

2016

The Flynn Rooms compressor/air bank instructions

HOW TO USE IT WITHOUT SCREWING IT UP (HOPEFULLY)
DRAFT

03/05/2016

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System description & schematic

The Flynn rooms compressor and gas bank system comprises of the following elements:

1. The blue Coltri MCH-32 compressor is located downstairs and permanently set to switch off at 300 bar (accessible to equipment officers & those doing partial pressure mixing only).
2. An air bank located in a gas cage outside consists of 4 x 50 litre 300 bar cylinders. This air bank can be used as a simple 200 litre buffer storage, or preferably as 2 x 100 litre sub banks which can be cascaded for maximum efficiency. Two high pressure hoses run from this bank to the control system & filling station upstairs. Because the bank can be used in cascade mode, it will usually be necessary to fill the bank in 2 halves as the pressure in bank #1 can be different to that in bank #2. ***If both bank valves (V1 & V2) are opened while there is significant pressure difference between the banks, the pressure will equalise in the banks, but there will also be heating of the bank cylinders. It is best not to open both banks if the pressure difference is > 100 bar.***
3. ***The bank cylinders were first installed in summer of 2015 & require a service in 2025. (Stewie Andrews)***
4. Upstairs two grey control panels control each compressor, duplicating the functionality of the compressor controls with the following exceptions:
 - a. No test purge button on the upstairs panels (the compressor has a timed purge feature).
 - b. The pressure cut outs on the gauges on these panels upstairs have been disabled. ***These panels are only to be opened by equipment officers with electrical training. The compressor will not run if these are opened.***
5. Various valves control the functions of the system which are:
 - a. Filling the air banks.
 - b. Filling bottles with air from the air banks.
 - c. Filling bottles with air from the compressor (including filling suitable bottles to 300 bar).
 - d. Filling nitrox using the blending panel & compressor.
6. An interlock system is in place to ensure that the bank is only filled with air.
7. As the compressor is now located in a very confined space, cooling air for it has to be forced in via a fan mounted in the top of the arch on the Science Gallery side. ***It is critical that this fan be operating when the compressor is running.*** The fan should automatically come on when a compressor motor is started, but fan operation should be verified each time.
 - a. There is a fan test button on the top of the grey box to the right of the blender panel. Holding down this button should start the fan.
 - b. Here is also a light beside the fan test button which is illuminated while the fan is running which indicates power is applied to the fan.
 - c. It's also no harm to verify fan operation by ear.
8. The final element of the system is the nitrox blending system which consists of oxygen cylinders in the gas cage outside which feeds oxygen at 4-8 bar to the blending panel upstairs where it is mixed with the incoming airstream for the compressor to produce nitrox up to 40%. It is only possible to use this system in conjunction with the compressor. A safety interlock ensures that the bank is shut off during nitrox blending to ensure that the bank contains only air.

We share Arch 1 with the mailroom. We are not allowed to use the compressor during working hours, hence the air bank.

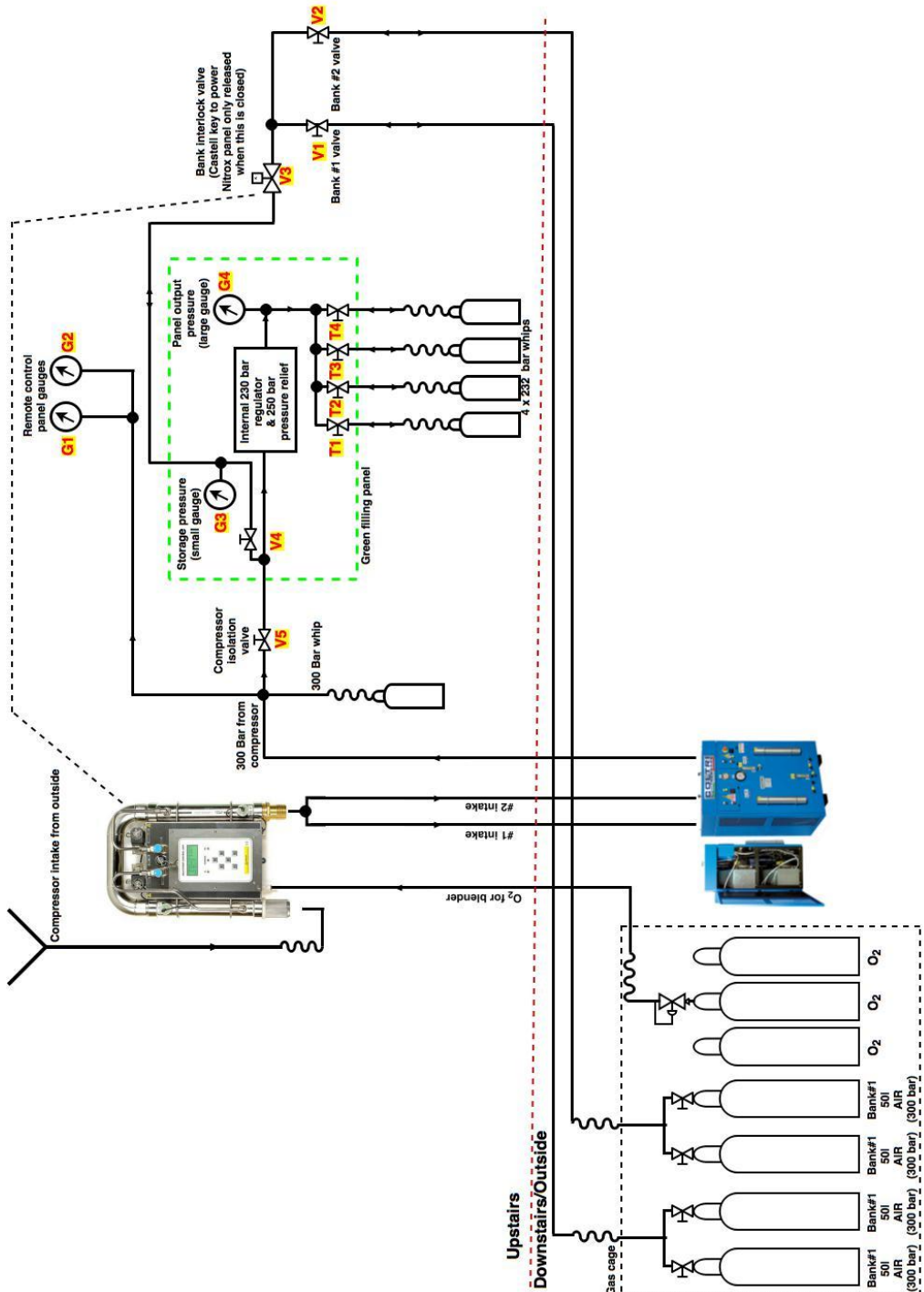


Fig. 1 - Schematic of the compressor/bank/blending system (gas)

Filling the air bank.

Because the bank can be used in cascade mode, it will usually be necessary to fill the bank in 2 stages as the pressure in bank #1 can be different to that in bank #2. ***If both bank valves (V1 & V2) are opened while there is significant pressure difference between the banks, the pressure will equalise in the banks, but there will also be heating of the bank cylinders. It is best not to open both banks if the pressure difference is > 100 bar.***

The procedure is outlined below (cascade operation of the bank is assumed):

1. Open the valve for bank #1 (V1).
2. Ensure the bank interlock valve (V3) is open. Note that this can only be opened if the Castell key is engaged in the interlock switch. If this key is not present in the interlock, check if it is in the power switch under the blending panel.
3. Ensure valve V4 on the left of the green filling panel & the compressor isolation valve (V5) are both open.
4. Verify that the emergency stop buttons on the grey compressor remote control panels are not active. (You should see a green ring under the red button as shown in Fig. 3.) If the green ring is not visible, twist the red knob to the left.
5. Start the first compressor by pressing on the green on button.
6. Wait 30 seconds.
7. Start the second compressor.
8. The compressor is set downstairs to stop at 300 bar. The pressure cut outs on the remote control panels upstairs are not active, though the gauges (G1 & G2) indicate the correct pressure in the compressor lines. You can also stop each side of the compressor manually by pressing the red off button or the emergency stop switch on the corresponding remote panel.
9. When the compressor has stopped, you can now close the valve for bank #1 (V1).
10. To fill bank #2, open the valve for bank #2 (V2), and repeat steps 2 – 8 above.

Filling cylinders from the bank (232 bar)

Because we are not supposed to use the compressor during mail room working hours (08:00-17:00), it is necessary to use the stored air in the bank to fill bottles during this time using the green filling panel for filling to 232 bar. The procedure is outlined below:

1. Check your cylinder pressure either by using a regulator or the gauge G4 on the green mixing panel. If using the gauge on the panel:
 - a. Ensure that bank valves V1 & V2 are closed OR that the valve V4 on the panel is closed.
 - b. Connect your cylinder to one of the green filling panel taps T1 to T4.
 - c. Pull the tap to which your cylinder is attached towards the front of the panel.
 - d. Open the pillar valve on your cylinder and read the cylinder pressure on G4 in the middle of the green filling panel.
 - e. Close the pillar valve on your cylinder & shut off the tap by pushing it towards the back of the filling panel.
2. Open the valve for bank #1 (V1).
3. Note the pressure on the storage pressure gauge on the green panel (the smaller one labelled G3).
4. Close the valve for bank #1 and open the valve for bank #2 (V2).
5. Again note the pressure. **You should use the bank with the lower pressure first unless the pressure in the cylinder you are trying to fill is higher.**
6. Ensure the bank interlock valve (V3) is open. Note that this can only be opened if the Castell key is operated in the bank interlock switch. If this key is not present in the interlock, check if it is in the power switch under the blending panel.
7. Ensure valve V4 on the left of the green filling panel is open.
8. Connect your cylinder to the filling panel using a whip.
9. Pull the corresponding filling tap (labelled T1 to T4) towards the front of the panel and then open the pillar valve on the cylinder. **Reversing the order of this step will dump the contents of your cylinder as these taps are self-venting when in the off position!**
10. You should hear the bottle filling. Fills are fast & the cylinder will get warmer than if filling with the compressor, resulting in a lower final pressure in your cylinder. This is normal. The panel is set to deliver more than 232 bar to compensate when the cylinder cools.
11. When the air stops flowing, if the large gauge (G4) on the green filling panel reads greater than 230 bar, then your bottle is full.
12. Close the pillar valve on the cylinder and push the filling tap towards the back of the panel. **Reversing the order of this step will dump the contents of your cylinder as these taps are self-venting when in the off position!** Pushing the tap back depressurises the whip allowing the cylinder to be disconnected if you are finished filling it.
13. If, during step 11 above, the large gauge (G4) on the green filling panel reads less than 230 bar, then this means the input pressure on the bank in use was not enough to fill the cylinder to the desired level. To get a fuller fill, close the valve on the bank you just used (either V1 or V2), then open the valve on the higher pressure bank and repeat steps 6 to 12 above.

While the above may seem complicated, using the bank in this cascaded manner ensures the maximum possible number of fills from the system before refilling the bank.

Filling cylinders from the bank (up to 300 bar)

Because we are not supposed to use the compressor during mail room working hours (08:00-17:00), it is necessary to use the stored air in the bank to fill bottles during this time using the 300 bar whip to the left of the filling panel (the one with the red valve) for filling 300 bar cylinders. (If you are filling a 300 bar cylinder from the bank, you are not going to get 300 bar in the cylinder even if the bank is full.) The procedure is outlined below:

1. Check your cylinder pressure by using a regulator.
2. Ensure valve V4 is open.
3. Open the valve for bank #1 (V1).
4. Note the pressure on the storage pressure gauge on the green panel (the smaller one labelled G3).
5. Close the valve for bank #1 and open the valve for bank #2 (V2).
6. Again note the pressure. **You should use the bank with the lower pressure first unless the pressure in the cylinder you are trying to fill is higher.**
7. Ensure the bank interlock valve (V3) is open. Note that this can only be opened if the Castell key is engaged in the bank interlock switch. If this key is not present in the interlock, check if it is in the power switch under the blending panel.
8. Ensure valve V4 on the left of the green filling panel is open.
9. Attach the cylinder to be filled to the 300 bar whip to the left of the green filling panel ensuring the bleed valve is closed.
10. Open the red handled valve on the 300 bar whip.
11. The cylinder pressure is given by the gauges on the grey remote control panels G1 or G2.
12. You should hear the bottle filling. Fills are fast & the cylinder will get warmer than if filling with the compressor, resulting in a lower final pressure in your cylinder. This is normal. The panel is set to deliver more than 232 bar to compensate when the cylinder cools.
13. When the air stops flowing, if the gauges G1 & G2 on the grey remote control panels read greater than ~280 bar, then your bottle is as full as you can reasonably expect. If you really need 300 bar, then you'll have to top it off using the compressor outside of mailroom working hours.
14. Close the pillar valve on the cylinder, close the red handled valve on the whip & open the bleed valve to allow the whip to be removed.
15. Close the bleed valve again.
16. If, after step 12 above, gauges G1 & G2 on the grey remote control panels read less than ~280 bar, then this means the input pressure on the bank in use was not enough to fill the cylinder to the desired level. To get a better fill, close the valve on the bank you just used (either V1 or V2), then open the valve on the higher pressure bank and repeat steps 6 to 12 above.

While the above may seem complicated, using the bank in this cascaded manner ensures the maximum possible number of fills from the system before refilling the bank.

Filling directly from the compressor (232 bar)

Outside of mail room working hours it is possible to use the compressor to fill bottles directly using the filling panel for filling to 232 bar. The procedure is outlined below:

1. Isolate bank #1 & bank #2 either by closing bank valves V1 & V2 or valve V4 on the green panel. (The bank interlock valve V3 also isolates the bank, but this is really for nitrox blending and should only be used for that).
2. Ensure the compressor isolating valve V5 is open.
3. Attach the cylinder to be filled to any of the taps T1 –T4.
4. Verify that the emergency stop buttons on the grey compressor remote control panels are not active. (You should see a green ring under the red button as shown in Fig. 3.) If the green ring is not visible, twist the red knob to the left.
5. Start the first compressor by pressing on the green on button.
6. Wait 30 seconds before starting the second compressor (if you are going to use 2 compressors).
7. Pull the appropriate tap (T1 – T4) towards the front of the panel, then open the cylinder.
Reversing the order of this step will dump the contents of your cylinder as these taps are self-venting when in the off position!
8. The cylinder pressure is indicated on gauge G4 on the filling panel. Even if the pressure from the compressor as shown on G1 & G2 is as high as 300 bar, the pressure on the 232 bar outputs will not exceed 240 bar.
9. Close the pillar valve on the cylinder and push the filling tap towards the back of the panel.
Reversing the order of this step will dump the contents of your cylinder as these taps are self-venting when in the off position! Pushing the tap back depressurises the whip allowing the cylinder to be disconnected if you are finished filling it.
10. The compressor is set downstairs to stop at 300 bar. The pressure cut outs on the remote control panels upstairs are not active, though the gauges (G1 & G2) indicate the correct pressure. You can also stop each compressor manually by pressing the red off button or the emergency stop switch on the corresponding remote panel.

Filling directly from the compressor (300 bar)

Outside of mail room working hours it is possible to use the compressor to fill bottles directly using the 300 bar whip to the left of the filling panel for filling 300 bar cylinders. The procedure is outlined below:

1. Isolate bank #1 & bank #2 either by closing bank valves V1 & V2 or valve V4 on the green panel. (The bank interlock valve V3 also isolates the bank, but this is really for nitrox blending).
2. Ensure the compressor isolating valve V5 is open.
3. Attach the cylinder to be filled to the 300 bar whip to the right of the green filling panel ensuring the bleed valve is closed.
4. Verify that the emergency stop buttons on the grey compressor remote control panels are not active. (You should see a green ring under the red button as shown in Fig. 3.) If the green ring is not visible, twist the red knob to the left.
5. Start the first compressor by pressing on the green on button.
6. Wait 30 seconds before starting the second compressor (if you are going to use 2 compressors).
7. Open the red handled valve on the 300 bar whip.
8. The cylinder pressure is given by the gauges on the grey remote control panels G1 or G2.
9. When the cylinder is full, close the pillar valve on the cylinder, close the red valve on the whip & open the bleed valve to allow the whip to be removed.
10. Close the bleed valve again.
11. The compressor is set downstairs to stop at 300 bar. The pressure cut outs on the remote control panels upstairs are not active, though the gauges (G1 & G2) indicate the correct pressure. You can also stop the compressor manually by pressing the red off button or the emergency stop switch on the corresponding remote panel.

Filling nitrox using the blending panel and the compressor (232 bar)

Outside of mail room working hours it is possible to use the compressor and mixing panel to blend nitrox using the filling panel for filling to 232 bar. The procedure is outlined below:

1. Isolate bank #1 & bank #2 ~~either~~ by closing the bank interlock valve V3, ~~at the same time~~ ~~inserting~~ the captive bolt on the valve lever into the side of the Castell lock mechanism (~~see Fig. 8 and 9~~) to allow the Castell key to be removed (you'll need to turn this captive bolt to the left in the mechanism to allow the key to be released). **This is a very important step which ensures that the bank cannot be filled with > 21% O₂.**
2. Remove the Castell key from the bank interlock valve & insert it into the switch underneath the blending panel. Turn the key to the right to power up the panel. (The key is now trapped in this switch.)
3. Make sure the blue needle adjustment valves at the top of the panel (~~see Fig. 7~~) ~~upstairs~~ are fully closed (clockwise).
4. In the gas cage outside:
 - a. Connect the regulator to the oxygen J cylinder pillar valve.
 - b. Turn the regulator knob fully off (anti-clockwise).
 - c. Slowly open the J cylinder pillar valve.
 - d. Set the O₂ regulator to deliver 4 bar or 7-8 bar if using both compressors.
5. Insert the key into the panel and turn on (only if the panel is not already on at this point).
6. Ensure the compressor isolating valve V5 is open.
7. Attach the cylinder to be filled to any of the taps T1 –T4.
8. Verify that the emergency stop buttons on the grey compressor remote control panels are not active. (You should see a green ring under the red button as shown in Fig. 3.) If the green ring is not visible, twist the red knob to the left.
9. On the mixing panel, select 'Calibration' on the mixing panel screen & and press Enter.
10. Turn on the compressor and open the 300 bar whip to allow the gas to flow.
11. Once the cell readings have stabilized turn off the compressor
12. Press the left button for Nitrox blending.
13. Enter the starting cylinder pressure iP and the starting mix percentage iF02.
14. Enter the desired cylinder pressure oP and the desired mix percentage oF02.
15. The mix percentage to be added will be displayed.
16. Start the first compressor by pressing on the green 'On' button on one of the grey remote panels.
17. Wait 30 seconds before starting the second compressor (if you are going to use 2 compressors).
18. Press Enter and then select Nitrox, the solenoid valve on the top left of the blending panel (~~see Fig. 7~~) should switch on (you will hear a click & see a red light on it).
19. Open the left needle valve slowly until the % of O₂ flowing past the sensor labelled S1 on the display is the same as calculated in step 15 above.
20. Close the 300 bar whip when the reading stabilises.
21. Pull the appropriate tap (T1 – T4) towards the front of the panel, then open the cylinder.
Reversing the order of this step will dump the contents of your cylinder as these taps are self-venting when in the off position!
22. Monitor the cylinder pressure on the green panel gauge G4. When it reaches 240 bar press the delete button on the nitrox mixing panel while the compressor is still running. This will turn off the oxygen supply while the compressor airflow flushes the sensors. Quickly close the pillar valve on the cylinder and then push the filling tap towards the back of the panel. Ensure the O₂ reading on the panel is not greater than 21%. If it is, open the 300 bar whip & run the compressor for 20 seconds or so to flush the excess O₂ from the mixing panel. The cylinder

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Commented [DD2]: Open the J cylinder using the attached wrench

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pressure is indicated on gauge G4 on the filling panel. Even if the pressure from the compressor as shown on G1 & G2 is as high as 300 bar, the pressure on the 232 bar outputs will not exceed 240 bar.

23. ~~Close the pillar valve on the cylinder and push the filling tap towards the back of the panel. Reversing the order of this step will dump the contents of your cylinder as these taps are self-venting when in the off position!~~ Pushing the tap back depressurises the whip allowing the cylinder to be disconnected if you are finished filling it.

24. The compressor is set downstairs to stop at 300 bar, best not to let it get this far — see the next point. The pressure cut outs on the remote control panels upstairs are not active, though the gauges (G1 & G2) indicate the correct pressure. You can also stop each the compressor manually by pressing the red 'Off' button or the emergency stop switch on the corresponding remote panel.

25. If the compressor shuts off, the O₂ % rises in the mixing panel. The blending panel solenoid will automatically shut off when the detected O₂ level at the sensor exceeds 43%, shutting off the oxygen supply. If this happens, the O₂ sensors in the panel can be left exposed to excess levels of oxygen. This severely reduces their lifetime. To avoid this, it is best to monitor the cylinder pressure on the green panel gauge G4. When it reaches 240 bar, press the delete button on the nitrox mixing panel while the compressor is still running. This will turn off the oxygen supply while the compressor airflow flushes the sensors. Ensure the O₂ reading on the panel is not greater than 24%. If it is, open the 300 bar whip & run the compressor for 20 seconds or so to flush the excess O₂ from the mixing panel.

~~26-25.~~ If no more nitrox fills are required, close the left needle valve on the panel and turn off the mixing panel by removing the Castell key beneath it. ~~Return the key to the bank interlock & open the bank isolation valve V3 to leave the bank system accessible to non-nitrox users.~~

~~27-26.~~ Close the left needle valve on the panel.

~~28-27.~~ In the gas cage outside:

- a. Note the pressure left in the cylinder and then turn off the O₂ supply on the J cylinder in the gas cage outside using the attached wrench.
- b. Turn the regulator knob fully open. (Clockwise)

Remember to pay for your Nitrox and fill in the log book!

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Filling nitrox using the blending panel and the compressor (300 bar)

Outside of mail room working hours it is possible to use the compressor and mixing panel to blend nitrox using the 300 bar whip to the left of the filling panel for filling 300 bar cylinders. The procedure is outlined below:

1. Isolate bank #1 & bank #2 either by closing the bank interlock valve V3, at the same time inserting the captive bolt on the valve lever into the side of the Castell lock mechanism to allow the Castell key to be removed (you'll need to turn this captive bolt to the left in the mechanism to allow the key to be released). ***This is a very important step which ensures that the bank cannot be filled with > 21% O2.***
2. Remove the Castell key from the bank interlock valve & insert it into the switch underneath the blending panel. Turn the key to the right to power up the panel. (The key is now trapped in this switch.)
3. Make sure the blue needle valves at the top of the panel upstairs are fully closed (clockwise).
4. In the gas cage outside:
 - a. Connect the regulator to the oxygen J cylinder pillar valve.
 - b. Turn the regulator knob fully off (anti-clockwise).
 - c. Slowly open the J cylinder pillar valve.
 - d. Set the O2 regulator to deliver 4 bar or 7-8 bar if using both compressors.
5. Insert the key into the panel and turn on (only if the panel is not already on at this point).
6. Ensure the compressor isolating valve V5 is open.
7. Verify that the emergency stop buttons on the grey compressor remote control panels are not active. (You should see a green ring under the red button as shown in Fig. 3.) If the green ring is not visible, twist the red knob to the left.
8. On the mixing panel, select 'Calibration' on the mixing panel screen & and press Enter.
9. Turn on the compressor and open the 300 bar whip to allow the gas to flow.
10. Once the cell readings have stabilized turn off the compressor
11. Press the **left** button for Nitrox blending.
12. Enter the starting cylinder pressure iP and the starting mix percentage iF02.
13. Enter the desired cylinder pressure oP and the desired mix percentage oF02.
14. The mix percentage to be added will be displayed.
15. Attach the cylinder to be filled to the 300 bar whip to the left of the green filling panel & open the bleed valve.
16. Start the first compressor by pressing on the green 'On' button on one of the grey remote panels.
17. Wait 30 seconds before starting the second compressor (if you are going to use 2 compressors).
18. Press Enter and then select Nitrox, the solenoid valve on the top left of the blending panel should switch on (you will hear a click & see a red light on it).
19. Open the left needle valve slowly until the % of O2 flowing past the sensor is the same as calculated in step 14 above.
20. Close the bleed valve on the 300 bar whip when the reading stabilises.
21. Open the red handled valve on the 300 bar whip & open the cylinder pillar valve.
22. The cylinder pressure is given by the gauges on the grey remote control panels G1 or G2.
23. The compressor is set downstairs to stop at 300 bar. The pressure cut outs on the remote control panels upstairs are not active, though the gauges (G1 & G2) indicate the correct pressure. You can also stop each side of the compressor manually by pressing the red off button or the emergency stop switch on the corresponding remote panel.

24. When the cylinder is full, close the pillar valve on the cylinder, close the red valve on the whip & open the bleed valve to allow the whip to be removed.
25. Close the bleed valve again.
- 29-28. When the compressor shuts off, the O2 % rises in the mixing panel. The blending panel solenoid will automatically shut off when the detected O2 level at the sensor exceeds 43%, shutting off the oxygen supply. When this happens, the O2 sensors in the panel can be left exposed to excess levels of oxygen. This severely reduces their lifetime. Open the 300 bar whip & run the compressor for 20 seconds or so to flush the excess O2 from the mixing panel.
26. If no more nitrox fills are required, turn off the mixing panel by removing the Castell key beneath it, **return the key to the bank interlock & open the bank isolation valve V3 to leave the bank system accessible to non-nitrox users.**
27. Close the left needle valve on the panel.
28. In the gas cage outside:
 - a. Turn off the O2 supply on the J cylinder in the gas cage outside using the attached wrench.
 - b. Turn the regulator knob fully open. (Clockwise)

System photos



Fig. 2 - The compressor remote control panels.



Fig.3 - The emergency stop switch in the on position allowing the compressor to start.

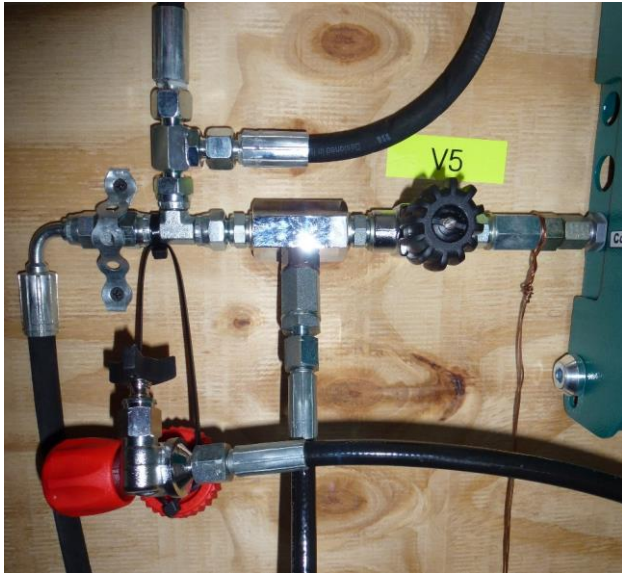


Fig. 4 - The 300 bar whip (red) and the compressor isolating valve.

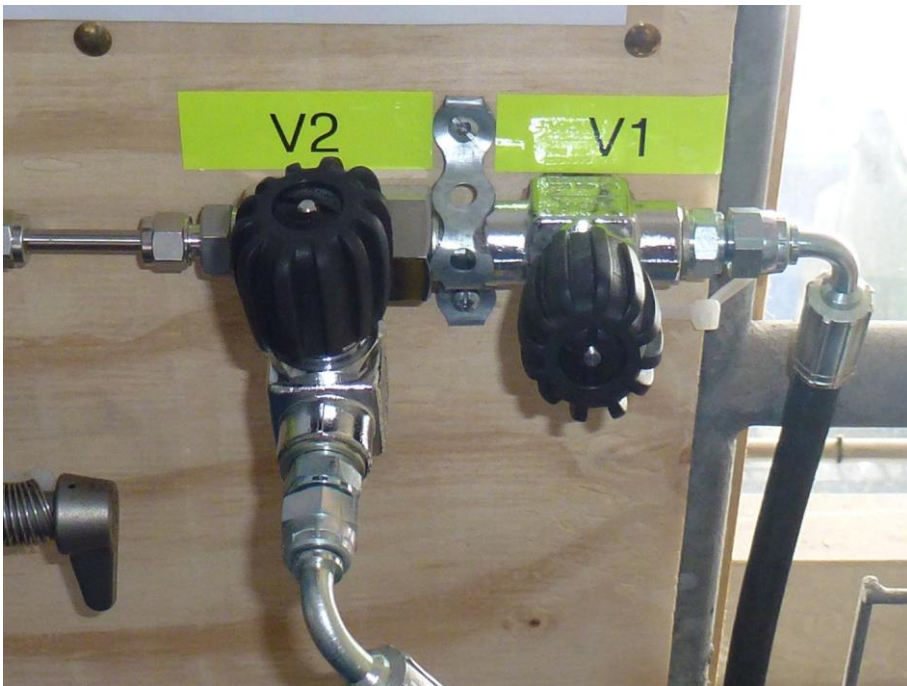


Fig.5 – The bank valves

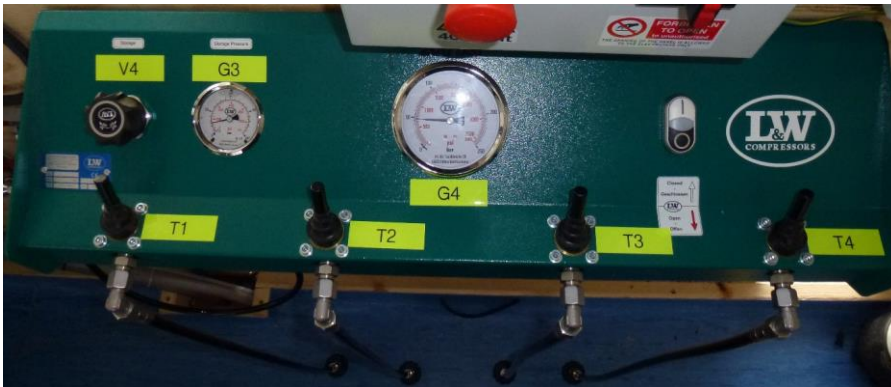


Fig. 6 - The 232 bar filling panel.



Fig. 7 - The blending panel with the Castell interlock power switch underneath.

Also indicated are:

- The O2 solenoid valve.
- The O2 needle adjustment valve.



Fig. 8 - The bank interlock system with the bank online.



Fig. 9 - The bank interlock system with the bank offline (note the Castell key is removed)



Fig. 10 – The gas cage. 4 x 50 litre air cylinders on the left, oxygen for nitrox on the right.