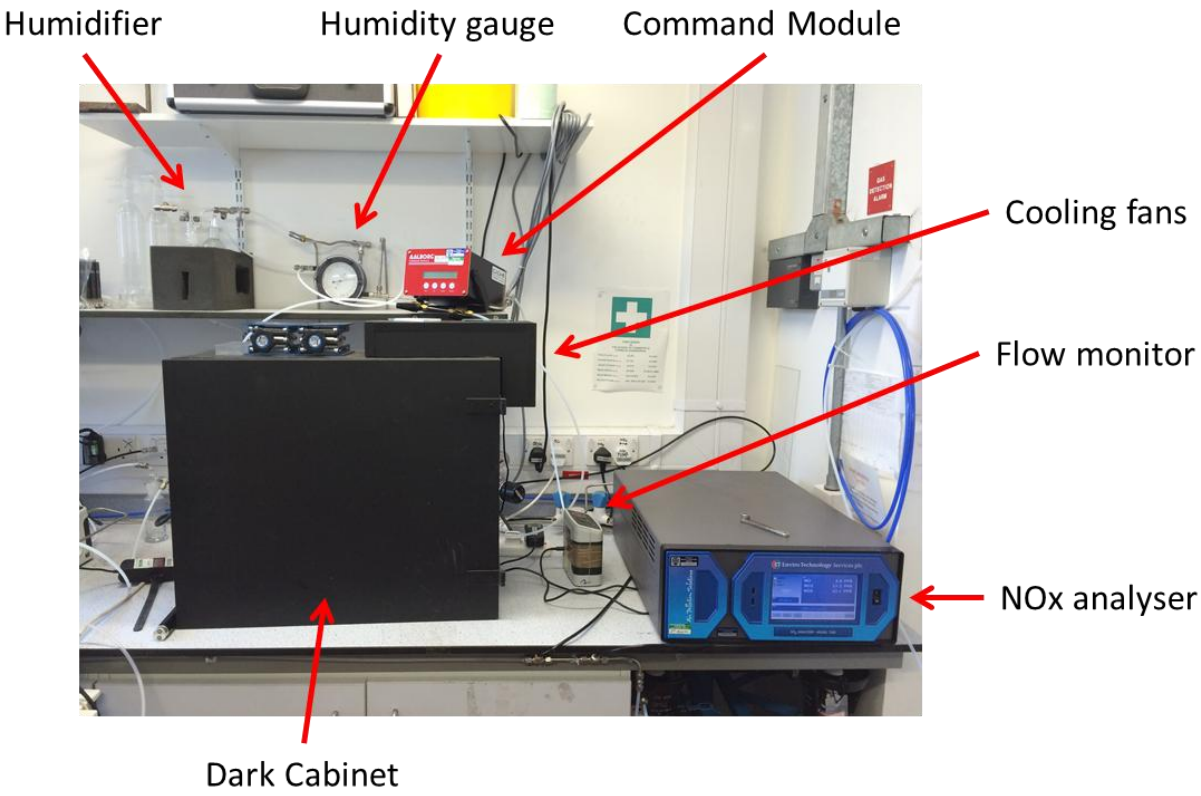
Standard Nox

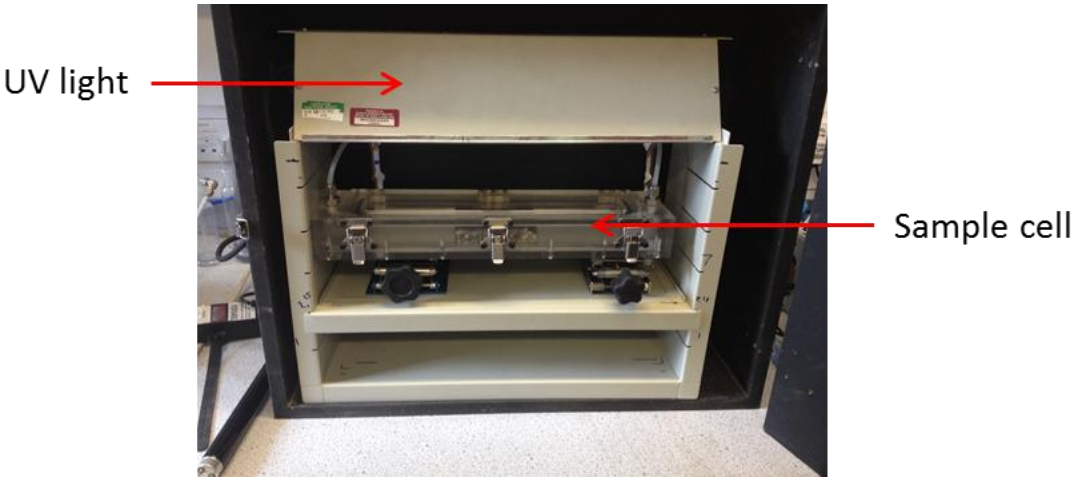
NOTE: Before reading this you MUST read the 'SOP - Energy and environmental impacts under normal, abnormal and emergency conditions' which is Mills group web site, https://www.profandrewmills.com/leaf-documents/. This addresses general energy and environmental impacts under normal, abnormal and emergency conditions considerations which you NEED to be cognisant of before conducting any experiment. If you identify anything in an SOP which can be improved, please contact the LO and PI to discuss the proposed change(s) before putting them into effect.

Please allow 7-8 hours for this test

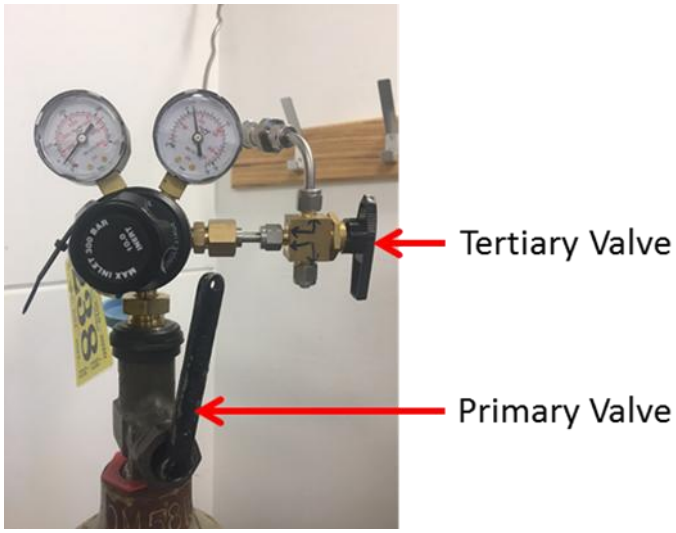
You will spend about an hour at the beginning and an hour at the end of each test in the NOx lab. It is advisable to check the experiment at least once during the 5 hour irradiation and to set an alarm so you do not forget when to switch it off.

1. Sample must measure 5 x 10 cm and be no more than 2.5cm thick
2. Irradiate customer sample for ≥5 hours under bench UVA lamp
3. Rinse with water and allow to dry
4. Check NOx logbook for any relevant notes i.e. Low cylinders, new cylinders, change of settings or any problems
5. Familiarise yourself with the apparatus

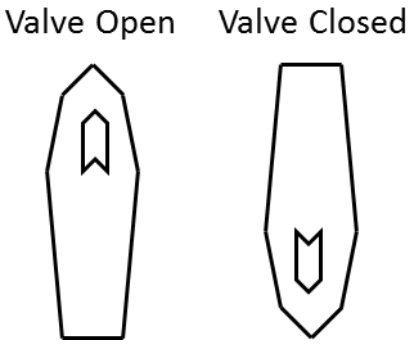




6. Open air cylinder primary valve by turning the cylinder key 180-270° anticlockwise and check the cylinder level, if needing replaced seek assistance. Note - Each fresh air cylinder is enough for 2 or 3 NOx ISO experiments

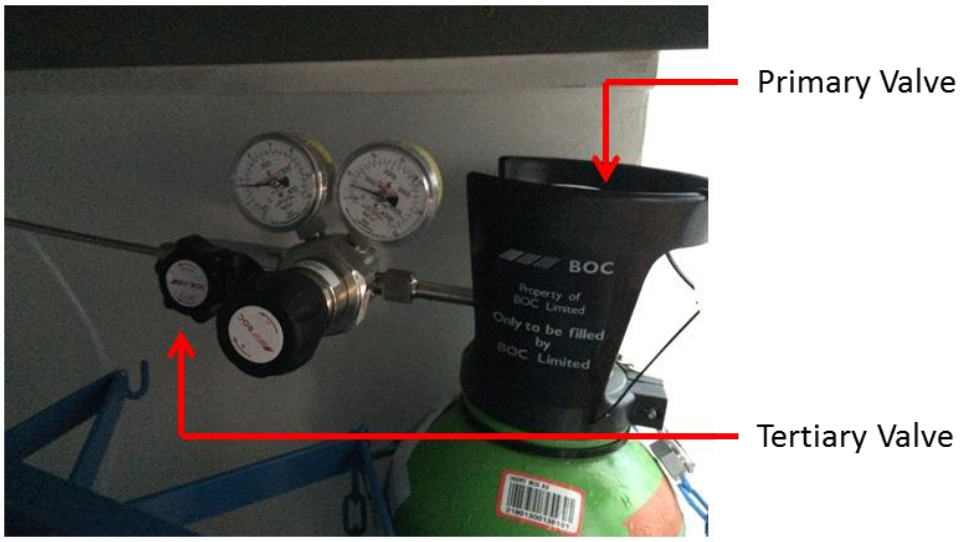


7. Open air cylinder tertiary valve

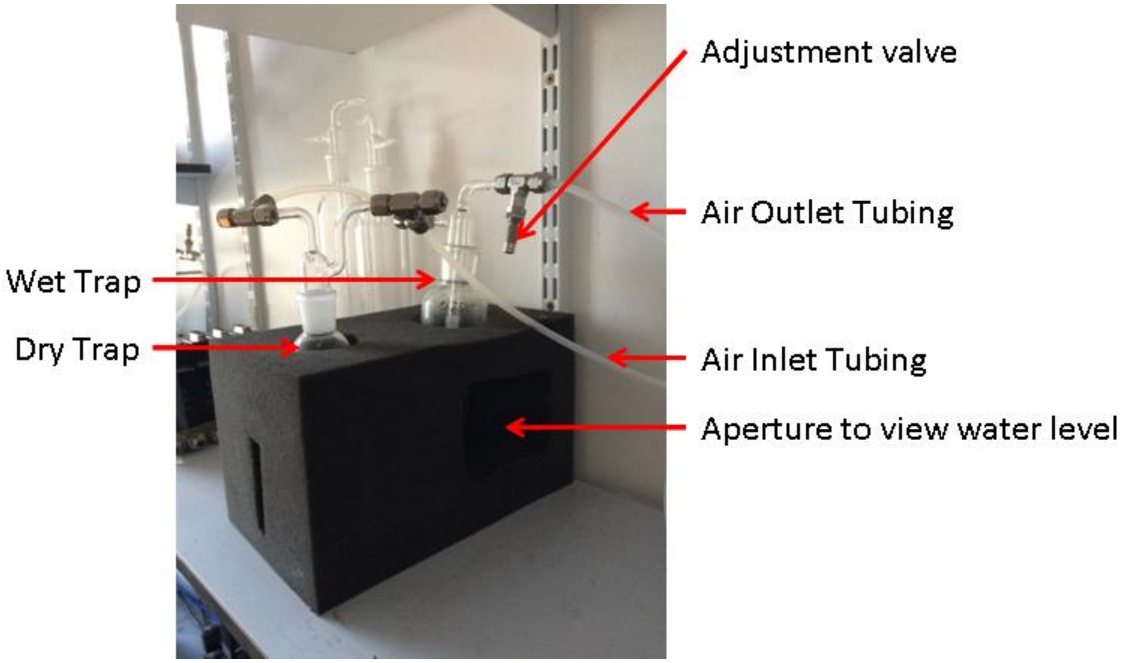


8. Check air pressure is approximately 4-5 bar

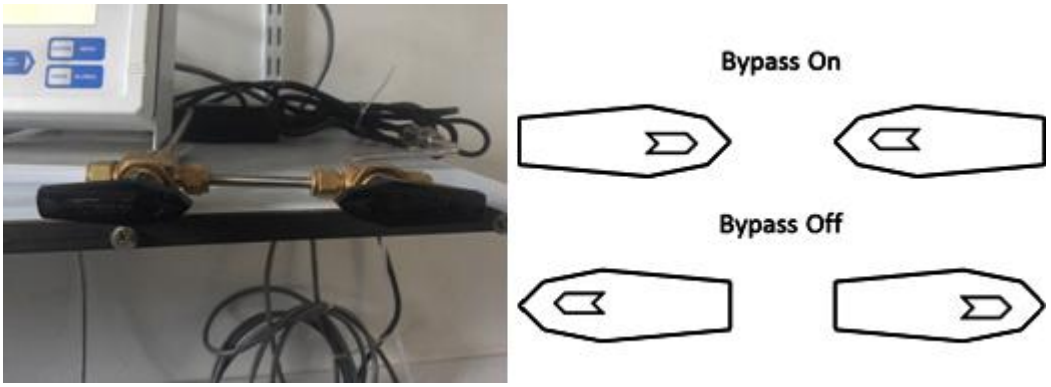
9. Open NO cylinder primary valve by turning anticlockwise. Fully open the valve and then slightly turn clockwise so that the cylinder does not get stuck in the open position.
10. Check cylinder level, if needing replaced seek assistance.



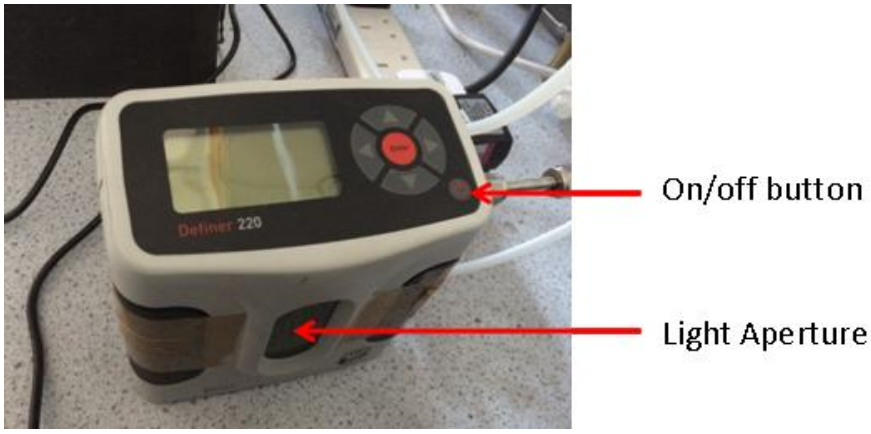
11. Open NO cylinder tertiary valve by turning anticlockwise. Fully open the valve and then slightly turn clockwise so that the cylinder does not get stuck in the open position
12. Check NO pressure is approximately 7 bar
13. Check NOx analyser is on
14. Locate mass flow controllers (one for air and one for NO) behind the dark cabinet.
15. Carefully check mass flow controller upper flow limits (MFC) are suitable for experimental flows
16. Check wet trap (humidifier) is at least half full of water, if not seek assistance



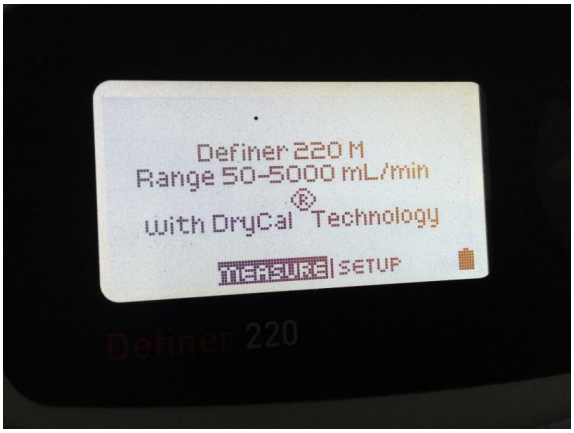
17. Check bypass valves are ‘ON’ so that gas is not flowing through sample cell



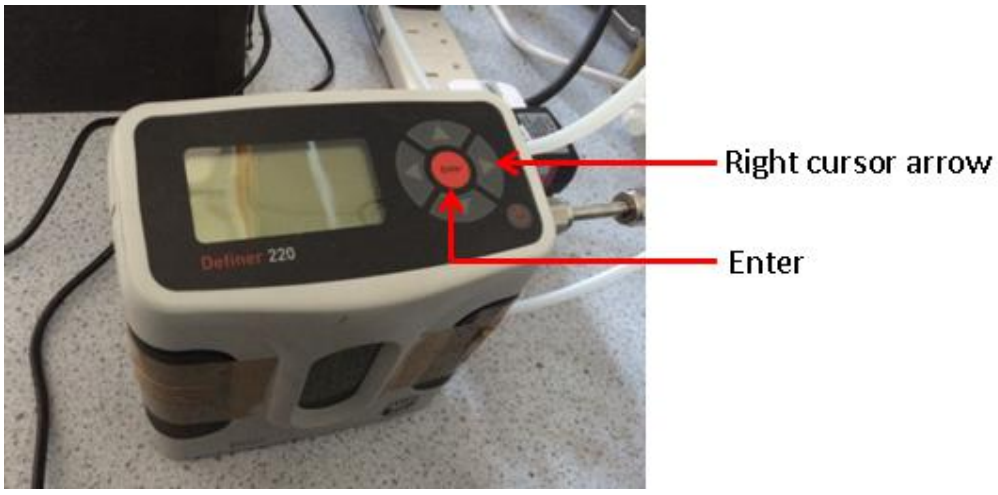
18. Carefully remove sample cell from lightbox and place on bench in front – be very careful with tubing so that it does not become bent or pulled
19. Switch on UV lamp
20. Switch on flow monitor by holding button until light goes on and quickly letting go



21. The start-up screen should look as follows

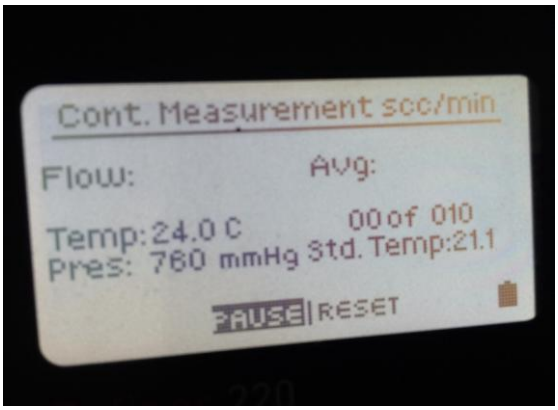


22. Press ‘enter’

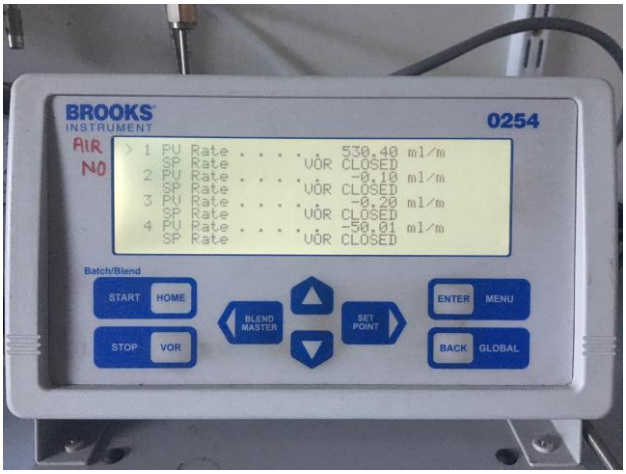


23. Using right cursor arrow select ‘cont.’ and press ‘enter’ button

24. The screen should now look like this

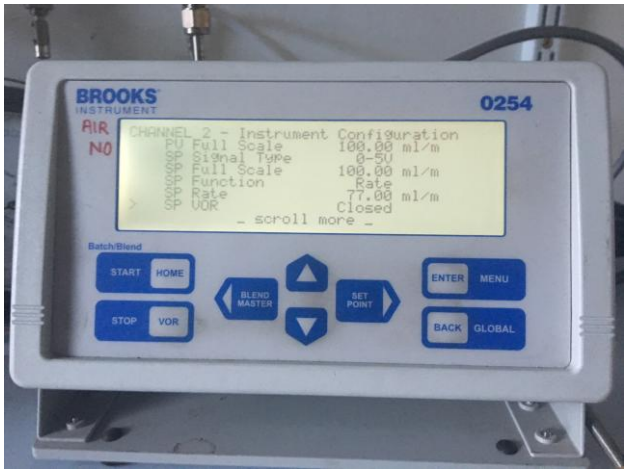


25. Switch on command module by switching on at the plug. The screen should look like this



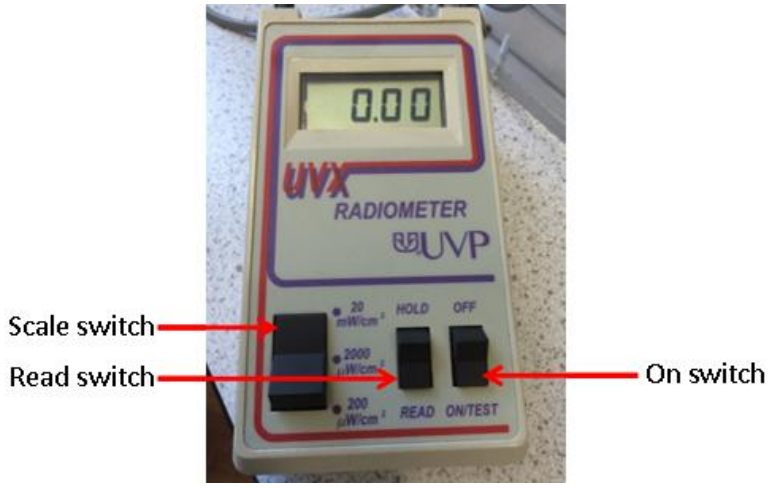
26. Using up and down buttons set pointer to ‘1’

27. Press the VOR button twice



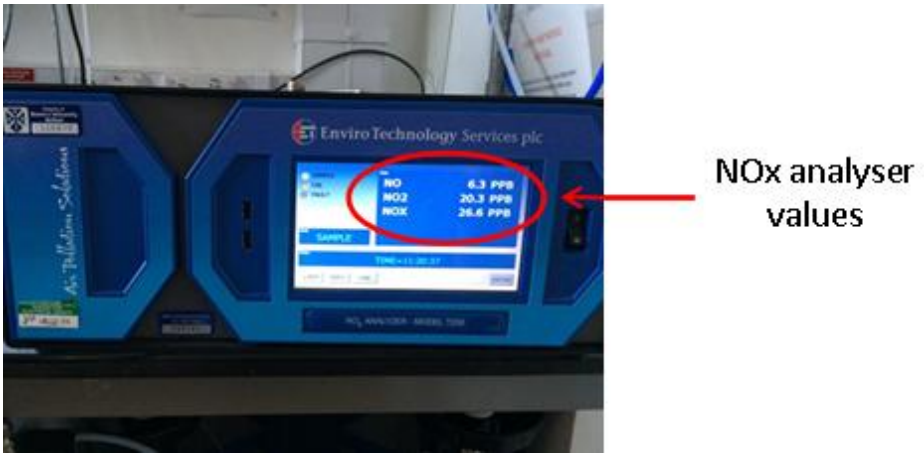
28. The word ‘closed’ will be flashing, press enter to confirm
29. Using up and down buttons go to ‘SP Rate’ and press enter, the number will now be flashing
30. Using left and right buttons go to values to be changed and then use up and down buttons to alter accordingly (for ISO it will be approx. 3000scc/min but refer to logbook for most recent SP Rate)
31. Once desired value is input press enter
32. Using up and down buttons got to ‘SP VOR’ and press enter, the word ‘closed’ will be flashing
33. Using up and down buttons to change this to ‘normal’ and press enter
34. The air will now be flowing through the system
35. Check air bubbles are in humidifier
36. Press the back button twice to return to the home screen
37. Check the flow monitor is measuring the expected flowrate (approx. 3000 ±100scc/min for ISO)
38. IMPORTANT – If the flowrate is much lower than expected (i.e. ≤2500scc/min for ISO) it is likely there is a leak! Check the dry and wet trap bottle lids have not popped up as this happens ocassionally. If that is not the source of the leak, switch off the air using the command module and seek help.
39. Locate UV meter and empty cell

40. Place empty cell with UV meter onto lab jacks
41. Switch on UV meter, set to ‘read’ and ‘20mW/cm^2’ scale

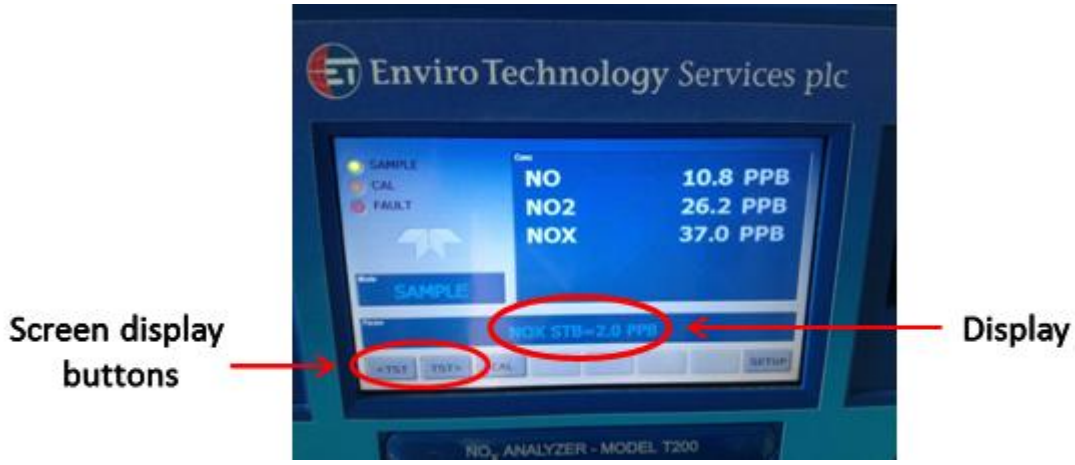


42. Adjust lab jack heights to obtain correct irradiance (1mW/cm^2 for ISO)
43. Switch off meter
44. Switch off lamp
45. Check the flow monitor is measuring the expected flowrate (approx. 3000 ±100scc/min for ISO)
46. Adjust air set point if necessary using small increments and patience!
47. Using up and down buttons set pointer to ‘2’
48. Press VOR button twice
49. The word ‘closed’ will be flashing, press enter to confirm
50. Using up and down buttons go to ‘set point’ and press enter, the number will now be flashing

51. Using left and right buttons go to values to be changed and then use up and down buttons to alter accordingly (for ISO it will be approx. 75scc/min but refer to logbook for most recent SP Rate)
52. Once desired value is input press enter
53. Using up and down buttons got to ‘valve setting’ and press enter, the word ‘closed’ will be flashing
54. Using up and down buttons to change this to ‘normal’ and press enter
55. Press the back button twice to return to the home screen
56. The NO will now be flowing through the system
57. Check NOx analyser values start to increase

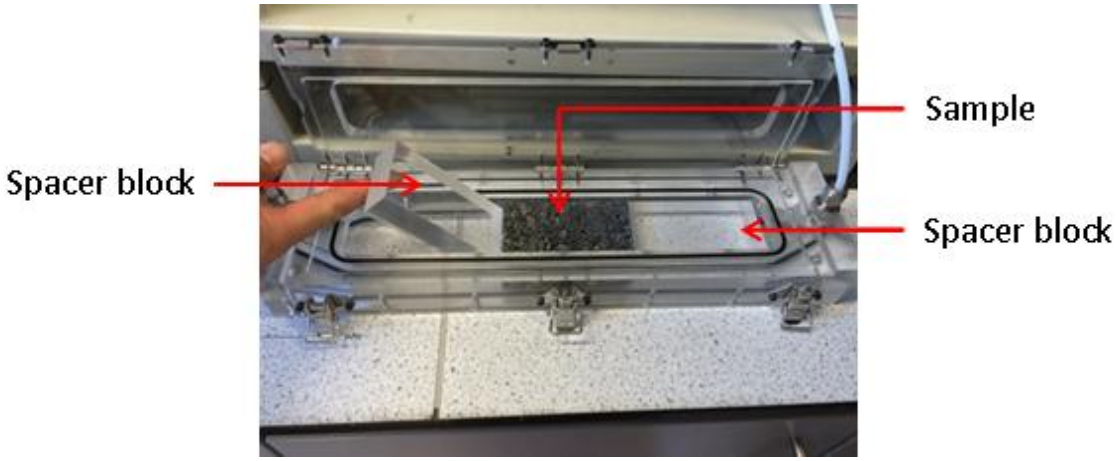


58. Switch to ‘time’ display on NOx analyser while setting up rest of apparatus. To do this press left or right ‘screen display button’ repeatedly until display is as shown below. Note this time as ‘time of initial set up’ in NOx Log book

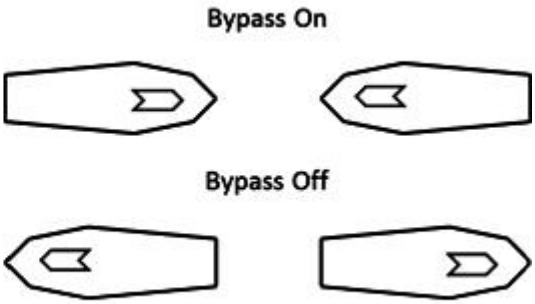


59. After 2 minutes check flow monitor is giving the expected flowrate (approx. 3000±100scc/min for ISO)
60. After 5 minutes check NOx analyser values (NO value should be approx. 1000±50ppb for ISO) and adjust command module set point if necessary using small increments
61. Check the humidity gauge

62. If humidity <47% turn adjustment valve a very small amount 180° anticlockwise
63. If humidity >53% turn adjustment valve a very small amount 180° clockwise
64. Allow 5-10 mins to settle between any changes
65. Once humidity, flow rate and NO levels are acceptable allow a further 10 minutes to settle
66. Switch to ‘time’ display on NOx analyser. To do this press left or right ‘screen display button’ repeatedly until display is as shown below. Note this time as ‘time of set up completion’ in NOx Log book
67. Switch to ‘NOX STB’ display on NOx analyser while setting up rest of apparatus. To do this press left or right ‘screen display button’ repeatedly until display is as shown below. This is the stability of the analyser readings and should keep decreasing and tend towards zero
68. Carefully open cell
69. Place sample inside, ensuring spacer blocks either side are level with the sample, and gently tighten clamps – careful not to break the glass lid

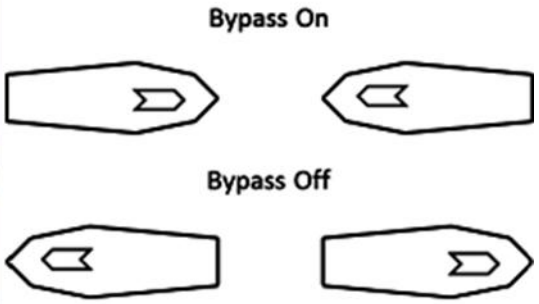


70. Place cell into dark cabinet on pre-set jacks, again being very careful not to bend or pull tubing
71. 10-15 minutes after the noted ‘time of set up completion’ check the ‘NOx STB’, it should be <1.5 ppb. If the value is not within range leave the system a further 5 minutes and check again.
72. Fill out relevant NOx log book sections
73. Switch to ‘time’ display on NOx analyser. To do this press left or right ‘screen display button’ repeatedly until display is as shown below. Note this time as ‘time of bypass off’ in NOx Log book
74. Switch off bypass by turning both valves anticlockwise simultaneously and allow gas to flow into cell

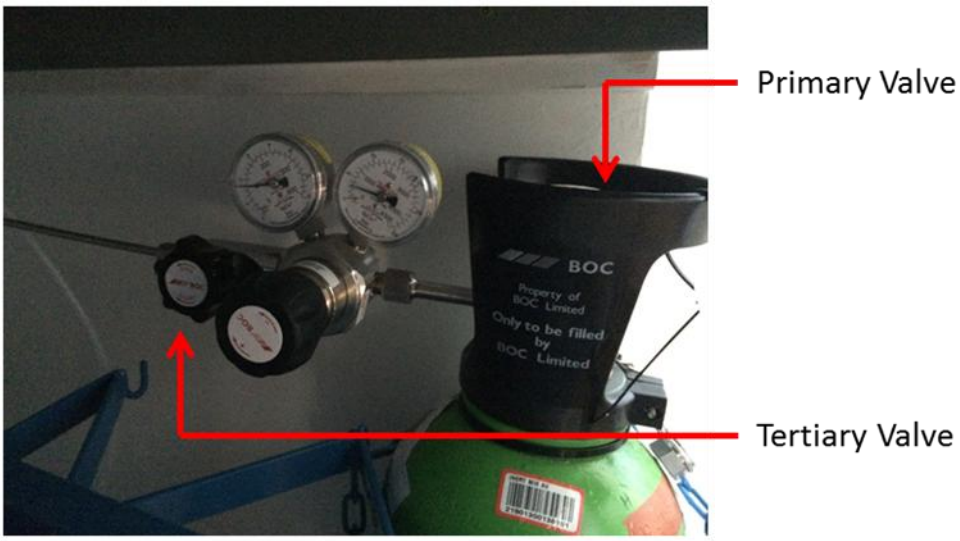


75. Check flow monitor gives expected flowrate. If not gently tighten cell clamps a small increment and check flowrate again
76. Allow system to settle for 15 minutes

77. Check the ‘NOx STB’, it should be <1.5 ppb. If the value is not within range leave the system a further 5 minutes and check again.
78. Check flowrate is still at expected flow rate
79. Fill out relevant NOx log book sections
80. Plug in cooling fans, lift cover, check they are operational and replace cover taking care not to disturb wiring
81. Switch to ‘time’ display on NOx analyser. To do this press left or right ‘screen display button’ repeatedly until display is as shown below. Note this time as ‘time of light on’ in NOx Log book
82. Switch UV light on
83. Observe the NOx analyser values for 10 minutes and if no observed change of the NO value (≥10ppb) you may wish to abandon the test at this point
84. Leave sample for 5 hours of irradiation, checking flowrate and values at least once during this time
85. Switch off lab lights and lock door when not present
86. Switch to ‘time’ display on NOx analyser. To do this press left or right ‘screen display button’ repeatedly until display is as shown below. Note this time as ‘time of light off’ in NOx Log book
87. Switch off UV light
88. Allow to settle for 15 minutes
89. Check the ‘NOx STB’, it should be <1.5 ppb. If the value is not within range leave the system a further 5 minutes and check again.
90. Switch to ‘time’ display on NOx analyser. To do this press left or right ‘screen display button’ repeatedly until display is as shown below. Note this time as ‘time of bypass on’ in NOx Log book
91. Switch bypass on by turning both valves clockwise simultaneously

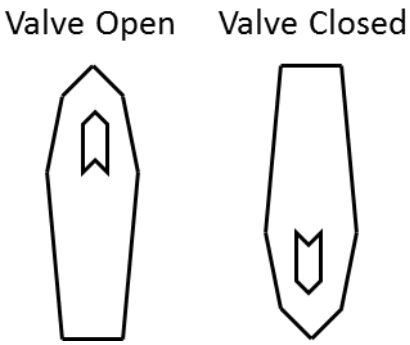


92. Allow to settle for 15 minutes
93. Check the ‘NOx STB’, it should be <1.5 ppb. If the value is not within range leave the system a further 5 minutes and check again.
94. Make any relevant notes in logbook i.e. low cylinders, new cylinders, change of settings or any problems
95. Unplug cooling fans
96. Go to command module
97. Using up and down buttons set pointer to ‘2’
98. Press VOR button twice
99. The word ‘normal’ will be flashing, using up and down buttons change this to ‘closed’ and press enter
100. The NO supply has now been stopped
101. Close NO cylinder tertiary valve by turning clockwise until tight

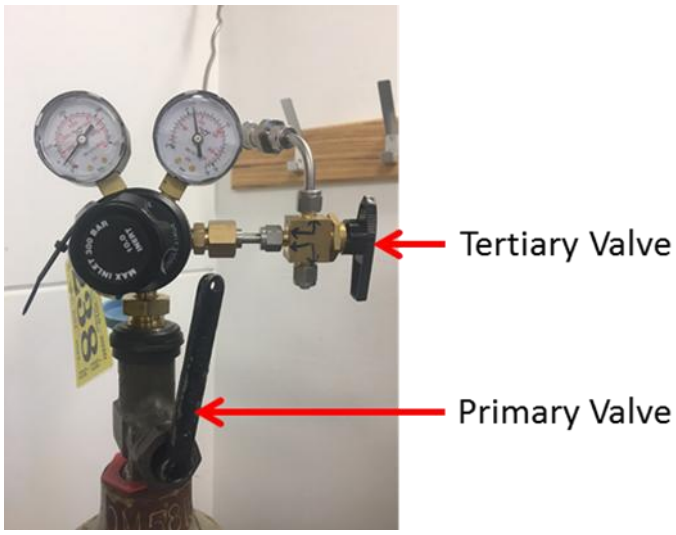


102. Close NO cylinder primary valve by turning clockwise until tight

103. Monitor until NO/NO_2/NOx values on NO analyser screen until less than 20ppb (back to ambient)
104. Go to command module
105. Using up and down buttons set pointer to '1'
106. Press VOR button twice
107. The word 'normal' will be flashing, using up and down buttons change this to 'closed' and press enter
108. The air supply has now been stopped
109. Wait until flow monitor shows no flowrate then switch it off using on/off button
110. Switch off command module
111. Switch off air cylinder, first with tertiary valve



112. and then with primary valve



113. Retrieve data from analyser, note location/file name in logbook, sign and write any notes in comment box

114. Ensure logbook complete before leaving. If time permits remove the sample from the cell as this is a delicate procedure do not rush to do so, it can wait until the following day
115. Double check everything is off!