

Title: SAFE USE OF COMPRESSED GASES/CYLINDERS

Location: CBE Laboratory Unit

## 1. PURPOSE

To describe the procedures for the safe use of compressed gas cylinders in the CBE laboratory unit.

## 2. SCOPE

To provide safety information and procedures to all persons using, or coming in contact with compressed gases, whereby a 'compressed gas' is any gas placed in a cylinder under pressure greater than that of normal atmospheric pressure and a 'cylinder' is any metal container used under pressure for the storage of permanently liquefied or dissolved gas.

This SOP describes in detail the procedures to be followed when replacing empty Carbon Dioxide, Oxygen and Nitrogen Cylinders located in gas pod 2 & 3. This SOP does not include details of any other gas type nor does it describe the use of gas cylinders within a laboratory. Operators using gases other than those mentioned above or systems that require gas cylinders to be placed within a laboratory will be required to review this current SOP or prepare a separate SOP.

## 3. RESPONSIBILITIES

### CBE Laboratory Users

1. Shall have received appropriate training before handling gas cylinders, details of training must be recorded in training file.
2. Shall follow the procedure described in this SOP according to Manufacturer's Operating Instructions and safe work practices.
3. Shall record and report any events that indicate non-conformance or malfunction and notify RP/LM immediately.

### Responsible Person (RP)/Laboratory Manager (LM)

1. Shall ensure laboratory personnel are given suitable information, instruction and training in the correct use and handling of gas cylinders and that this is recorded in training files.
2. Shall coordinate monthly maintenance duties.
3. Shall investigate any reported problems, deviations, adverse events or non-conformities.
4. Shall organise the maintenance and repairs as required by trained and authorised contract / service personnel.

## 4. SPECIAL NOTES: HEALTH & SAFETY

- When handled properly, compressed gases pose a minimal risk to users. When handled or stored improperly, however, they may explode or rupture, releasing their contents into the environment.
- Compressed gases have the potential for creating both mechanical and chemical hazards. If the gas is flammable then a fire or explosive hazard may exist. Also, additional hazards can arise from the reactivity and toxicity of the gas, and asphyxiation can be caused by high concentrations of even "harmless" gases such as nitrogen.

Version 004

Effective Date: 21.07.2020

Review 21.07.2022

Written by: P.Hourd

Reviewed by: A.Chandra

Approved by: R.I .Temple

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- The large amount of potential energy resulting from compression of the gas makes a compressed gas cylinder a potential rocket or fragmentation bomb.

(i) Personal Protective Equipment:

- Depending on the type of gas being used, personal protective equipment will vary, but in all instances EYE PROTECTION MUST BE WORN when moving cylinders or “sniffling” (venting small amount of gas to clean out debris before fitting a regulator). Each case should be evaluated on an individual basis to determine the associated hazards/risks and the use of additional protective equipment (safety shoes, lab coats, etc). Contact the Departmental Safety Office for more information if needed.

(ii) Engineering/Ventilation Controls:

- All areas in which Compressed Gases are used and/or stored should be well ventilated and kept at the appropriate temperature for that particular gas, as specified by the manufacturer.
- All the cylinders must be firmly supported by restraining chains, bench clamps or similar devices. All other cylinders should be kept in a properly constructed well ventilated store, where full and empty cylinders should be separated, and where smoking and the use of naked flames is prohibited. Cylinders of oxidising gases must be kept separate from cylinders of flammable gases, and toxic and/or corrosive gases should always be stored separately. Refer to the Guidelines for Gas Cylinder Storage published by the British Compressed Gases Association.
- Large gas cylinders should be moved on an approved gas cylinder trolley and should never be dragged or slid across the floor by the main valve. Cylinders must be sited at a safe distance from any high risk fire area, and never beside the door or other escape route from the laboratory.
- The contents of a pressurised gas cylinder must never be used without the correct regulator and/or valves which must always be fitted by a competent person. The inlet and outlet connections must be free of oil, grease, dirt and fragments of plastic from the "full cylinder" seal. Oil and grease will ignite in the presence of pure oxygen and if the latter is under pressure, an explosion can occur. The valve, the regulator and any other connections at high pressure should always be checked for leaks using a soap or detergent water solution.
- Where any gas is to be passed through a reaction vessel a pressure release device and a trap to prevent suck-back should be used. An appropriate arrangement is generally: cylinder: regulator: (valve): suck-back trap pressure relief device: reaction vessel. The main valve of the gas cylinder should always be turned off after use and any excess pressure in the regulator released with caution.
- Certain cylinders and their contents require special precautions and/or storage conditions, manufacturers or supplier's instructions must be adhered to at all times.

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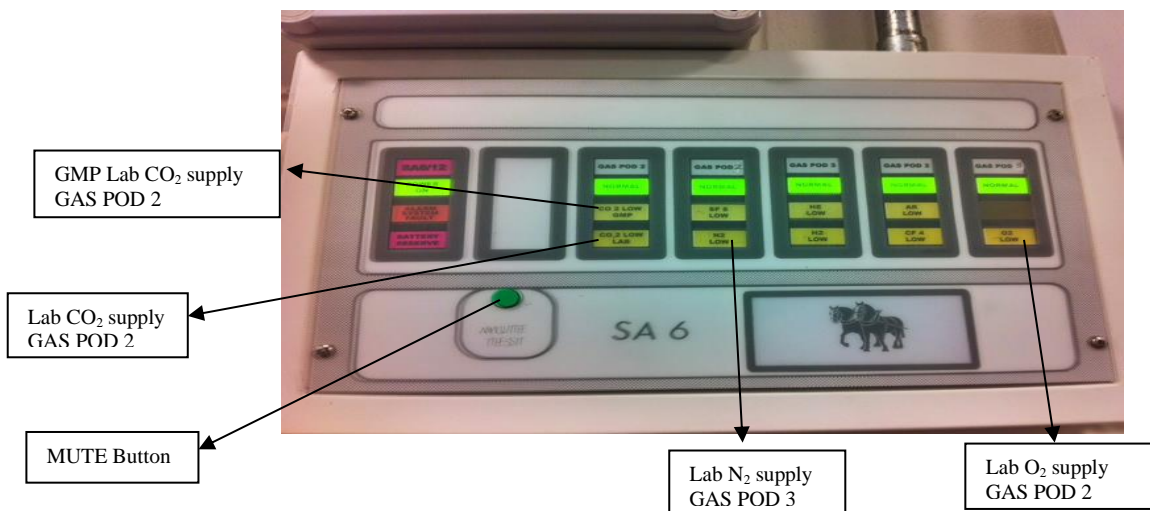
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## 5. PROCEDURE

### 5.1 Office Alarm System.

- A. An audible alarm will sound when a gas cylinder is low, a flashing light on the control panel located in the CBE office will indicate the location of the cylinder which is about to expire.  
**Alarms should NEVER be ignored, if unsure/not trained as to how to replace a gas cylinder, you must alert the lab manager and/or responsible person immediately upon hearing the alarm.**
- B. While you go outside to change the gas cylinder or wait for assistance the alarm can be temporarily muted, by pressing the green mute button



### 5.2 General Safe Handling Procedures

- A. Suitable PPE must be worn at all times, especially safety goggles.
- B. All couplings and valves must be kept free of oily substances.
- C. Close all valves when cylinder is not in use and remove regulator where practical.
- D. When a cylinder is not connected to a regulator or manifold, make sure the protective valve cover is in place.
- E. Use only the recommended cylinder-valve outlet connections, as specified by the Compressed Gas Supplier to prevent mixing of incompatible gasses.
- F. Use only the manufacturer's recommended tools for turning on and off cylinders.
- G. When moving cylinders a short distance (5 metres Max.), they can be tilted and rolled on the bottom edge (*churning*) however, they should **not** be dragged or rolled.
- H. Use a manufacturer approved gas bottle trolley to move large cylinders. **Never manually lift cylinders.**
- I. Always close valves, remove regulator and replace dust cap where available, before moving cylinder.
- J. Always assume a cylinder is pressurized - handle it carefully and avoid bumping and dropping.
- K. Cylinders should be securely clamped into position at all times; **Never** leave an unsecured cylinder unattended.
- L. Examine the cylinder and all attachments for signs of wear and/or damage. If any fault noted, do not connect gas, contact lab manager immediately.
- M. Threads that do not fit should not be forced. Make sure that threads on regulator connections match those on the container valve outlet. Also double check the gas cylinder being hooked up contains the correct gas; any cylinders with damaged or obscured labels, should not be used and instead sent back to supplier immediately.
- N. Cylinders should be opened slowly, turning counter clockwise to a maximum 3/4 of a turn, leaving the bottle key in place at all times in case of an accident or incident.
- O. Stand clear of the position regulator gauge faces when opening valves. If valves are defective, return the cylinder to the supplier. Only open the cylinder counter clockwise to a maximum of 3/4 of a turn.

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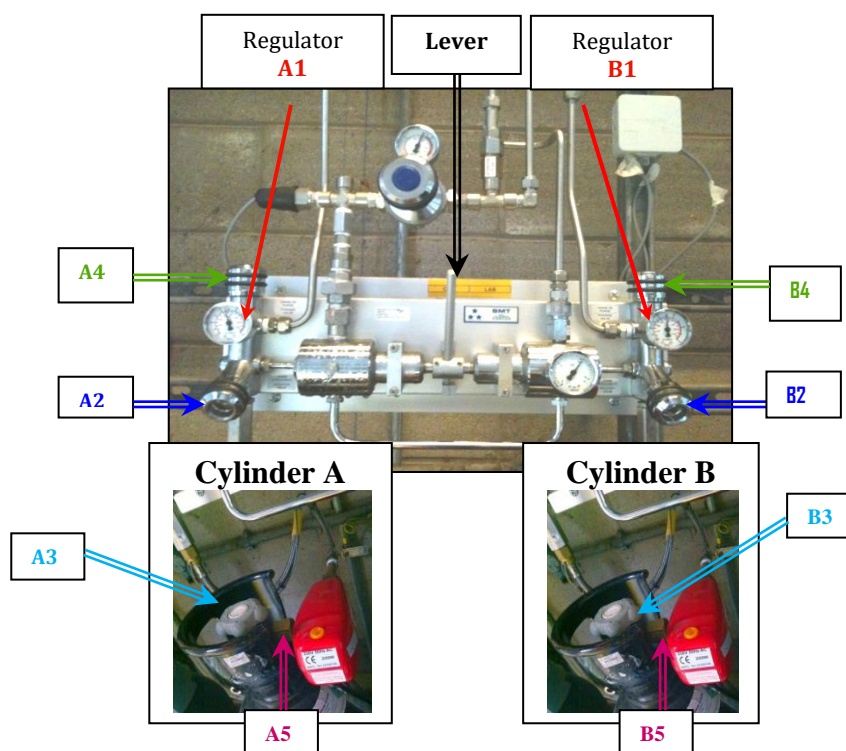
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## 5.2 - CO<sub>2</sub> Cylinder Replacement Procedure

### AUTHORISED CBE PERSONNEL ONLY

**AUTHORISED CBE PERSONNEL MUST HAVE COMPLETED GAS SAFETY TRAINING & MANUAL HANDLING TRAINING**



**Step 1** Check lever, direction arrow is pointing, points to the cylinder that requires changing. Confirm this by **checking the position of the regulator A1 or B1 needle**; the regulator of the empty cylinder should be < 10 bar. (If not contact RP/LM immediately as this indicates a false alarm and the system is not operating correctly)

**Step 2** Confirm other cylinder is full, by **checking regulator of opposite cylinder** (either **A1** or **B1**) is reading >40 bar. If so, **pull down or push up lever** to switch feed to full cylinder, action depends on whether the right (push up) or left (pull down) cylinder has expired.

**The next steps depend on the cylinder being changed, cylinder on the left follow "A" commands or the right cylinder follow "B" commands**

**Step 3** **Close Valve A2 or B2** turning clockwise.

**Step 4** On wall behind cylinders (right of gas bank), **switch off power to heater**, each heater is numbered, double check number on heater corresponds to wall switch.

**Step 5** **Close valve A3 or B3 on cylinder A or B**, turning clockwise

**Step 6** **Open valve A4 or B4** to purge line, **close immediately**, once line empty.

**Step 7** **Using wrench** (pull towards yourself) **to loosen the bolt A5 or B5**, attaching the gas line to the cylinder and remove.

**Step 8** Untie cylinder from clamp, slightly tilt cylinder and churn cylinder to another location, clamp to secure. Using chalk, write "empty" and initial and date on the cylinder. Note the last 5 digits of the serial number of the empty cylinder.

**Step 9** Select a new cylinder, remove grey dust cap from valve, inspect valve for any signs of damage (if any damage noted, write "do not use", clearly on cylinder and report to RP/LM), untie new cylinder and churn to gas bank, ensure to position the cylinder so that the **valve (A5 or B5) faces to the right**, secure using clamp tie. Note the last 5 digits of the serial number of the full cylinder to be fitted. Email these numbers along with the date and time to Eleri ([e.a.bristow@lboro.ac.uk](mailto:e.a.bristow@lboro.ac.uk)) for stock tracking. Fill in the cylinder change tracking sheet in the CBE main corridor outside of first change.

**Step 10** Using fingers **connect gas line to valve A5 or B5, tighten bolt with wrench**.

**Step 11** **Switch power to heater** back on

**Step 12** **Open valve A3 or B3 on cylinder**, turning anti-clockwise.

**Step 13** **Open Valve A2 or B2** turning anti-clockwise

**Step 14** Double check both regulators **A1** and **B1**, both regulators should be reading >40 bar. (If not, double check that valve A3 or B3 and A2 or B2 are open, if so contact LM/RP immediately).

**Security Services dial 888 from an internal phone line; alternatively dial 999 for emergency assistance**

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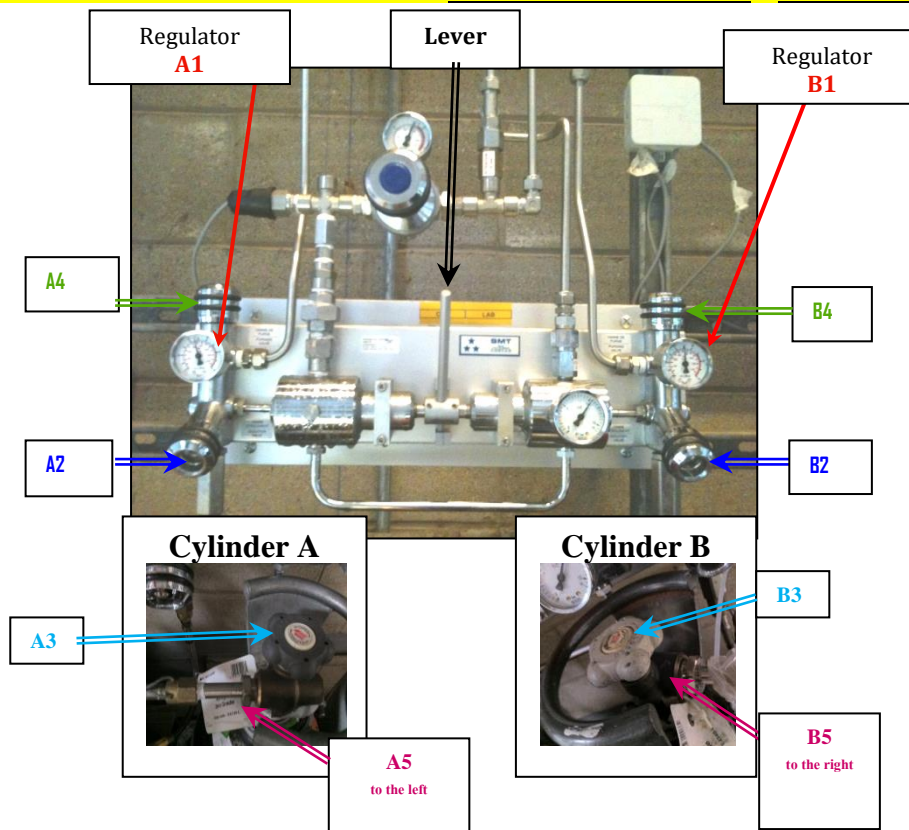
**Emergency Contact Numbers**

Jon Harriman - 07716306950  
Bob Temple – 076 54383735 (pager)

**5.3 - N<sub>2</sub> and O<sub>2</sub> Cylinder Replacement Procedure**

**AUTHORISED PERSONNEL ONLY**

**AUTHORISED PERSONNEL MUST HAVE COMPLETED GAS SAFETY TRAINING & MANUAL HANDLING TRAINING**



**Step 1** Check lever, direction arrow is pointing, points to the cylinder that requires changing. Confirm this by **checking the position of the regulator A1 or B1 needle**; the regulator of the empty cylinder should be < 10 bar. (If not contact RP/LM immediately as this indicates a false alarm and the system is not operating correctly)

**Step 2** Confirm other cylinder is full, by **checking regulator of opposite cylinder** (either **A1** or **B1**) is reading >40 bar. If so, **pull down or push up lever** to switch feed to full cylinder, action depends on whether the right (push up) or left (pull down) cylinder has expired).

**The next steps depend on the cylinder being changed, cylinder on the left follow "A" commands or the right cylinder follow "B" commands**

**Step 3** Close Valve **A2** or **B2** turning clockwise.

**Step 4** Close valve **A3** or **B3** on cylinder **A** or **B**, turning clockwise

**Step 5** Open valve **A4** or **B4** to purge line; **close immediately**, once line empty.

**Step 6** Using wrench (pull towards yourself) to **loosen the bolt A5 or B5**, attaching the gas line to the cylinder and remove.

**Step 7** Untie cylinder from clamp, slightly tilt cylinder and churn cylinder to another location, clamp to secure. Using chalk, write "empty" and initial and date on the cylinder. Note the last 5 digits of the serial number of the empty cylinder.

**Step 8** Select a new cylinder, remove protective grey dust cap from valve, inspect valve for any signs of damage (if any damage noted, write "do not use", clearly on cylinder and report to RP/LM),

**Step 9** Untie new cylinder and churn to gas bank, positioning the cylinder depends on the cylinder being changed, cylinder on the left, position so that the valve **A5** faces to the left, while the cylinder on the right, position so that the valve **B5** faces to the right, as in photo above. Note the last 5 digits of the serial number of the full cylinder to be fitted. Email these numbers along with the date and time to Eleri (e.bristow@lboro.ac.uk) for stock tracking. Fill in the cylinder change tracking sheet in the CBE main corridor outside of first change.

**Step 10** **FOR NITROGEN CYLINDERS ONLY** - Neatly wind PTFE tape around the thread of the gas line end two times to help prevent leaks. **NEVER USE PTFE TAPE WITH OXYGEN CYLINDERS THE TAPE CAN IGNITE IN REACTION WITH PURE OXYGEN.**

**Step 11** Using fingers **connect gas line to valve A5 or B5, tighten bolt with wrench.**

**Security Services dial 888 from an internal phone line; alternatively dial 999 for emergency assistance**

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**Step 12** **Open valve A3 or B3 on cylinder**, turning anti-clockwise.

**Step 13** **Open Valve A2 or B2** turning anti-clockwise.

**Step 13** Double check both regulators **A1** and **B1**, both regulators should be reading >40 bar. (If not, double check that valve A3 or B3 **and** A2 or B2 are open, if so contact LM/RP immediately).

**Emergency Contact  
Numbers**

Jon Harriman - 07716306950  
Bob Temple - 076 54383735 (pager)

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#### 5.4 Inspection and Maintenance of Cylinders and Equipment

All compressed gas cylinders, should be constructed, tested, and filled in accordance with applicable manufacturers regulations, and used for the purpose for which they are intended.

1. Inspect hoses, manifolds/cylinders frequently (once a month recommended) and replace if out of date, worn or damaged. This should be completed & recorded by the responsible person on the form FSOP058.1.
2. Regulators should be replaced/re-validated after 5 years of service.
3. Regular inspection and testing of regulators must be conducted, at least once a year and these events documented.
4. Remove the cylinder from service if damaged or leaking and return to manufacturer.
5. A pressure vessel inspection is performed annually on the gas cylinders. This is arranged by the Wolfson School Facilities Manager through the insurance inspector.
6. An annual maintenance contract ensures that all cylinders receive an annual inspection which includes pressure tests & gauge checks. Every five years the gauge is revalidated or changed. This report is filed in the laboratory management file.

## 6 DOCUMENTATION

The following records are outputs of this SOP:

### 6.1 FSOP058.1. Routine Inspection Log for Cylinders and Equipment

These records shall be filed in the Equipment File and stored in the CBE Office or otherwise archived for future review or retrieval.

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### SOP Version History

Version Reviewed	Date Revised/ Reviewed	Revision Summary	New Version Number
001	14Oct2009  Reviewed by K. Brosnan	<ol style="list-style-type: none"> <li>1. <b>Section 3</b> – added additional references to university policies</li> <li>2. <b>Section 7.2</b> added step 2 to check cylinder for damage before connecting and step 3 to always double check that the gas is correct for the intended use</li> <li>3. <b>Section 7.3</b> – added step 1 to give certificate accompanying each cylinder to lab manager for filing and step 3 for staff to be aware that each cylinder should carry an authority inspection stamp</li> </ol>	<b>002</b>
002	14 June 2010 Reviewed by A. Chandra Amended RIT	<ol style="list-style-type: none"> <li>1. The data for all gases used in the laboratory is recorded.</li> <li>2. Added a section to use the automatic switchover</li> <li>3. use of the CEN changeover manifold is added for the CO<sub>2</sub> lab gas.</li> </ol>	003
003	23 <sup>rd</sup> October 2012 Reviewed by K.Brosnan (no longer in role) & C. Kavanagh (completed review)	<ol style="list-style-type: none"> <li>1. Transferred to lean template &amp; major changes made to make lean &amp; provide more clarity using diagrams.</li> <li>2. Removal of form, this is now on the CBE website.</li> </ol> <p>The following statements were added:</p> <ol style="list-style-type: none"> <li>3 A pressure vessel inspection is performed annually on the gas cylinders. The report is filed by Mr. Chris Harris (Facilities Manager, Wolfson school)</li> <li>4. An annual maintenance contract ensures that all cylinders receive an annual inspection which includes pressure tests &amp; gauge checks. Every five years the gauge is revalidated or changed. This report is filed in the laboratory management file.</li> </ol>	004
004	13 <sup>th</sup> November 2015 Reviewed by K. Sikand	Reviewed, minor editorial changes, same version number kept.	004

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Written by: K. Brosnan	Reviewed by: C. Kavanagh	Approved by: R.I.Temple
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Location: **CBE Laboratory H25**

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<b>004</b>	<b>Reviewed 18/06/2018 by J Harriman</b>	<b>Reviewed. Updated emergency contact numbers. Added use of PTFE tape to N<sub>2</sub> cylinder change. Added warning not to use PTFE tape for O<sub>2</sub> cylinder change. Added serial number tracking info.</b>	<b>005</b>
<b>005</b>	<b>Reviewed by C.Kavanagh 21/07/2020</b>	<b>No amendments</b>	<b>005</b>

Written by: K. Brosnan	Reviewed by: C. Kavanagh	Approved by: R.I.Temple
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