# Safe Work Instruction

## Installation, Use and Disconnection of Compressed Gas Cylinders

When installing, using and disconnecting a gas cylinder you must assess the hazards and wear Personal Protective Equipment:

<table>
<thead>
<tr>
<th>Hazard Type</th>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressed Gases</td>
<td>![Icon]</td>
<td>Pressure Hazard</td>
</tr>
<tr>
<td>Explosive Risk</td>
<td>![Icon]</td>
<td>Flammable Gas may be present</td>
</tr>
<tr>
<td>Potential Asphyxiant in case of leak</td>
<td>![Icon]</td>
<td>Oxidizing Gas may be present</td>
</tr>
<tr>
<td>Flammable Gas may be present</td>
<td>![Icon]</td>
<td>Toxic or Corrosive Gas may be present</td>
</tr>
<tr>
<td>No Naked Flames</td>
<td>![Icon]</td>
<td>Authorised Personnel only</td>
</tr>
<tr>
<td>No Oil, Grease or combustible materials</td>
<td>![Icon]</td>
<td>Safety glasses Required to protect against sudden release of gas from cylinder valve and over-pressure safety valves</td>
</tr>
<tr>
<td>Enclosed Footwear</td>
<td>![Icon]</td>
<td>Leather gloves Recommended to protect: + fingers from crush injuries + fingers and hands from sudden release of gas from cylinder valve</td>
</tr>
<tr>
<td>Safety glasses Required to protect against sudden release of gas from cylinder valve and over-pressure safety valves</td>
<td>![Icon]</td>
<td>Hearing Protection On Hand for operating cylinder valve to protect from loud noise due to sudden release of gas from valves</td>
</tr>
</tbody>
</table>

### Warnings:

- **When working with cylinder valves and fittings** **DO NOT:**
  - apply any oils or greases or other combustible substances including liquid or tape sealants or lubricants
  - use ammonia-based leak detection fluids
  - attempt to repair or modify the cylinder valves or safety devices
  - open cylinder valve unless it is connected to regulator

- **Point cylinder valve outlet away from user or other people in the area.**

  The sudden release of pressurized gas from a valve outlet can cause injury eg burns, eye damage, pressure injection into bodily tissue which could create an embolism and the loud noise can damage eardrums,
• Cylinder valves and ball valves need to be opened slowly for flammable and oxidizing gases as the adiabatic compression in the regulator can cause ignition.

• Take care of the gas cylinder DO NOT:
  o heat a gas cylinder above 45°C
  o recompress the gas
  o transfer gases between cylinders
  o use the cylinder as a roller or for storage

• DO NOT empty cylinder completely, leave with a slight positive pressure (eg. 200kPa) and the valve closed to prevent diffusion of air and/or moisture into the system. Mark cylinder as empty.

• Removing fittings under pressure may result in serious personal injury as fittings may be ejected at high velocity.

• For flammable gases:
  o Do not use gas in proximity of sources of ignition eg flames, hot surfaces, sparks from electrical switches or static electricity.
  o Only use gas in well ventilated areas or in a fume cupboard. Flammable gases can be carried by draught through a laboratory area which can bring them into contact with a source of ignition.

**Approval / Competencies / Supervision required**

*Supervisor to demonstrate and instruct on the correct process.*

**Resources / conditions required when using**

- User is competent in the installation and decommissioning of gas cylinders
- Identify the composition and type of gas from the cylinder identification label

- Consult the SDS for the properties and hazards of the gas
- Appropriate storage infrastructure is in place and the gas reticulation system is suitable (SOP 1 sections 5 & 6).
- Assess and put on appropriate PPE *(refer to SOP 1 and Risk Assessment)*
- When handling Toxic and Pyrophoric gases do not work alone.

**Installation at storage location:**

- **Cylinder must be stored away from:**
  o heat sources
  o minimum 50 cm from ignition sources (includes pipework) for flammable or oxidizing gases and other gases where practical
  o areas with potential for mechanical damage
  o any electrical device/circuit which could inadvertently pass current through the cylinder *(may seize the valve or create an explosion)*

- **Mount gas cylinder upright in wall brackets of appropriate size and height. Secure with safety straps/chain.**
• Gas cylinder must be undamaged, with the over-pressure safety valve in good condition and cylinder clearly labelled (with the label visible).

Over-pressure safety valves

• Direct the over-pressure safety valve away from any barrier or other gas cylinders
• The temperature and test tag on the cylinder must not be distorted and must be within the test date.

Temperature and Test Tag

Instructions – step by step
Connecting the Gas Cylinder to the Regulator:

1. Before starting, ensure the cylinder valve is closed:

2. Remove the valve protection cover and the valve outlet cap/plug
3. Valve outlet must be free of mechanical damage and not contaminated by oil, grease, dust or moisture.
   Use a fluorescent light to check for grease or oil for oxygen or oxidizing gas cylinders.
4. Use a clean, dry, oil, grease and lint-free cloth to remove any contamination.
   DO NOT ‘crack’ the valve to blow away loose material or use compressed air as this can result in contamination of the cylinder contents.
5. The pressure regulator must be less than 5 years old, well maintained and suited to the gas and the inlet and outlet pressure.
   Read the manufacturer's instructions.

Single Stage Regulator
1. Pressure regulator inlet spigot thread needs to match that of the cylinder valve outlet. *Flammable regulators are fitted with left-hand threads and non-combustible gases with right-hand threads. Some countries use different thread systems.*

2. Regulator connections must be clean (as with the cylinder valve) and the O-ring or seal in place and in good condition.

3. Screw out the regulator knob (anti-clockwise) so there is no flow through the regulator and close the regulator outlet valve.

A. **GAS IN CYLINDER IS INERT:**

1. Carefully thread the pressure regulator on by hand and then use only a fraction of a turn with a regulator spanner to achieve a gas tight seal. Connect the gas system to the regulator outlet connection.

2. Connect the regulator to the gas supply system.

3. Purge and Leak test the regulator and gas system

B. **GAS IN CYLINDER IS either TOXIC, FLAMMABLE, OXIDISING PYROPHORIC:**

1. The cross-purge tee must have the same thread as the regulator and the cylinder valve

2. Carefully thread the gas supply inlet of the cross-purge tee to the cylinder valve by hand and gently tighten with a regulator spanner. 

3. Carefully thread the pressure regulator on to the cross-purge tee by hand and then use only a fraction of a turn with a regulator spanner to achieve a gas tight seal. Connect the gas system to the regulator outlet connection.

4. Attach an inert gas supply to the purge gas inlet

5. Purge and Leak test the regulator and gas system

---

**Purging the Regulator and Gas Supply System using the Dilution Purging Method:**

A. **GAS IN CYLINDER IS INERT:**

1. Locate a tee with a valve on the side-branch close to the instruments in the gas line between the regulator and the instruments (see figure). Connect the tee to a safety vent.

2. Turn regulator control knob to fully closed. Then close the safety vent valve and the valve near the instruments. Open the regulator outlet valve

3. Open and quickly close the cylinder valve to pressurize the inlet side of regulator.

4. Turn the regulator control knob to provide appropriate delivery pressure and open the vent valve to bleed off the regulator pressure

5. Repeat the purge cycle 3- 5 times to ensure regulator and connecting line are properly purged.
B. GAS IN CYLINDER IS either TOXIC, FLAMMABLE, OXIDISING, PYROPHORIC:

Use the cross-purge configuration and purge with an inert gas (eg. Nitrogen)

1. Vent needs to be piped to an area with local exhaust ventilation suited to the gas type (see SWI 4)
2. Turn regulator control knob to fully closed. Close the vent valve and the valve near the instruments. Open the regulator outlet valve.
3. Open and quickly close the purge gas inlet valve to pressurize the inlet side of the regulator.
4. Turn the regulator control knob to provide appropriate delivery pressure and open the vent valve to bleed off the regulator pressure.
5. Repeat the purge cycle 3-5 times to ensure regulator and connecting line are properly purged.

The oxygen content of gas supply systems prior to the introduction of flammable gas should not exceed 1%v/v

Leak Testing:

- **Note:** For Toxic, Flammable, Oxidizing and Pyrophoric Gases the leak test needs to be conducted with inert gas (eg. Nitrogen) in the gas supply system. Some gases eg hydrogen and helium are extremely penetrative and will leak through joints that have proved leak tight with nitrogen.

- **A leak may be indicated by a hissing sound, a smell or the regulator gauge pressure dropping when the cylinder valve is closed in a closed system.**

1. Leak test the regulator and gas system using leak detection fluid (an oil free bubble solution) or a gas leak detector. Carefully check all joints at working pressure. *If using oxygen or an oxidizing gas use a compatible leak detection fluid to avoid spontaneous ignition*
2. If there is bubbling or foaming of the leak detection fluid, a leak has been detected. Depressurize the system back to atmospheric pressure and then tighten the connections
3. Wipe the joints dry with a clean lint-free cloth after completing the check

Once purged and leak-tight, the system is ready for operation

Using the gas:

1. Screw out the regulator knob (anti-clockwise) so there is no flow through the regulator and close the regulator outlet valve.
2. Open the cylinder valve slowly in an anti-clockwise direction. The gas cylinder pressure will be shown on gauge 2. Opening the cylinder valve quickly can damage the regulator. *The valve needs to be opened slowly for flammable and oxidizing gases as the adiabatic compression in the regulator can cause ignition.*
3. Do not leave the cylinder valve fully open, turn back half a turn so as to avoid seizure in an open position.
4. Slowly turn the regulator control knob until the regulator pressure shown on gauge 1 is at the desired level
5. Open the regulator outlet valve to allow gas into the gas supply system

When finished use:

1. Close the regulator valve and then close the cylinder valve slowly.
2. Keep cylinder valve closed when not in use. If cylinder is not connected to a gas system, replace the valve cap.

*If cylinder is in a laboratory area and not in use, disconnect the cylinder and move to a designated gas storage area or arrange return to supplier.*
Disconnecting the gas cylinder from the gas supply system:

1. Ensure the gas cylinder valve is closed
2. Ensure any remaining pressure downstream of the cylinder valve is released by slowly opening the outlet valve on the regulator and watching that the pressure gauges on the regulator fall to zero
3. Close the regulator control valve
   Shut the gas system down and purge the gas system using the dilution purging method. Purging of the gas supply system with inert gas is required for toxic, flammable, pyrophoric and oxidizing gas.

   **Flammable gas systems need to be purged until the concentration of flammable gas in the purge gas is less than 25% of the Lower Explosion Limit.**
   **Toxic gases need to be purged to ensure that if the piping is disconnected that the concentration of the Toxic gas would not be a health hazard i.e. the concentration needs to be below the Time Weighted Average in the SDS**

4. Disconnect the regulator from the supply system, fit a protective cap to the supply point connection to prevent contamination
5. Disconnect the regulator from the gas cylinder
6. Leak check the gas cylinder valve outlet and refit the valve plug/cap and any valve protection device if provided.

**Emergency Shutdown:**
See SWI Emergency Procedures for Situations with Gas Cylinders

**First Aid:**

**Clean up and Waste Disposal**
See SWI Waste gas and Gas Cylinder Disposal

**Other related procedures and supporting documents**

- AS4332:2004(AMT1 2016) The storage and handling of gases in cylinders
- DR AS2243.2:2018 Safety in Laboratories Part 2: Chemical Aspects
- AS2243.6:2010 Safety in Laboratories Part 6: Plant and equipment aspects
- Flowchart Gas cylinder requisition, installation, use, maintenance & disposal
- Risk Assessment Compressed gas cylinder use
- Guideline Evaluation of atmospheric risk from gases in enclosed workspaces
- Atmospheric risk analysis tool
- SOP Infrastructure requirements for compressed gas cylinders
- SWI Transport of gas cylinders
- SWI Installation, use and disconnection of compressed gas cylinders
- SWI Safety inspection and maintenance for compressed gas cylinders and lab infrastructure
- SWI Waste gas and of gas cylinder disposal
- SWI Emergency procedures for situations involving gas cylinders
- Checklist Installation of gas cylinders

**BOC Australia Guidelines for Gas Cylinder Safety,** viewed 24 October 2018

**Scott Specialty Gases ‘Gas system design +safety handbook’** viewed 30 November 2018

**Matheson Tri.Gas ‘Instruction manual Purging high purity gas delivery systems’** Viewed 30 November 2018
[https://www.mathesongas.com/pdfs/litCenter/InstructionManuals/Instructions-Purging.pdf](https://www.mathesongas.com/pdfs/litCenter/InstructionManuals/Instructions-Purging.pdf)

**British Compressed Gas Association ‘Code of Practice 18: The safe storage, handling and use of special gases’** Rev 3 2014, viewed 30 November 2018

### ASSESSED AS COMPETENT:

<table>
<thead>
<tr>
<th>Name/Position</th>
<th>Date</th>
<th>Assessor:</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: