# **Standard Operating Procedure (SOP) Title: Use of Gas cylinders and regulators**

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| Assessor:  | Joshua Linfoot | Location of work:  | MSRH 502 |
| Principal Investigator:  | Prof Alan Spivey |
| Date of approval:  | 13/09/2021 | Date for review: | 13/09/2022 |

## **Justifying the hazards:**

The Department of Chemistry has centralised the supply of nitrogen to its laboratories. The BOC group supplies a selection of gases in cylinders of different sizes. Where possible, laboratory users should return to BOC those cylinders that have been stored for a long time without use.

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| Identify hazards with specific risk assessments and a College or a departmental approval process  |
| [Ionising radiation sources](https://www.imperial.ac.uk/safety/safety-by-topic/laboratory-safety/) | [ ]  | [Biological sources](https://www.imperial.ac.uk/safety/safety-by-topic/laboratory-safety/) (microorganisms, human/animal tissues, plants) | [ ]  |
| [Class 3R, 3B or 4 Lasers](https://imperiallondon.sharepoint.com/sites/fons/faculty/safety/lasers/SitePages/laserhome.aspx) | [ ]  | [Offsite work](http://www.imperial.ac.uk/safety/safety-by-topic/off-site-working/) | [ ]  |
| Confirm if [Lone working](https://www.imperial.ac.uk/safety/safety-by-topic/lone-working/) is permitted with this SOP? [ ]  If it is permitted, describe the control measures for lone workers:  |

## **Preparing for the SOP:**

All personnel are required to undertake training on Compressed Gases and Connecting Gas Regulators <http://www.imperial.ac.uk/staff-development/safety-training/safety-courses-/compressed-gases-and-connecting-gas-regulators/> before undertaking any work with gas cylinders and regulators.

* **DON’T** use soap for leak testing.
* **DO:** Leak test your pressure system each time a regulator is attached to the cylinder with an oil-free leak test product e.g. 1% TEEPOL or [SNOOP](http://www.sigmaaldrich.com/catalog/product/aldrich/z273910?lang=en&region=GB&cm_sp=Insite-_-prodRecCold_xorders-_-prodRecCold2-1). Soap and other oil-based products are NOT suitable for leak testing compressed gas cylinders.
* **DO:** Check the tubing or pipework connecting the cylinder to the equipment. If any signs of damage are present, replace the tubing.
* **DO:** Store gas cylinders in Gas Cabinets. Small vessels could be stored in dedicated 90 min rated flammable cabinet.

## **Procedure:**

# **Before use:**

1. Ensure that the cylinder is positioned correctly and appropriately secured.
2. Ensure the correct regulator is connected and that its service is in date (see attached BOC tag).
3. Open the gas cylinder valve completely.
4. Adjust the regulator pressure adjusting knob to raise the delivery pressure to the desired value. Do not exceed the maximum delivery pressure indicated by the model number label on the regulator.
5. Open the outlet valve on the regulator to establish gas flow to the system. This valve is used to control the gas flow.

# **While using:**

For temporary shutdown (less than 30‐minute duration), simply close the regulator outlet valve. For extended shutdown (beyond 30‐minute duration):

1. Shut off the gas cylinder valve completely.
2. Open the regulator pressure adjusting knob and the outlet valve to drain the contents of the regulator through the system in use. Both regulator gauges should descend to zero.
3. When using a toxic or other hazardous gas, purge the regulator and system with an inert gas.
4. Close the regulator by rotating the pressure adjusting knob counter-clockwise. Close the outlet valve by rotating the valve knob clockwise. **NOTE: The opposite directions to those stated here should be applied to the valves on flammable gas cylinders.**

# **After use:**

1. Keep regulators turned off when not in use.
2. Do not remove keys or spanners from cylinders that are in use.

## **Disposal:**

Empty cylinders should be labelled as such and returned to the supplier. If not possible, they should be disposed of as hazardous waste. BOC will collect any cylinders that they have supplied.

## **Personal Protective Equipment (PPE):**

Lab coat, appropriate gloves, safety glasses

## **Risk Analysis of SOP and emergency procedures:**

(In addition to [Safe Lab Practice](https://imperiallondon.sharepoint.com/sites/fons/faculty/safety/SitePages/Basic%20Laboratory%20Rules%20for%20All%20Laboratories%20in%20FoNS.aspx))

### **Always remember to include fire associated risks and control measures where appropriate**

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| Hazard | Raw risks | Current control measures | Residual risk(Low/Med/High) |
| Compressed gasses | Explosion, fire, gas release | Ensure cylinders in use have an appropriate regulator for the gas type and pressure and that the regulator is serviced and maintained as per the [Imperial College Code of Practice on Compressed Gases](https://www.imperial.ac.uk/safety/safety-by-topic/laboratory-safety/gases--cryogenics/compressed-gases/).Ensure cylinders of flammable gases (or mixtures) have suitable flash back arrestors fitted. If these are reusable, they must be serviced and maintained as per the manufacturer’s instructions.Those changing regulators on cylinders have to attend the College course on compressed gases and connecting regulators.Ensure all tubing and connections are appropriate and secure to prevent leakage of gases.Secure compressed gas cylinders using an appropriate brace or similar to prevent toppling. Ensure numbers of cylinders in lab areas are kept to the minimum required for the experiment.Ensure that the smallest practicable size of cylinder for the work is used in the lab area.Store compressed gas cylinders away from heat sources, flammable and highly combustible materials (such as oil and greases) and any exit points, and segregated according to hazard class and chemical compatibility. Ensure that flammable and oxidizing gases are separated.Store flammable gases away from flammable solvents, combustible materials, ignition sources (including unprotected electrical connections), and oxygen gas cylinders and liquid oxygen (at least 20 feet if possible). Additionally, follow all substance-specific storage guidance provided in safety data sheet (MSDS/SDS) documentation.Immediately replace any damaged or defective regulator.Keep regulators clean and undertake a visual inspection prior to each use.Do not force any regulator that does not fit and do not attempt ‘home made’ repairs or modifications.Do not use PTFE tape or jointing compounds on regulator threads in an attempt to seal leaks. These are designed to be metal-on-metal connections and if fitted properly should not result in leaks. If a satisfactory connection cannot be made, contact a BOC representative.Regulators must be replaced or refurbished every 5 years (every 2 years for corrosive gases), due to the potential for time-related deterioration of the internal components. | Low |
| Gas cylinders | Risk of injury during manual handling | Compressed gas cylinders must be transported using a suitable trolley that secures the cylinder in place. Trolleys must be 3 or 4 wheel type and of the correct size for the cylinder concerned.BOC can deliver to point of use, avoiding the need for lab users to move the cylinders themselves.Those moving cylinders need to attend the College manual handling course. | Med |

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| **Additional control measures to minimise residual risks** | **Implementation date** |
| Gas regulators designed specifically for the selected gas should be used. Gas regulator only attached by the trained user.The gas and its use must be risk assessed ([compressed gas RA form](http://www.imperial.ac.uk/safety/forms/)). |  |

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| **Who may be harmed** |
| Staff / students [x]  | Cleaners / Engineers [x]  |
| Supporting staff [x]  | Others (specify):  |

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| **Emergency procedures** – describe the response(s) required by the user and lab members |
| If **a cylinder** is dropped or topples during transportation, return to the supplier immediately for inspection with an explanation of the incident.If you discover **a fire** in a room where there are compressed gas cylinders - shut all doors and activate the fire alarm. Inform the Emergency Response Team, Fire Safety Officers or Security of where the fire is and what it involves when they arrive at the building (call 4444 (+44 20 7589 1000)).If there is an **uncontrolled release of gas** from a cylinder - shut off the supply if safe to do so, and evacuate the area. Only allow access to the area after the concentration of gas falls below that which could cause harm.If **crushing injury** occurs - contact first aider immediately – use ice/cool pack (if on hand only) to reduce immediate swelling – seek medical attention if required. |

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| Recommended trainings and records: |
| **LDC training Compressed Gases and Connecting Gas Regulators** [**http://www.imperial.ac.uk/staff-development/safety-training/safety-courses-/compressed-gases-and-connecting-gas-regulators/**](http://www.imperial.ac.uk/staff-development/safety-training/safety-courses-/compressed-gases-and-connecting-gas-regulators/)**The BOC group** [**https://www.imperial.ac.uk/finance/purchasing/recommended-suppliers/by-product-type/lab-supplies/a-z-list-of-lab-suppliers/boc/**](https://www.imperial.ac.uk/finance/purchasing/recommended-suppliers/by-product-type/lab-supplies/a-z-list-of-lab-suppliers/boc/) |

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| List of individuals competent to demonstrate safe work practice and train others (level 1 trainers): | Names of those that have been trained and can work unsupervised (level 2) and date training completed: |
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