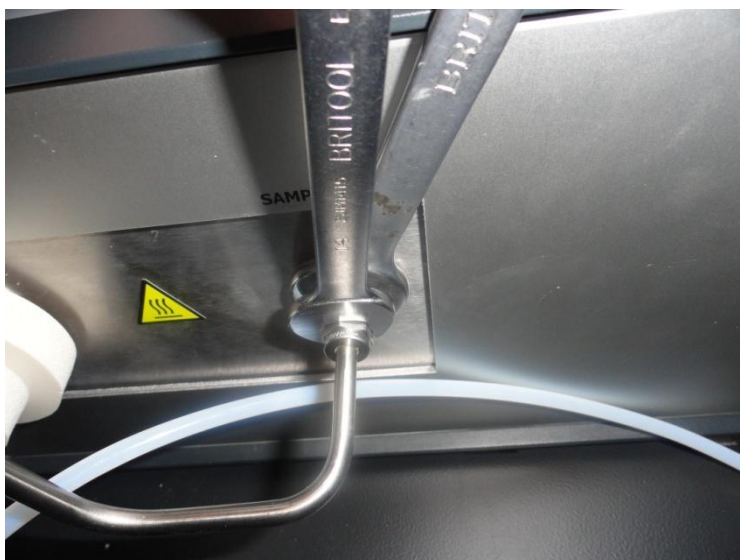




Connect the optics purge and cell purge pipes to the FTIR unit



Connect the Sample Out pipe to the FTIR unit (note that if this is metal then you can “break” it at the flow restrictor to get better access into tightening the joint)



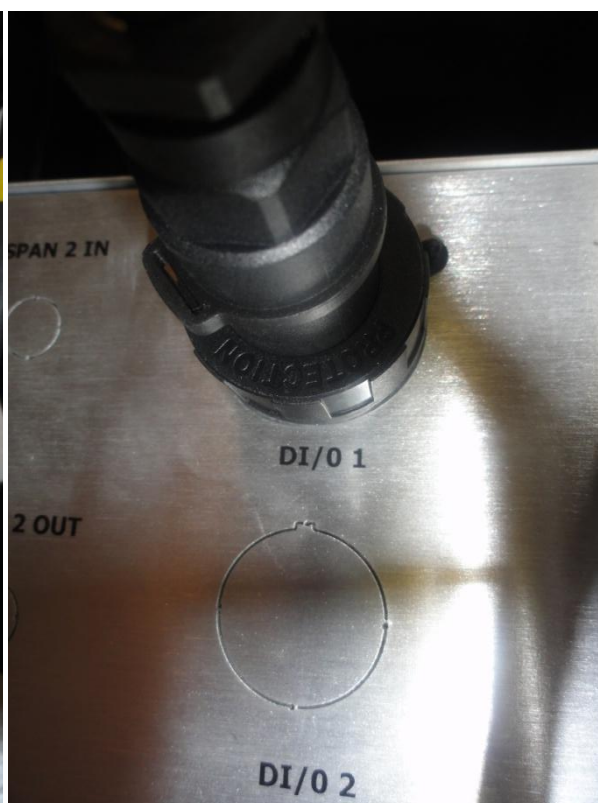
Connect the power, LAN and comms cables to the front of the FTIR rack and ensure that the front door will close.

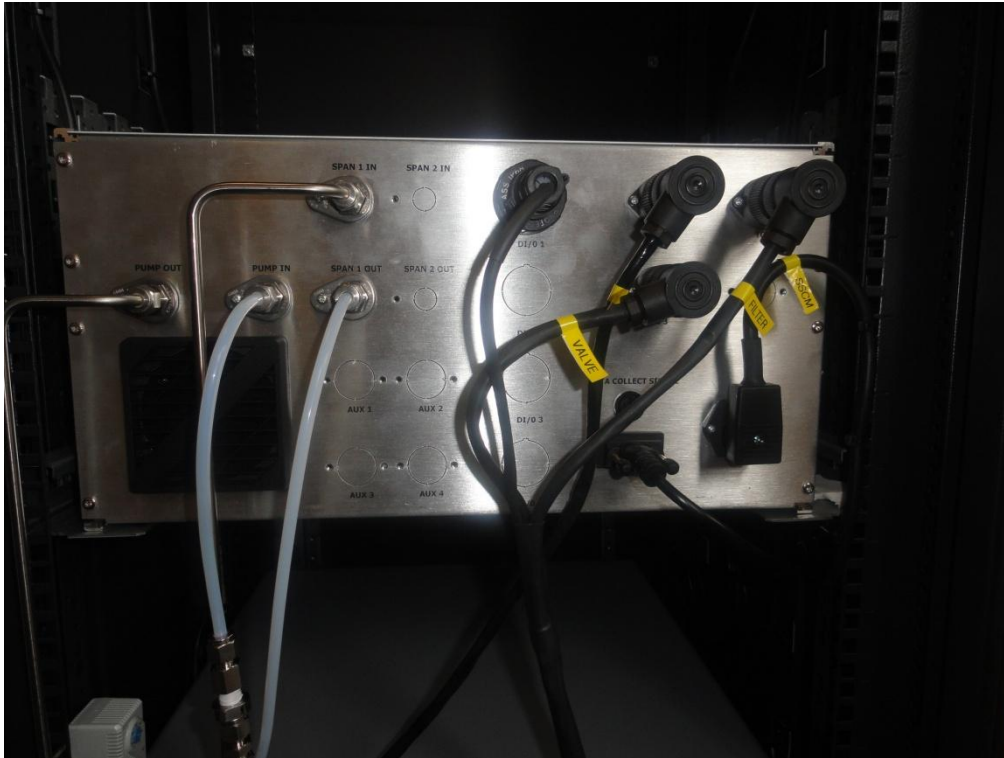


Connect PTFE 6 mm tube to Span 1 Out



Connect heated line to TC1, connect Filter to TC2, Connect Valve to TC3 (are these round the correct way?? – after some work (see below) it was agreed that Filter in TC2 and Valve in TC3 will be the standard FTT setup). Connect the two pin Bulgin to the DI/O 1 socket





Gently slide the FTIR unit back so front door can be closed and pipes at rear are not clashing on anything and are not bent.

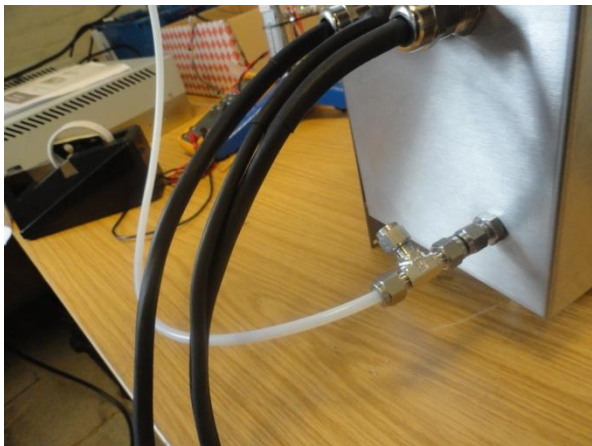
Put doughnut A on HIB inlet and one on heated line. Tighten into place. Then attach the bracket to the HIB to support the heated line. Connect the three electrical connectors.





Get a SS 6 mm Tee and port connector. Remove one nut from the Tee and remove the ferrules. Put the port connector in the nut and connect to the air/span gas in fitting on the HIB. Crimp the Tee piece onto the other end of the port connector as shown. Then connect the end of the PTFE span gas line to the Tee.







Turn power on

Fan does not work - but is this because of the thermostat setting?

SSCM turns on

FTIR turns on

PC turns on

Connect nitrogen to both Purge In and N2 in (use a tee piece) - 1 bar nitrogen only gives 75 ml/min on optics purge, regardless of whether N2 purge is on or off – is this OK? – no too low, flow orifice replaced on 29 May



Connect span gas and adjust to 1 bar.

Wait for FTIR cell to warm up to temperature

Find that Chemometrics has been set to Stream 1 = "REV3" and stream = "REV1", but the calibration details sent with the instrument are REV2 !!!!! Andy from Protea tells me to change both the REV3. Need to have this confirmed and ensure that the software and calibrations sheet are identical. I am surprised this was not picked up at Protea during testing – suggest this is added to check list of tests at Protea.

I check that the Valve and Filter electrical connections into the HIB are consistent with the connections at the rear of the SSCM. Currently TC2 = filter, TC3 = valve. Need to label cables. Done
Need to check if decision was made on FTT5 to have TC2 = filter. No, but now decided TC2 = filter, TC3 = valve

Operation of 3 way valve checked – OK.

Will need to test switching system (heated line, heated filter and PAS-Pro setup) between SDC and Cone Done on 29 May

I perform a background test: – results are Saturation: 60.4, water 0.2, CO2: 17.9, source 0.3, Position 1917.64.

Perform a second background test: – results are Saturation: 61.0, water 0.3, CO2: 18.2, source 0.3, Position 1917.64.

Background	Saturation	Water	CO2	Source	Position
27 May 2014 (1)	60.4	0.2	17.9	0.3	1917.64
27 May 2014 (2)	61.0	0.2	18.2	0.3	1917.64

Check system with N2 purge – most gases go back to 0. NO looks a bit noisy - going to negative 5, HBr between 0 and 5 ppm

Run a span check with our standard gas (2697 ppm CO and 8.09% CO2), FTIR reads 2656 ppm and around 8.5% CO2, but CO2 appears quite noisy.

28 May 2014

Rear door does not close properly. Neil notices that the vertical strengthening bar is fouling on the electrical connector in the TC2 socket. Cut a "slot" in the bar and the rear door then closes fine, without a bend in the panel.





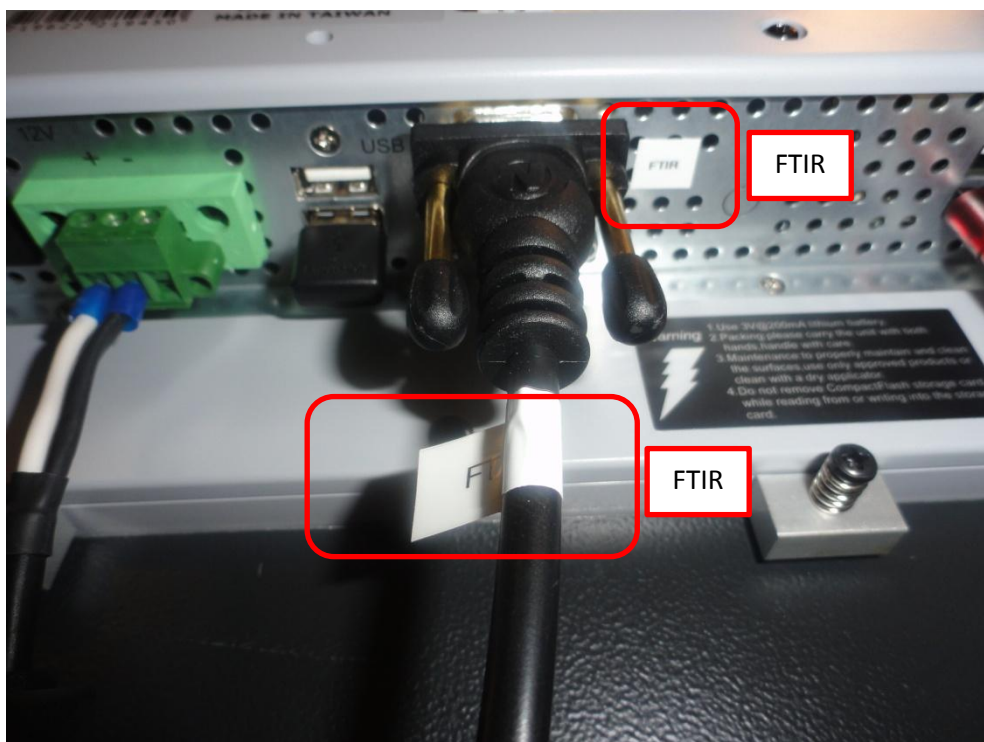
Install wireless keyboard and mouse (Microsoft Wireless 800). Note position of receiver.

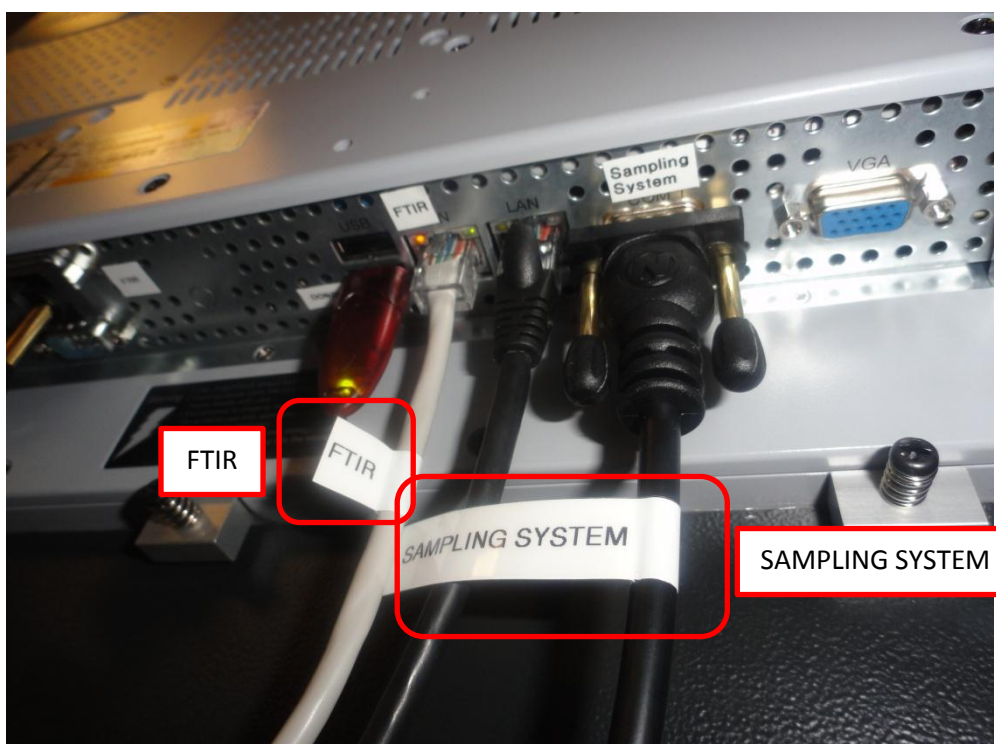
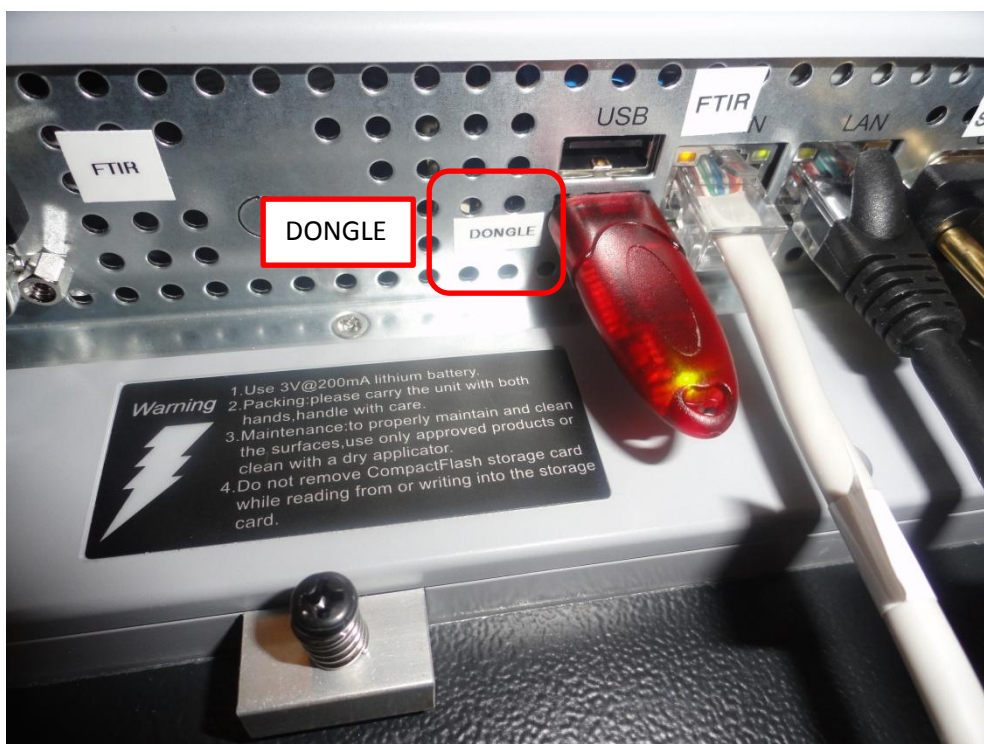


Labels put on SDC heated line cable at HIB end



Labels put on computer and cables

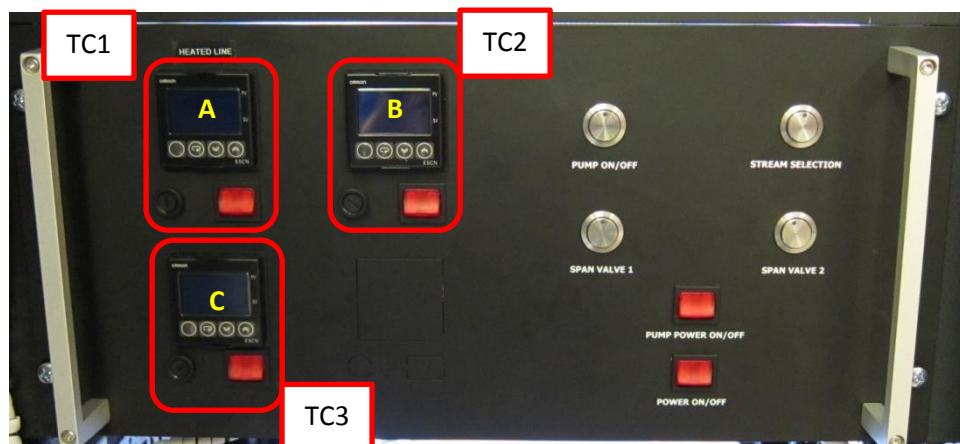




Investigate the variation in the temperature displayed on the temperature controllers

It was noticed that the controller connected to TC2 had a wider swing in temperature than the one connected to TC3.

The following investigation considered the positions of the controllers to be TC1, TC2 and TC3 and the actual temperature controllers to be A, B and C as shown below



With no filter or filter holder in the HIB unit

Controller B at TC2: connected to Filter: 178.8 – 181.4 °C

Controller C at TC3: connected to Valve: 180.1 – 180.8 °C

Then put filter and filter holder in the HIB unit

Controller B at TC2: connected to Filter: dropped to 156.5°C and alarm appeared on software when temperature dropped below 160. Then range settled to 179.2 – 181.2 °C

Controller C at TC3: connected to Valve: dropped to 176.0°C. Then range settled to 179.7 – 180.1 °C

Then swapped the connections on the rear of the SSCM control unit. So TC2 = Valve, TC3 = Filter

With no filter or filter holder in the unit

Controller B at TC2: connected to Valve: 178.2 – 182.1 °C

TC3: connected to Filter: 179.9 – 180.1 °C

Then put filter and filter holder in the unit

Controller B at TC2: connected to Valve: dropped to ????. Then range settled to 178.2 – 181.8 °C

Controller C at TC3: connected to Filter: dropped to 160.6°C. Then range settled to 180.0 – 180.3 °C

Conclusion: larger variation in temperature from controller B at TC2 position regardless of whether the load in the filter or the valve

Then physically swapped the innards of controller B (at TC2 position) with controller C (at TC3)

With filter and filter holder in the unit

Controller C at TC2: connected to Valve: 179.8 – 180.1 °C

Controller B at TC3: connected to Filter: 179.3 – 180.6 °C

Then swapped the controllers back to their original positions

With filter and filter holder in the unit

Controller B at TC2: connected to Valve: 178.1 – 182.0 °C

Controller C at TC3: connected to Filter: 179.9 – 180.1 °C

Conclusion: controller B is not as good as controller C! (regardless of position or load) – are the settings in the controller the same? How do we get into the settings in the controller? No – PID settings were different – changed PID settings in controller B to same as controller C P=11, I=11.2, D=19 Will need to check the values during installation – the ones I have typed here are from memory – forgot to get the values from the controllers before shipping!

I conduct a background – results are Saturation: 60.0, Water: 0.2, CO2: 23.6, Source: 0.3, Position: 1917.65 – **is CO2= 23.6 OK – significant change from yesterday? This is fine, since it is affected by the CO2 concentration in the atmosphere and the number of people in the room**

Background	Saturation	Water	CO2	Source	Position
27 May 2014 (1)	60.4	0.2	17.9	0.3	1917.64
27 May 2014 (2)	61.0	0.2	18.2	0.3	1917.64
28 May 2014	60.0	0.2	23.6	0.3	1917.65

Then perform several span checks

Span check 1: with pump ON using Rev3 calibration file – seems less noisy today

Span check 2: with pump OFF using Rev3 calibration file – shows no change in performance, so pump is not the issue

Span check 3: with pump ON using Rev4 calibration file sent from Andy Toy – seems more noisy than Rev3 for the CO2 and CO, AND we notice that when measuring around 8% the current range was 25%

Span check 4: with pump ON using Rev3 calibration file – back to similar performance as Span check 1 today (current range = 10.53%).

Span check 5: with pump ON using Rev4 calibration file sent from Andy Toy – seems more noisy than Rev3 for the CO2 and CO, AND confirm that when measuring around 8% the current range was 25%

Note that the average CO2 value is higher than the calibration bottle. But this can be handled by modifying the Span Adjust

Andy and Richard from Protea are going to come to look at the system tomorrow.

29 May 2014

Reload the sampling system file to the FTIR as instructed by Andy Toy. Here are his instructions:

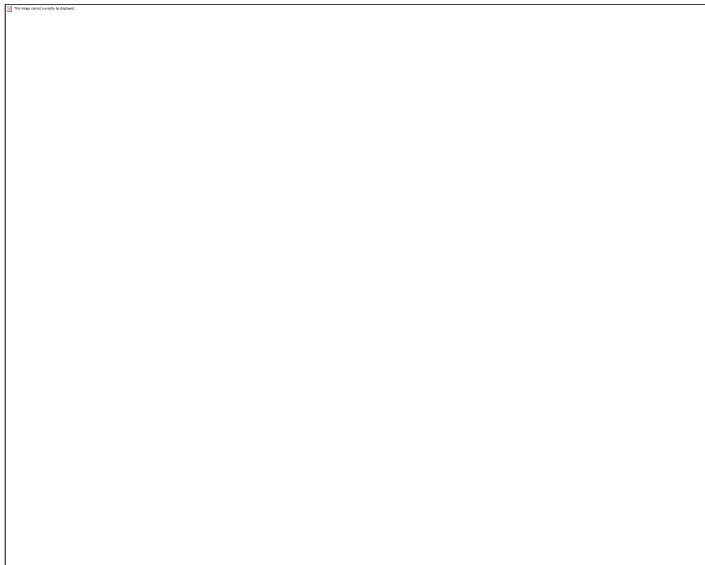
“Prior to us arriving tomorrow, could you re-load the sampling system file to the FTIR. This is the file that contains the calibrations for analyser temperature, pressure and alarms.

To do this, please close PAS-Pro. On the desktop there should be an executable called Sampling System.exe. Run this program and the following window will appear:



Click on Open Configuration and then browse to the following file: C:\PAS-Pro\Setup\AFS-B-15-1401.xml

Then back in the window ensure Serial Port #1 is set and then click Control Panel. This will re-load the calibration file to the boards. A window like this will appear giving the temperature and pressure readings in the left hand window:



”

Cut across a radius of an “A” doughnut and fit to heated filter holder stem.



Fit some type C/D doughnuts on the bent smoke chamber tube – we will cut this to suit on site during the installation.



I conduct a background – results are Saturation: 56.5, Water: 0.3, CO2: 20.1, Source: 0.4, Position: 1917.65 – is CO2= 20.1 OK – significant change from yesterday? This is fine, since it is affected by the CO2 concentration in the atmosphere and the number of people in the room

Background	Saturation	Water	CO2	Source	Position
27 May 2014 (1)	60.4	0.2	17.9	0.3	1917.64
27 May 2014 (2)	61.0	0.2	18.2	0.3	1917.64
28 May 2014	60.0	0.2	23.6	0.3	1917.65
29 May 2014	56.5	0.3	20.1	0.4	1917.65

I remove the Optics Purge fitting at the rear of the FTIR analyser but the flow through the flow meter does not change – still 75 ml/min

Andy Toy and Richard Barker arrive and look at the system

We discuss the issues found with the system.

What I have done this morning is effectively putting the correct PID settings into the FTIR unit. At Protea the unit was final tested on the bench and had a different set of PID settings “blown” in. Now it has the correct PID settings.

Try span check with Rev3 and Rev4.

Rev3 shows that opening the back door of the cabinet dramatically changes the noise on the CO2 reading. Rev4 is smoother than Rev3 and is not having any influence in readings when the rear door is opened. But it is still basing the CO2 value at 8% on a 25% calibration range.

Note that data in the span check folder is being smoothed (averaged over a number of points – as specified in the Pas Pro Setup), so should really use the data in the Results folder to reproduce the data shown on the screen while PAS Pro is running. When checked the number of points over which the span check data is averaged was set to 5.

Replace the orifice going to the optics purge – flow is now 120 ml/min – great.



The PID settings in the controller B is made the same as controller C (the good/stable one). Both the heated filter and heated valve are then controlled well.

Andy makes a REV6 calib file and the sets the span adjust got CO₂ and CO to give a value the same as the calibration bottle.

Check with our new beta gas (8.47% CO₂, 9250 ppm CO) – CO₂ is OK, CO is a little bit high (but OK) – could make another span adjust for this.

Then see a message “Unable to read spectrum data. (Fail)” on the screen. Andy takes the data from the PC and will investigate back at Protea.

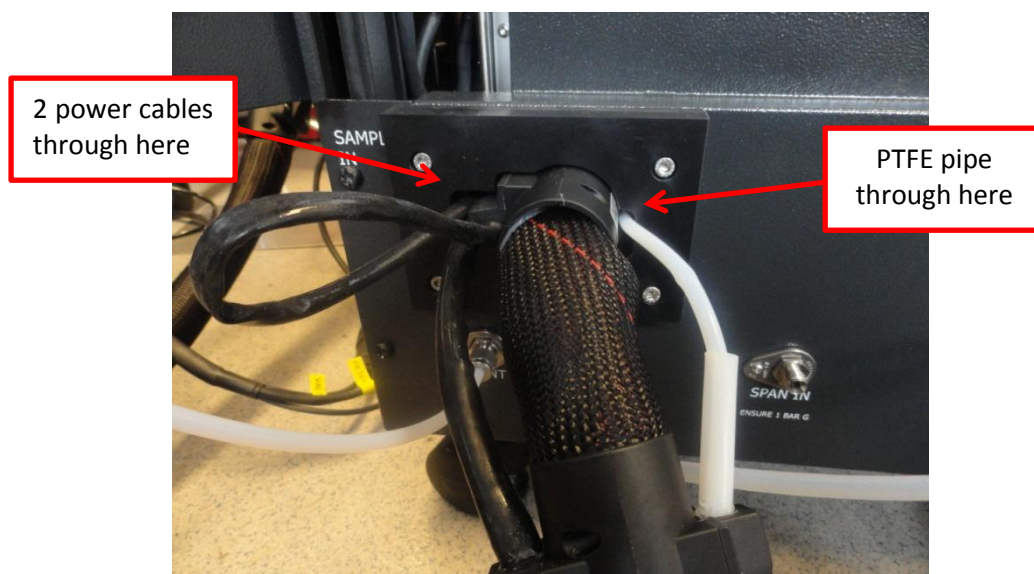
Heated filter holder will not fit into filter housing easily – suggest that Protea look into this on System 7.

Les puts labels on temperature controllers and TCx connections on rear of SSCM



Remove SDC heated line and electrical connections

Connect M & C probe and cone heated line



Turn power on (Probe MCB) – M & C probe “lights up” and starts heating

Adjust PAS Pro setup for Cone operation. (No of streams = 1, PLC mask = 2, Stream 1 name = Cone). Ensure that Heater Filter and Heated Valve controllers are turned off.

Start PAS Pro and perform span check (around 1830) – seems OK (CO2 maybe a little bit lower than earlier on.)

Now cold, we try to fit the Heated filter holder into the filter housing – it still will not fit in – the filter cage will not spring into holder, it just keep “catching” on something in the spring mechanism – this seems to be quite an issue now that needs to be resolved

Disconnect heated line and M and C probe

Shutdown system (purge with nitrogen for 15 minutes, then turn power off, but leave optics purge gas flowing overnight)

It was agreed that Heated Line is TC1, controller A, Heated Filter is TC2, controller B, Heated Valve is TC3, controller C

30 May 2014

Set PAS-Pro Setup back to the Smoke Chamber setup with 2 streams for use with the HIB unit. However note that when stream 2 is added then all the settings for stream 2 are reset, so there is a little bit more to set than just adding and naming the stream:

- a) General Tab: No of streams = 2
- b) Chemometrics Tab: Select Stream 2, then select the appropriate Calibration File (ensure it is the same as Stream 1), then tick the Apply Pressure Correction option, ensure that the Reference Pressure is 1013 mBar. Press Pathlength Correction and ensure that Calibration Pathlength = 3.60 and Analyser Pathlength = 4.20 (then press OK). Press View Final Results and select Stream 2 and set the Span Adjust settings as appropriate (then press OK).
- c) PLC Tab: Set Alarm Bitmask = 0
- d) Stream Tab: Select Stream 1: set Stream Name "Smoke Chamber", Select Stream 2: Set Stream Name "Ambient Air", Analyser Name "AFS-B-15-1401" (same as Stream 1), Sample Temperature (est) = 180, Sample Pressure (est) = 1000 mBar, Atmospheric Pressure (est) = 1013 mBar, Estimated H₂O = 1.5 %Vol, Sample Filter Pore Size 2 µm

So to change from Smoke Chamber use to single stream use (e.g. Cone Calorimeter)

- a) General Tab: No of streams = 1
- b) PLC Tab: Set Alarm Bitmask = 2
- c) Stream Tab: Select Stream 1: set Stream Name "Cone Calorimeter"

Suggest that two settings files are created so that the user can switch between the two by renaming the file to the appropriate settings file name (C:\Documents and Settings\All Users\Application Data\Protea\PAS-Pro.xml) – will need to do this on site

Package system up – put back in wooden crate and prepare for shipping.

Questions:

Build

1. Why have the door handles changed to now have key opening? Rack was ordered with key locks, since last rack made (not for FTT) was made with keys – suggest this goes back to non-keys handle in future
2. Were there support brackets down the side of the PC screen in previous systems? No – not with the three point locking mechanism
3. What is the part under the red sleeving – flow orifice? Yes - this is the flow orifice
4. Is there a plumbing diagram for the FTIR system?
5. Should TC2 be the filter or the valve? It was agreed that Filter cable is connected to TC2 and Valve is connected to TC3 will be the standard FTT setup
6. Why is the “Pump in” connector plumbed in PTFE now – used to be SS This is at the advice from Charles Austen

Performance

7. Is there a longer warm up time than we thought? Protea recommend 5 hours warm up
8. Purge flow is only 75 ml/min – is this enough? No – replaced flow orifice, now 120 ml/min
9. Is the CO2 reading in background OK from 28 May? Yes, OK – CO2 reading affected by ambient concentration of CO2
10. Is there interference from another gas affecting the value calculated?
11. Pump feels like it is pulsing – is this OK? Yes – this is normal
12. Need to look at settings in controllers B and C – are they the same? Why different performance? PID settings were different – changed so both controllers the same and good
13. Protea span check results show CO2 = 9.4% - with a 8.35% gas? FTT span check shows span check results CO2 = 8.6% - with a 8.09% gas. Can this anomaly be explained.
14. Is there anywhere that tells you what calib file has been used to process spectra into a result or span check output? No
15. Can you show how we can use PAS to reprocess data – so we can collect one set of spectra and see the effects of rev3 vs rev4 vs rev5 (rather than repeating the test)

Comments:

1. Need silicone doughnuts for the heated filter handle – could you supply some with system 7 please
2. Comment about the bent pipe at rear of HIB
3. Comment about leaving the SDC tube inside the HIB wrapped in bubble
4. Labels need to be added to all cables and ports
5. All fittings need to be checked for tightness
6. System should be tested as it will be used by the client
7. Richard Camm was going to give a quote for Library lookup software – could this be progressed please (SpectralID)
8. Rear door is clashing with the TC2 connector
9. It was agreed that Heated Line is TC1, controller A, Heated Filter is TC2, controller B, Heated Valve is TC3, controller C
10. Filter handle is not going into the filter holder in the HIB. Handle has NOT been shipped with System 6 to FTT's client. This needs to be investigated and resolved before the installation.
11. Suggest that two PAS-Pro settings files are created so that the user can switch between the two by renaming the file to the appropriate settings file name (C:\Documents and Settings\All Users\Application Data\Protea\PAS-Pro.xml)