Chemical Risk Management Protocol

Safe Methods of Use (SMOU)

UN Class 2 Gases

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1 Purpose

This Safe Method of Use (SMOU) applies to principal investigators (PIs), laboratory managers, designated laboratory person (DLPs), and all staff and students who direct or participate in the use of UN Class 2 gases at the University of Auckland.

2 Disclaimer

Safety Data Sheet (SDS) Databases should be consulted for specific information about the compound you will be using. Gold FFX SDS Database is available on the Library database. Instructions on how to source this information can be found on the Health, Safety and Wellbeing Databases website:

https://www.auckland.ac.nz/en/health-safety-wellbeing/health-safety-topics/laboratory-safety/chemical-safety/databases.html

Please read this SMOU in conjunction with the Chemical Risk Management Guidelines.

Note: 'Shall' denotes a mandatory requirement and 'should' denotes a recommendation.

3 Classification

This SMOU covers the use of UN Class 2 gases. In the other chemical classification systems of NZ, this includes:

HSNO classes 2.1.1 (flammable gases), 2.1.2 (flammable aerosols)

GHS7 classes flammable gas, aerosol, compressed gas, liquified gas, refrigerated liquefied gas, dissolved gas

4 Incompatibilities

Flammable gases and aerosols shall be stored and used away from sources of ignition.

Flammable gases and aerosols shall not be stored with HSNO Class 3 Flammable Liquids, HSNO Class 4 Reactive Solids, HSNO Class 5.1 Oxidising Agents or HSNO Class 5.2 Organic Peroxides.

5 General Precautions for Storage and Use of Compressed Gases

- The number of cylinders in a workshop or laboratory shall be kept to a minimum to minimise the fire and toxic risk, and empty cylinders should be removed promptly.
- Gas cylinders shall be stored secured to a wall or immovable object- preferably with an upper and lower restraining chain.
- Never drop a cylinder or allow cylinders to strike each other violently. Avoid dragging, rolling or sliding cylinders.
- When moving cylinders it is recommended to wear PPE including safety shoes, gloves to protect hands from pinching/cutting injuries and to improve grip, and safety glasses to protect eyes from unexpected pressure release.
- Cylinders of liquefied gas (ammonia, carbon dioxide, chlorine, nitrous oxide, acetylene) shall always be stored and used vertically.
- Cylinders shall be transported by means of a suitable hand trolley. Free standing cylinders are not permitted. Gas trolleys shall not be used as stands.
- Never tamper with safety devices in valves or cylinders.
- Cylinder regulators shall be checked periodically and serviced particularly if corrosive or toxic gases are being used.
- Where a cylinder key is used to open a cylinder valve, the key shall be kept with the gas cylinder.
- Cylinder valves should be opened slowly to prevent damage to the regulator, or in some cases, compression heating within the regulator.
- Never allow cylinders to reach a temperature greater than 50 degrees.
- Never use grease on threads which may come in contact with any gases.
- Valves should open with hand pressure using a standard key. If the valve fails to open return the cylinder to the supplier as faulty. Do not use excessive leverage or hammers to open the valve.

- The valve outlets for combustible gases are screwed left-hand and those for non-combustible are screwed right-hand to avoid the dangers that could arise by the interchange of cylinders during use.
- Flash back arrestors shall be fitted to valves carrying flammable gases to a flame eg: oxy-acetylene welding equipment or flame spectrophotometer.
- Do not position cylinders where they may become part of an electrical circuit. In arc welding operation, precautions shall be taken to prevent an arc striking the cylinder.
- To ensure cylinder valves can be quickly turned off, cylinder keys shall be present on cylinders of toxic and flammable gases when the gas is in use.
- Cylinders shall be turned off when not in use.
- Faulty cylinders shall be returned immediately to the gas supplier!

6 Precautions for Specific Gases

Corrosive/toxic/flammable gas inventories shall be reviewed regularly.

6.1 Acetylene

- Cylinders shall always be stored in an upright position.
- Only approved regulating valves shall be used.
- Pipe fittings employing copper or copper alloys shall not be used - this reduces the risk of formation of potentially explosive copper acetylides.
- Flashback arrestors shall be fitted on acetylene tanks used in welding operations or flame spectrophotometers.
- Pressure in any piped acetylene system shall not exceed 1.6 bar and the system shall be fitted with flashback arrestors. If oxygen is piped into the system, oxygen cylinders shall also be fitted with flash back arrestors.

6.2 Carbon dioxide

- Cylinders shall always be stored in an upright position.
- Carbon dioxide is an asphyxiant. Check all fittings for leaks.

6.3 Hydrogen

- Flashback arrestors shall be employed when hydrogen gas is supplied to a flame.
- Cylinder valves should be opened slowly to prevent static discharge which could cause ignition.
- Cylinder key/Operating device shall be attached to gas cylinder when in use so that the cylinder can be closed and isolated rapidly.
- Cylinders will always be closed/isolated at valve when not in use.

6.4 Toxic Gases (including Carbon Monoxide, Hydrogen Cyanide, Hydrogen Sulfide)

- Specific protocols recommended in Safety Data Sheets (SDS) shall be followed when using these gases.
- A fume hood shall be employed to store and use small cylinders of toxic gases. Note that the mandatory requirement to store cylinders in a fume hood applies to cylinders that have a regulator attached.
- Closed cylinders with no regulator attached may be stored outside a fume hood in a well-ventilated area.
- Cylinder key/operating device shall be attached to gas cylinder when in use so that the cylinder can be closed and isolated rapidly.
- Cylinders will always be closed/isolated at valve when not in use. This is particularly important for acid gases which could cause premature failure of regulator.
- Larger bottles of flammable gas shall be stored and used in rooms with adequate ventilation so that in event of leak (a leak lasting longer than 12 hours) the level of gas never exceeds 10% of the Lower Explosion Limit or the TLV (Threshold Limit Value) for that gas.

6.5 Oxygen

- An oxygen-enriched atmosphere dramatically increases fire risks and increases the risk of explosions in the event of a fire.

- Never use grease or oils on valves, regulators or gas lines encountering oxygen gas.

6.6 Chlorine Gas

- Shall never be stored or used near any UN Class 4 solid or hydrogen, acetylene methane or acetylene gas.
- A fume hood shall be employed to store and use chlorine gas.
- Cylinder key/operating device shall be attached to gas cylinder when in use so that the cylinder can be closed and isolated rapidly.

6.7 LPG cylinders

A number of restrictions apply to the use of LPG inside buildings. Please contact the Hazards and Containment Manager for more information.

7 Storage

- Compressed gas shall be stored in cool dry atmosphere with adequate ventilation.
- Lecture size bottles of toxic or corrosive gas shall be stored in a fume hood when a regulator is attached to the cylinder.
- Larger bottles of flammable gas shall be stored and used in rooms with adequate ventilation so that in event of leak (a leak lasting longer than 12 hours) the level of gas never exceeds 10% of the Lower Explosion Limit or the TLV (Threshold Limit Value) for that gas. Note this also applies to Oxygen.
- Gas inventories inside the laboratory should be kept to a minimum - no more than 2 cylinders of the same gas should be attached to any single analytical machine.

8 Limits on storage time

- Ethylene oxide should not be stored longer than 6 months.
- Corrosive gas inventory shall be reviewed regularly and bottles older than 4 years old shall be disposed.

- For other gases, gas inventory should be regularly reviewed as significant costs are associated with gas cylinder rental.

9 Regulators

Only regulators compatible with gas shall be used (contact BOC Gases if you are unsure whether the regulator is suitable).

Regulators used with corrosive gases shall be overhauled or replaced every 2 years.

10 Procurement and Disposal

Specific regulations govern the construction, testing and filling of gas cylinders. Unless there is a very compelling reason for purchasing cylinders, use hire cylinders for gas suppliers.

Return all surplus gas cylinders promptly to your gas supplier.

11 Cryogenic Liquids

Refer to the Safe Method of Use for Cryogenic Materials

12 Emergency Procedures

Leaking Lecture Bottles: If safe to do so, place bottle in fume hood. Otherwise evacuate the area immediately.

Flammable or toxic gas leak from cylinders larger than D size: Evacuate the area immediately.

Nitrogen Gas Leak: Nitrogen is an asphyxiant. DO NOT enter the room.

Appendix 1: General Instructions For Hooking Up A Cylinder

Preparation for use

- Cylinder should be free of oil, grease or other combustibles.
- Confirm cylinder valve matches.
- Regulator connection - make sure regulator valve is off.
- Remove disposable seal and discard.

Cylinder hook-up

- Open and close valve momentarily to blow away any grit or foreign matter, making sure the handler's face is averted and appropriate protective equipment is worn (Do NOT do this with hydrogen or toxic gases).
- Ensure the connection on the manifold or regulator is clean.
- Ensure that the correct regulator is selected – cylinders containing flammable gases have a different thread to prevent incorrect regulator being attached.
- Attach regulator using only reasonable force to tighten and ensure regulator is closed.
- The cylinder valve can now be opened SLOWLY.
- Open the valve fully and then close 1/4 turn to enable subsequent users to determine open or closed.

After use

- Cylinder valves should always be closed after use.
- Use only sufficient force to close cylinder valves.
- Ensure valve blanking nuts, where fitted, are refitted to the empty cylinder.
- Never leave an empty cylinder connected to a process.

Leak Detection

- Locate leaks by brushing areas with oxygen-compatible leak detection fluid and watch for bubbles.

- Leaks may occur at the connection between the valve and the yoke on oxygen cylinders.
- Verify by closing the cylinder and note fall in pressure.
- Remedy - tightening connection to the valve or replace the Bodok washer (for oxygen cylinders).
- Never use sealing or jointing compounds to cure leaks.

Appendix 2: Examples of Classification of Gases

Flammable Gases

- Acetylene, dissolved
- Butadienes, inhibited
- Butane
- Butylene
- Carbon monoxide
- 1-Chloro-1,1-Difluoroethane (Refrigerant Gas R 142b)
- Cyclopropane
- Deuterium, compressed
- 1,1-Difluoroethane (Refrigerant gas R 152a)
- Dimethyl ether (methyl ether)
- Dimethylamine, anhydrous
- 2,2-Dimethylpropane
- Ethane
- Ethyl Chloride (chloroethane)
- Ethylamine
- Ethylene Oxide
- Ethylene
- Ethyl methyl ether
- Hydrogen, compressed
- Hydrogen cyanide
- Isobutane (2-methylpropane)
- Isobutylene (2-methylpropene)
- Methane
- Methyl Chloride (Refrigerant R 40)
- Methyl Fluoride (Refrigerant R 41)
- Methylamine (monomethylamine)
- Methoxyethane (methyl ethyl ether)
- Petroleum Gases, liquefied
- Propane
- Propylene (propene)
- Silane, compressed Silicon Tetrahydride, monosilane, silicane, silicon hydride
- 1,1,1-Trifluoroethane (Refrigerant Gas R 143a)
- Trimethylamine, anhydrous
- Vinyl Bromide, inhibited bromoethylene
- Vinyl Chloride, inhibited or Vinyl Chloride, stabilised

Oxidising Gases

- Chlorine gas
- Nitrous oxide
- Oxygen

Toxic Gases

- Ammonia, anhydrous
- Boron Trichloride (trichloroborane)
- Boron Trifluoride
- Carbon Monoxide
- Carbonyl Sulphide
- Chlorine
- Dinitrogen tetroxide
- Ethylene Oxide or Ethylene Oxide (oxirane)
- Hexafluoroacetone (hexafluoro-2-propanone)
- Hydrogen Bromide (anhydrous hydrobromic acid)

- Hydrogen Chloride (anhydrous hydrochloric acid)
- Hydrogen cyanide
- Hydrogen iodide, (anhydrous hydroiodic acid)
- Hydrogen sulphide (dihydrogen sulfide, sulfur hydride)
- Methyl Bromide (halocarbon 40b1)
- Methyl Mercaptan (methanethiol)
- Nitric Oxide and Nitrogen Dioxide Mixture)
- Nitrogen dioxide (nitrogen peroxide)
- Nitrosyl Chloride
- Phosgene (carbonyl dichloride oxide, carbon oxychloride, diphosgene)
- Phosphine hydrogen phosphide (phosphorus trihydride)
- Silicon Tetrafluoride, compressed (tetrafluorosilane)
- Sulphur Dioxide (sulfurous anhydride, sulfurous oxide)
- Sulphuryl fluoride