Safe Method of Use 9
HSNO Class 2 Gases

Purpose: This Safe Method of Use applies to **principal investigators (PIs), sector managers, designated laboratory person (DLPs)**, technical staff and students who use laboratories within the University of Auckland.

A. Incompatiblities

Flammable Gases ***shall*** be stored and used away from sources of ignition.

Flammable Gases ***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.

B. General Precautions for Storage and Use of Compressed Gases

- The number of cylinders in a workshop or laboratory ***must*** be kept to a minimum to minimise the fire and toxic risk, and empty cylinders are to be removed promptly

- Gas cylinders ***must*** 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

- Cylinders of liquefied gas (Ammonia, carbon dioxide, chlorine, nitrous oxide, acetylene) ***must*** always be stored and used vertically.

- Cylinders ***must*** be transported by means of a suitable hand trolley. Free standing cylinders are not permitted. Gas trolleys ***must not*** be used as stands

- ***Never*** tamper with safety devices in valves or cylinders.

- Cylinder regulators ***must*** 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 ***must*** 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 must 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 off.*

Faulty cylinders must be returned immediately to the gas supplier!

C. Precautions for Specific Gases

Corrosive/toxic/flammable gas inventories must be reviewed regulary!

Acetylene

- Cylinders ***must*** always be stored in an upright position.
- Only approved regulating valves ***shall*** be used.
- Pipe fittings employing copper or copper alloys must 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 must not exceed 1.6 bar and the system must be fitted with flashback arrestors. If oxygen is piped into the system, oxygen cylinders must also be fitted with flash back arrestors.

Carbon dioxide

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

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.

<u>Toxic Gases (including Carbon Monoxide, Hydrogen Cyanide and Hydrogen Sulfide)</u>

- 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
- A fume hood ***shall*** be employed to store and use of chlorine gas. 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.

<u>Oxygen</u>

- Oxygen atmosphere dramatically increase 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 coming in contact with oxygen gas.

<u>Chlorine Gas</u>

- Must ***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 of chlorine gas. 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.
- 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.

D. 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.

E. Maximum Quantities

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

F. 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 ***must*** be disposed.

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

G. 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.

H. 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.

I. Cryogenic Liquids

- Refer to specific Safe Method of Use for Cryogenic Liquids

J. Emergency Procedures

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

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

3. 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 handlers 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 nut's, 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 e.g. 1% Teepol in water 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: 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 and Carbon Dioxide mixture with more than 9% but not more than 87% ethylene oxide
Ethylene, compressed ethene
Ethylene, refrigerated liquid ethene
Ethyl methyl ether
Hydrogen, compressed
Hydrogen cyanide
Isobutane 2methylpropane
Isobutylene 2 methylpropene
Methane, Compressed or Natural Gas, Refrigerated Liquid with high methane content
Methane, Refrigerated Liquid or Natural Gas, Refrigerated Liquid with high methane content
Methyl Chloride (Refrigerant Gas R 40) Chloromethan
Methyl Fluoride (Refrigerant Gas R 41)
Methylamine, anhydrous 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

Non-flammable, Non-toxic Gases

Air, compressed
Argon, compressed

Argon, Refrigerated Liquid
Carbon Dioxide
Chlorodifluoromethane (Refrigerant gas R 22) freon22
Chlorodifluoromethane and Chloropentafluoroethane mixture
with fixed boiling point, with approximately 49% chlorodifluoromethane
(Refrigerant Gas R 502)
Chloropentafluoroethane (Refrigerant Gas R 115) amyl chloride, pentyl
chloride
Chlorotrifluoromethane (Refrigerant gas R 13) freon 13
Chlorotrifluoromethane and Trifluoromethane Azeotropic Mixture
with approximately 60% chlorotrifluoromethane (Refrigerant Gas R 503)
Dichlorodifluoromethane (Refrigerant gas R 12)
Dichlorodifluoromethane and Difluoroethane Azeotropic Mixture
with approximately 74% dichlorodifluoromethane (Refrigerant Gas R 500)
1,2-Dichloro-1,1,2,2-Tetrafluoroethane (Refrigerant Gas R 114) freon114
Difluoromethane (Refrigerant Gas R 32)
Helium, compressed
Helium, Refrigerated Liquid
Heptafluoropropane (Refrigerant Gas R 227)
Hexafluoroethane, Compressed (Refrigerant Gas R 116, compressed) freon
116
Neon, compressed
Nitrogen, compressed
Nitrogen, Refrigerated Liquid
Nitrous Oxide
Octafluoropropane (Refrigerant Gas R 218)
Oxygen, compressed
Oxygen, refrigerated liquid liquid oxygen
Pentafluoroethane (Refrigerant Gas R 125)
Refrigerant Gas R 404A
Refrigerant Gas R407C
Sulphur Hexafluoride
1,1,1,2-Tetrafluoroethane (Refrigerant Gas R 134a)
Tetrafluoromethane, compressed (Refrigerant Gas R 14, compressed)
Trifluoromethane (Refrigerant Gas R 23) fluoroform, freon-23
Trifluoromethane, Refrigerated Liquid fluoroform, freon-23
Xenon, compressed

Toxic Gases

Ammonia, anhydrous
Boron Trichloride (trichloroborane)
Boron Trifluoride
Carbon Monoxide, compressed
Carbonyl Sulphide
Chlorine
Dinitrogen tetroxide
Ethylene Oxide or Ethylene Oxide with Nitrogen up to a total pressure of 1
Mpa (10bar) at 50oC ethoxyethane (oxirane)

Hexafluoroacetone hexafluoro-2-propanone
Hydrogen Bromide (anhydrous anhydrous hydrobromic acid)
Hydrogen Chloride (anhydrous hydrochloric acid)
Hydrogen cyanide
Hydrogen iodide, anhydrous
Hydrogen sulphide (dihydrogen sulfide, sulfur hydride)
Methyl Bromide (halocarbon 40b1)
Methyl Mercaptan (methanethiol)
Nitric Oxide and Dinitrogen Tetroxide Mixture (Nitric Oxide and Nitrogen Dioxide Mixture)
Nitrogen dioxide (nitrogen peroxide)
Nitrosyl Chloride
Phosgene carbonyl dichloride (carbon oxychloride, diphosgene)
Phosphine hydrogen phosphide (phosphorus trihydride)
Silicon Tetrafluoride, compressed (tetrafluorosilane)
Sulphur Dioxide bisulfite (sulfurous anhydride, sufurous oxide)
Sulphuryl fluoride