SAFE METHOD OF USE
HSNO CLASS 2 GASES

Flammable Gases Subclass 2.1.1

HSNO Class 2

Flammable Gas & Compressed Gas

	2.1.1A Flammable gases 2.1.1B Flammable gases	High hazard, extremely flammable gas Medium hazard, flammable gas
	2.1.2A Aerosols	Extremely flammable aerosol
	Gases under pressure, not otherwise Hazardous	Gas under pressure; may explode if heated

Threshold Criteria for Flammable Gases
Any gas or gas mixture which is sufficiently flammable to be able to be ignited when mixed with air in a proportion within a flammable range for that substance, at 20°C and at a pressure of 101.3 KPa absolute pressure, is a flammable gas.

Classification of Flammable Gases
There are two categories for flammable gases that exceed the defined threshold:
(i) Category A (high hazard) classification 2.1.1A
Any gas or gas mixture, which at 20°C at a pressure of 101.3 kPa absolute:

- is ignitable when in a mixture of 13% or less by volume with air; or
- has a flammable range with air of at least 12%, regardless of the lower flammability limit.

[Flammability should be determined by tests or by calculation in accordance with methods adopted in section 5, ISO 10156: 1996).]

(ii) Category B (medium hazard) . classification 2.1.1B
Any gas or gas mixture, other than those of high hazard (classification 2.1.1A), that at 20°C and a pressure of 101.3 kPa absolute, is sufficiently flammable to be capable of ignition when mixed with air in a proportion within any flammable range.

Examples:
Liquefied petroleum gas has, at 20°C and a standard pressure of 101.3 kPa, a lower flammable level in air of 2% and an upper flammable level in air of 9%. Therefore it is a Class 2.1.1A flammable gas according to the criteria above.

Ammonia has a lower flammable level in air of 16% and an upper flammable level in air of 25%. Therefore it is a Class 2.1.1B flammable gas according to the criteria above.

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

- Gas cylinders MUST be stored secured to a wall or immovable object preferably with an upper and lower restraining chain.

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

- Never drop a cylinder or allow cylinders to strike each other violently. Avoid dragging, rolling or sliding cylinders

- Never tamper with safety devices in valves or cylinders.

- 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 centigrade.

- 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.

- 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.

Always turn a cylinder off when not in use

Faulty cylinders must be returned immediately to the gas supplier!

C. PRECAUTIONS FOR SPECIFIC GASES

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.

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

- At least one other person shall be present when working with these gases.
- Specific protocols recommended in Safety Data Sheets (SDS) MUST be followed when using these gases.
- A fume hood shall be employed to store and use of toxic gases.

- For gases such as Carbon monoxide, at least one other person is present when working with this gas.

Oxygen

- 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.

Chlorine Gas

- Must NEVER be stored or used near any HSNO Class 4 solid or hydrogen, Acetylene, methane or acetylene gas.

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

D. STORAGE

- Compressed gas shall be stored in a cool dry atmosphere with adequate ventilation.

- Lecture size bottles of toxic or corrosive gas shall be stored in a fume hood.

- Larger bottles of flammable gas shall be stored and used in rooms with adequate ventilation so that in event of a leak (a leak lasting longer than 12 hours) the level of gas never exceeds 10% of the Lower Explosion Limit or the WES (Workplace Exposure 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 Property Services for more information.

F. LIMITS ON STORAGE TIME

- Ethylene oxide should not be stored longer than 6 months.

- Corrosive gas inventory must be reviewed regularly and bottles older than 4 years old must be disposed.

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

G. DISPOSAL

Specific regulations govern the construction, testing and filling of gas cylinders. Return all surplus gas cylinders to your gas supplier.

H. CRYOGENIC LIQUIDS - LIQUID NITROGEN

- Liquid nitrogen has a boiling temperature of -169 degrees Celsius. It is capable of inflicting severe burns.

- Nitrogen is also an asphyxiant. One litre of liquid nitrogen will form 683 litres of nitrogen vapour. NEVER store vessels containing liquid nitrogen in rooms.

- Full face shield must be worn when decanting or using liquid nitrogen.

- Loose gloves of material impervious to liquid nitrogen must be worn when using liquid nitrogen. Porous or fabric gloves must NEVER be worn.

I. 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 1 above .
Evacuate the area immediately.

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

4. Liquid Nitrogen Burn
- Clothing will often remain stuck to skin burnt with liquid nitrogen.
- Do not attempt to remove clothing from the burnt area unless absolutely necessary.
- Cover affected area in warm clothing. DO NOT use warm water.
- Seek medical assistance immediately

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 50^{o}C 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