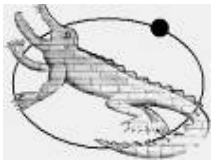


A Code of Practice for Handling Compressed Gases in the Department of Physics

Scope

This code of practice describes the hazards and the measures that should be taken to guard against the risks presented by commercial compressed gases.

Contents

1 Introduction to Compressed Gases

1.1 Gas Packaging

Gases are supplied in cylinders (also known as bottles), the vast majority of which remain the property of the gas supplier. The cylinder is a pressure vessel, and the owner, normally the gas supplier, is responsible for the periodic inspection and testing of the cylinder. The standard gas cylinder is built to a high specification and can be refilled many times. Refilling gas cylinders should only be done by the supplier, please, with the exception of our helium manufacture facility.

We buy the gas that is inside, and pay rental on the cylinder. Therefore, never dispose of any cylinder unless you are absolutely certain that it is your property. It is to our advantage to keep the inventory of gas to a minimum, to reduce the rental costs.

The exception to this is the small bottles; lecture bottles and disposable cylinders. These are bought outright and should be disposed of when finished (note, this can cost hundreds of pounds!). Under no circumstances should refilling be attempted. Since gas supplied in small quantities is inevitably expensive, it is usually more economical in the long run to buy full-sized cylinders for the common gases.

Cylinders are manufactured from a variety of materials – principally steels or aluminium. The cylinders are stamped with various items of information on the shoulder – their date of manufacture, weight, serial number, retest date, etc. They also carry a colour and shape-coded tag around the neck, indicating when the next pressure vessel test is due. You can ignore this, because the pressure vessel test only becomes due when the cylinder is returned for refilling. Sizes vary from tiny lecture bottles up to cylinders around 1.7 m high.

Common cylinder sizes.

Gas cylinders are painted in distinctive colours to aid identification. However, because not everyone is able to see in full colour, and because colour codes are complex and vary from one country to another, the primary means of identification of the contents of the cylinder is by means of the label that is attached to the shoulder of the cylinder. This should always be checked before connecting up the gas. If the label is unreadable, the cylinder should be returned to the supplier.


Manifolded, palleted hydrogen

For high delivery rates, or high capacity, a number of cylinders can be manifolded together. The pipe and connectors are subjected to full cylinder pressure, so it is essential that they are made from materials completely compatible with the gas, and are tested before use. Some gases may be purchased already manifolded together in a cradle.

Many types of gas cylinder have a pressure relief device. These come in three main types:

- Relief valves, which re-seal when the pressure falls to normal
- Bursting discs, which release the entire contents of the cylinder
- Fused plugs, which operate on temperature rise and also release the entire contents.

1.2 Properties of Common Gases

Acetylene

Acetylene is supplied at a pressure of 15 bar (225 lb/in^2) at 15^{o}C. It has a distinctive garlic-like odour, is lighter than air, and can therefore collect in roof spaces. Acetylene is highly reactive and may explode if compressed alone. It is also extremely flammable, with ignition limits from 2.5% to 100%. Cylinders for acetylene

are filled with a porous substance, such as kieselguhr, on which acetone is adsorbed. The acetylene is dissolved in the acetone.

Mechanical shock to the cylinder, or overheating, may cause decomposition of the gas inside, and this may lead to high temperatures inside with possible detonation. The porous mass inside the cylinder is designed to slow down or to prevent the gas from decomposing. The time from initiation to explosion should be several hours. However, it can be much quicker if the mass inside the cylinder has been damaged by, say repeated flashback, mishandling of the cylinder such as dropping, if the valve is leaking or if the pressures are too high.

Acetylene cylinders must always be stored and used in an upright position and the gas should not be withdrawn at a rate exceeding one fifth of the cylinder contents per hour, to avoid withdrawing acetone with the acetylene. Only acetylene regulators are to be used.

If fittings have to be made up for the acetylene supply it is most important to ensure that copper, copper-rich or silver-rich alloys are not used. Copper or silver in contact with acetylene are liable to form dangerously explosive acetylides. Only metals containing less than 70% copper should be used. If fittings are silver-soldered, no more than 0.3 mm width of filler metal should be exposed at the joint, and the filler should not exceed 21% copper or 43% silver.

Attempts to compress acetylene are extremely dangerous, and in general illegal. At pressures over about 1.5 bar, the gas becomes explosive, even in the absence of air or an ignition source. Special permission from the Health and Safety Executive is required to work with pressurised acetylene.

Argon

Argon is an inert gas that is heavier than air. It will readily collect in the bottom of a confined area. It does not support life, and entry into an area deficient in oxygen due to displacement by a gas such as argon can cause rapid loss of consciousness followed by death. Death may occur even for those who have been rescued almost immediately.

Helium

Helium is an inert gas that is significantly lighter than air. In other respects it presents the same hazards as argon.

Hydrogen

Hydrogen is lighter than air, colourless, odourless and non-toxic. It is an explosion hazard and is extremely flammable. Concentrations between approximately 4% and 75% will burn, with a flame that is almost invisible. It has a low ignition energy, and can ignite spontaneously on release from a cylinder at high pressure. For this reason, hydrogen should NEVER be ‘snifted’ or ‘cracked’.

Special care should be taken to use only hydrogen regulators. The same thread is used for the other fuel gases, LPG and acetylene, and so regulators designed for use at a much lower pressure with these gases could be connected accidentally to hydrogen cylinders if personnel fail to check.

LPG and propane

This category includes several gases and proprietary mixtures, such as butane and MAPP® (methyl acetylene propadiene mixture). Propane is supplied in large diameter

red cylinders and stored in liquid form. A propane regulator should always be used. The cylinders must always be stored and used in an upright position, to avoid the discharge of liquid instead of gas. LPG and propane are heavier than air, and can collect in drains and trenches. Vapours can flow along the ground and can be ignited at some distance from the source. They present potential fire, explosion and asphyxiation hazards. Propane is frequently stenched to aid detection.

Nitrogen

Nitrogen is largely inert, but presents an asphyxiation hazard. It is worth remembering that it is responsible for more deaths than toxic gases.

Oxygen

Oxygen is crucial to life, but if present in excess can create a significant fire hazard. Most metals, especially in powdered form, burn in oxygen. Fires in an oxygen-enriched atmosphere (say 23% or more) are extremely difficult to extinguish, and many materials that are not normally flammable become so in an oxygen-rich atmosphere. It is therefore not permissible to use oxygen to 'sweeten' the air, where it is feared that the oxygen level has fallen.

Oils, greases and other organic materials can spontaneously explode on contact with pure oxygen. **Only** oxygen regulators should be used. Pipelines for oxygen service must be thoroughly cleaned before use. Tape, including PTFE, **MUST NOT** be used on fittings.

Oxygen should never be used for driving pneumatic tools, inflating vehicle tyres, cooling or refreshing air in confined spaces, or for dusting down apparatus - it is not a substitute for air.

Light metals, such as aluminium are not suited to oxygen service. The recommended materials include copper, copper alloys and ferrous alloys.

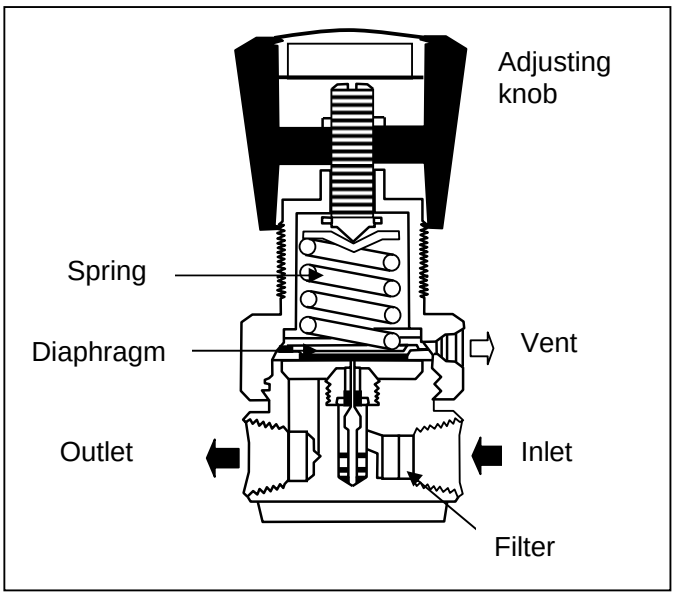
Mixtures

Many gases are supplied as mixtures. At the filling plant, the supplier will have ensured that the gases are well mixed. For permanent gases there is no tendency for gases to stratify in the cylinder due to differences in density. However, if one of the constituents can liquefy when the temperature falls in winter, then it may do so, leading to an inhomogeneous product.

1.3 Regulators

In a **very small** number of cases, generally the withdrawal of vapour or liquid from low pressure liquefied gases such as ammonia and sulphur dioxide, cylinders may be used without any equipment to regulate the pressure or flow.

In all other cases regulators must be fitted to the cylinders to reduce the gas pressure from cylinder pressure to the working pressure of the laboratory equipment.



There are two basic types of regulator – single stage and two-stage. The diagram alongside shows a single stage regulator in cross section. Single stage regulators are cheaper to buy, but it is often difficult to maintain a steady outlet pressure – it tends to rise as the cylinder empties because there is less gas pressure exerted on the valve stem. Two stage regulators (which are of similar construction to two single-stage regulators in series) give a steadier outlet pressure, and a finer control over the outlet pressure.

High pressure gas enters the regulator through the inlet into the high pressure chamber. The adjusting knob, when turned clockwise, compresses the spring and this exerts a force against the diaphragm. This pushes the valve stem open, releasing gas into the low pressure chamber. Equilibrium is reached when the spring force on the diaphragm is equal to the opposing force of the gas in the low pressure chamber. In a two stage regulator the first stage reduces the inlet pressure to a preset intermediate pressure – typically 25 to 35 bar, and then by adjusting the control knob the second stage reduces the intermediate pressure to the desired delivery pressure.

The use of a regulator or other equipment not rated for the pressure of the contents of the cylinder can result in catastrophic failure of these items, and a fatal accident is possible.

NEVER use an adaptor to connect a regulator to a cylinder of the opposite thread. They are opposite threads because the contents are incompatible!

As a precaution against connection of the wrong regulator, the outlet threads of fuel gases are left hand, whereas oxygen and inert gases are right hand threaded. While the outlets are left or right hand thread to prevent connecting the wrong regulator, the user must still check the contents, to ensure that the regulator is suited to the purpose.

Regulators must be built to an approved standard and designed for the gas being used. For instance, using a nitrogen regulator on a helium cylinder may well result in the regulator leaking. Make sure you buy and use a regulator that can deliver the outlet pressure that you need. For special gases such as silane or chlorine, seek the recommendation of the supplier both as to the type of regulator that you should use, but also the material of manufacture.

Oxygen service requires clean equipment. If you use an oxygen regulator for another gas, then it is down-rated, and **must not be used for oxygen again**. Stick a label on it to warn others.

1.4 Flashback or flame arrestors

In applications such as gas welding, there is a risk of 'flashback', where a backfire can propagate a flame back into the hose and it is possible for it to continue back towards the regulator. If it were to reach the acetylene cylinder it might internally fire it, and eventually the cylinder could explode.

Flashback arrestor

A flashback arrestor contains an element that rapidly quenches a flame. These devices also frequently incorporate a pressure or temperature actuated cut-off valve in order to cut off the gas supply.

It is strongly recommended that a flashback arrestor with a cut-off valve is fitted to the pressure regulator outlet of all acetylene cylinders, or to the outlet from an acetylene distribution system. It is also good policy to fit them to the outlets of oxygen and other fuel gas regulators, in welding applications.

It is possible to fit the flashback arrestor at the blowpipe inlet, but it should be borne in mind that this leaves the hose unprotected in the case of a leak that is inadvertently ignited. For long hoses (in excess of 3 m), it is recommended that a flashback arrestor with cut-off valve is fitted at the regulator outlet and a simple flashback arrestor at the blowpipe.

1.5 Non-return valves

Non-return valves are useful for preventing gas from one line flowing back into another when the pressures become unbalanced. These are also highly recommended for welding applications, where it is strongly recommended that non-return valves are fitted to both the gas lines at the blowpipe inlet to reduce the risk of oxygen flowing into the fuel line and vice versa. Older style devices, known as 'hose check valves' or 'hose protectors' rely on a floating plate to stop the flow. These are ineffective at low pressures and should be discarded. Non-return valves complying with BS EN 730 or equivalent should be used.

2 Risk Assessment

2.1 Chemical Hazards Presented by Stored Gases

Gases present a range of hazards, examples of which are:

- Toxic, e.g. ammonia, fluorine and chlorine,
- Corrosive, e.g. fluorine,
- Oxidising, e.g. nitrous oxide, oxygen
- Spontaneously flammable, e.g. silane
- Highly flammable and/or capable of forming explosive mixtures in air, e.g. propane, hydrogen
- Reactive, e.g. fluorine
- Not capable of supporting life, e.g. inert gases, SF_6.

Users should read the manufacturer's safety data sheet, and familiarise themselves fully with the properties of the gas they are using. The properties of the gas will affect the decisions made about location, suitable materials to use, integrity of pipework, gas detection strategies, work procedures, disposal and contingencies.

2.2 Physical Hazards

Fire

The contents of cylinders of flammable gases could present a serious fire hazard if they escape. A serious fire was once caused by an employee dragging an LPG cylinder along the ground – the sparks from the abrasion of the steel against the concrete ignited a cloud of flammable vapour.

Electrical apparatus can provide the spark that can ignite a cloud of flammable gas, causing a fire and/or an explosion.

Cylinders involved in fire in buildings can explode, and for this reason the fire action plans for the site include plans to evacuate personnel to a considerable distance in the event of a real emergency.

Uncontrolled release of pressure

If the regulator fails, the gas is released suddenly with possible fatal consequences, but fortunately failures of regulators that have been purchased to the correct standard, and selected correctly for the service are rare.

Opening the valve causes gas to be ejected at very high pressure, and a risk of injection of gas into the bloodstream if any part of the body is in the gas stream. Gas in the bloodstream can be fatal. The eyes are vulnerable to even a reflected gas jet.

The release of gas under pressure can also create significant levels of noise – sufficient to cause damage to hearing.

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A relatively common accident is breaking off the regulator at the neck or breaking off the main valve at the neck. A typical oxygen cylinder is filled to a pressure of 230 bar, and weighs 60 kg or more. The regulator has a relatively narrow stem where it joins the cylinder. If a gas cylinder is knocked over, with the main valve open, there is a real risk of the regulator shearing off. Likewise, even a closed cylinder, if it is knocked over beside a wall or other obstruction can lose its main valve due to it shearing off. This will cause the cylinder to become rocket-propelled as the gas escapes (Air Products quoted a figure of 0 – 34 m.p.h. in a tenth of a second). There is potential for very serious, or fatal injury. The cylinder is capable of punching through walls.

Manual handling injuries

Cylinders are heavy, and unstable. If a cylinder is dropped it can cause serious leg and foot injuries. Working regularly with gas cylinders can cause hand injuries. Attempts to lift cylinders, or to prevent them from dropping out of control can lead to serious back injuries.

3 Safe Systems of Work with Compressed Gases

3.1 Storage of Compressed Gases

We have a special store set aside for gas cylinders, where a number of safety precautions have been built-in. There is also a dedicated area in the building for the return of empties.

If your group requires its own gas store it is best if the store is out-of-doors. The store should be constructed from fire resistant materials. The floor should be clean, even and well drained. Provision should be made to store full cylinders separately from empty cylinders, and to segregate flammable gases from others either by distance, or using fire-resistant walls. Ventilation should be provided top and bottom so that it is effective both for gases that are lighter than air, and heavier than air. There should be no sump or pit in which heavy gas can accumulate.

If stored in the open, cylinders should be protected against direct sunlight to avoid excessive heating (in the height of the summer in the UK). This may be combined with roofing, again of lightweight construction, to provide protection against rain if the store is outside, or oil drips or spray if the store is within an enclosed workshop. The materials used to construct the shelter should be non-combustible.

Any electrical fitting within the immediate vicinity of the fuel gas store should be of flame-proof construction, to avoid ignition of any accidental escape of gas, see BS EN 60079 part 14. For the same reason, no smoking should be allowed in or near the store. A prominent sign should be erected to remind people of the prohibition.

Advice should be sought from the gas suppliers and from the enforcement authorities if it is intended to create a store inside a building. There are strict rules regarding segregation distances.

Cylinders should be easily placed into, and secured in, racks clearly marked to indicate gas type and whether full or empty. As an alternative, gas cylinders, other than those for acetylene and propane, may be stacked horizontally. The stack should not be more than four cylinders deep, with the large cylinders at the bottom, and they must be safely wedged. Acetylene and propane must always be stored and used in the vertical position.

Other products must not be left in the cylinder store, especially oils, petrol, paints and corrosive liquids.

Adequate access should be available for both the gas supplier's delivery transport and the user's distribution transport. The area should be used for storage of cylinders only and be kept clean and tidy; this can best be done by appointing a responsible person, who can then be trained on action that should be taken in the event of an emergency. A permanent notice

Store area

outside the store should indicate the type and location of all the gas cylinders within, and the name and location of the responsible person.

When not in use the cylinder heads should be protected to prevent damage to the valves. Some cylinder designs have a screw-on cap, but many have a shield permanently secured to the cylinder; this demands no user action, and gas from a leaky valve cannot accumulate inside. This shield should not normally be used for lifting the cylinder.

3.2 Moving Compressed Gases Around the Laboratory

Gas cylinders must be treated with care and not subjected to mechanical damage or falls. If cylinders have to be handled by means of a crane they should be secured in a special carrier, and on no account should an ordinary chain sling, rope or sling, or a magnetic lifting device be employed.

Where cylinders are moved with a fork lift truck, they must be secured so as to avoid rolling off the forks. The valves, too, will be exposed to risk of damage if narrow doorways have to be negotiated, and special care should be taken in such circumstances.

Cylinders must not be lifted by the valve or valve protection cap unless it has been specifically designed for that purpose. To avoid damage to the cylinder, or injury or strain to the person moving them, a trolley should be used. Cylinders should never be transported with the regulator attached, unless it is in a purpose built trolley, and in this case the valve must be shut.

NEVER, NEVER, transport a gas cylinder with its main valve open, even over a short distance.

ALWAYS shut the valve first.

Where portable plant is required the oxygen and fuel gas cylinders are generally housed in a dedicated trolley, which should never be allowed to rest horizontally.

Care is also needed if cylinders are moved by hand. There is guidance for the avoidance of manual handling injuries issued by the British Compressed Gases Association. Cylinders must not be dragged or rolled along the ground.

When handling the gas cylinders, wear protective footwear and industrial gloves. Loose clothing, especially loose sleeves, which can catch on the cylinder valve, should be avoided. 'Milk churning' cylinders is permissible, but it requires practice and should not be used for long distances or on uneven ground. Never try to catch a cylinder that is toppling - let it go.

3.3 Connection and Use of Compressed Gases

Preliminaries

Ensure the cylinder is properly tethered, either to an immovable object, or in the case of oxy-acetylene kit, in its dedicated trolley. Ensure that the cylinder is not too close to any source of heat, such as a furnace.

No screwdrivers! Please use a strap wrench

If the cylinder has a valve cap this should be removed first. DO NOT insert a screwdriver

or other implement in through the holes to do this. Instead, use a chain wrench or constrictor device.

Identify a suitable regulator, of the correct type for the gas. Check the labels and the inlet and outlet gauges, to be sure that it is suitable for the pressure of the cylinder. Before the regulator is fitted, the threads and the seats of the cylinder and the regulator should be inspected. If either is damaged, then it may be difficult to obtain a leak-tight seal. If there appears to be foreign material inside the regulator, do not use it, but contact the manufacturer for service or replacement.

Check the rating of the regulator. It may be written on the body. Check it against the maximum fill pressure of the cylinder.

If the outlet of the cylinder is contaminated by hydrocarbons – oil or grease, then the cylinder must be quarantined, marked as hazardous and returned to the supplier. It is not safe to attempt to remove hydrocarbon contamination yourself.

All equipment for oxygen service (or for other oxidisers) must be scrupulously clean. Any oil or grease can potentially lead to serious accident.

Connection

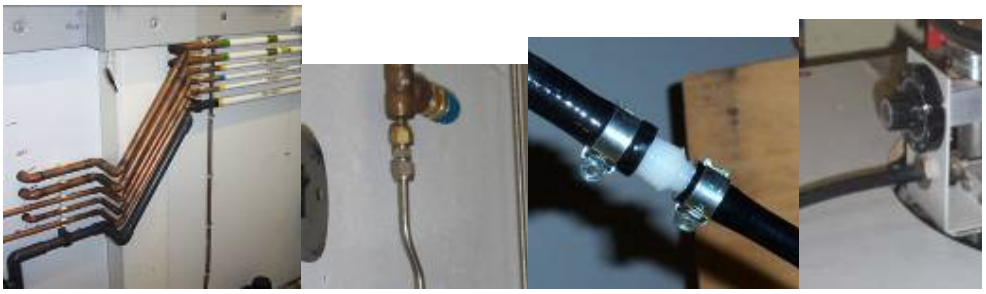
The outlet to the cylinder must be undamaged, clean and dry. Attach the regulator and tighten the inlet nut securely. If it does not seal properly when first connected, then it should be dismantled, the threads and seat cleaned and tried again. Do NOT use tape or other means to try and get a seal. If the regulator does not screw in easily, then do not force it - it is probably the wrong type. Never try to connect a regulator that is left hand thread to a right hand threaded cylinder, or vice versa.

Unions, nuts and connectors should be inspected before use. Faulty seats are liable to lead to leaks and should be discarded. Valves and fittings for all purposes should be kept scrupulously clean, and care should be taken to make certain that no grit or other foreign matter is allowed to remain on them. Attention to this small point will save much trouble arising from leaks, and will prevent the build up of any dangerous concentrations of gas. Care should be taken to avoid leaving any swarf when assembling the system. The assembled equipment should be checked for leaks with a leak-detecting agent.

Fit flashback arrestors, where required.

Pay attention to the integrity of the pipework. High integrity can be obtained by brazing or soldering pipes. A slightly lower degree of integrity can be obtained by the use of good quality dismantleable joints, and the lowest degree of integrity is provided by hose pushed onto straight or tapered fittings and (perhaps!) fastened with bits of wire, jubilee clips, etc. The latter will almost certainly fail at some time, probably when it is extremely inconvenient or even dangerous.

Pipework integrity



Decreasing integrity and reliability

Snifting or cracking

It is common practice to 'snift' or 'crack' cylinders to clean the outlet. This practice consists of briefly opening the main valve of the cylinder, and quickly closing it again. It is a potentially extremely dangerous practice, since the gas is emerging at very high speeds. On no account should a hand or other part of the body be placed in the gas stream. The gas stream can permanently damage the eyes, and gas injected into the body through cuts or other damaged areas can lead to fatal conditions. **Eye protection and gloves** must be worn, and care should be taken that there is no source of heat or ignition nearby.

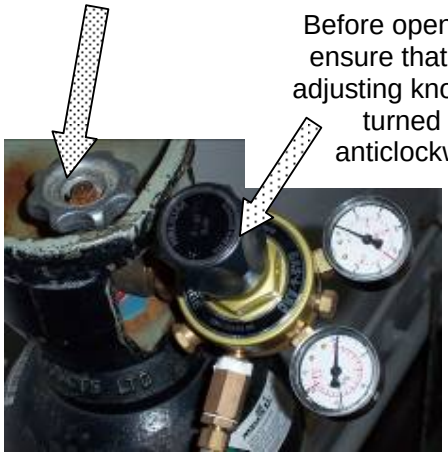
Snifting or cracking is NOT recommended.

Never, never, snift hydrogen, since the emerging gas may ignite spontaneously. **Never snift toxic or pyrophoric gases.** It is therefore recommended that snifting is not used, but that the outlet is cleaned by wiping and/or the use of a low pressure compressed air jet.

Opening the cylinder and adjusting the pressure

Close the regulator by winding the adjusting knob fully anti-clockwise. Then place both hands on the cylinder valve and slowly open it (anti-clockwise), using the hand wheel or a spindle key, depending on the type. Allow the pressure to rise gradually in the regulator, and stand so that the cylinder is between you and the regulator. Wear goggles.

Cylinder valve opened by handwheel



Make sure that, if the valve is key operated, you have a key for each cylinder. You should not open a valve by more than about one full turn. Never leave a valve fully open in case it gets stuck on the back stop and cannot then be closed. In particular, an acetylene valve should never be opened by more than three turns.

Check the diaphragm for creep – leakage of gas from the high pressure side to the low pressure side when the adjusting knob is fully anticlockwise. The regulator should be taken out of service if it creeps.

The pressure is adjusted by turning the adjusting knob clockwise to establish the pressure you require, by referring to the reading on the low pressure gauge. Always make sure that the valve is accessible.

Should a valve, regulator, or any other piece of equipment become frozen in use (e.g. due to high flow rates), it should be thawed out by means of hot (but not boiling) water; no other method should be employed to thaw equipment.

Whenever gas delivery is not required, close the main valve.

Check your regulator, before you use it:

- Is it 'in date'? Reject if not
- Is it suitable for the gas and the inlet and outlet pressure? Reject if not.
- Does the regulator carry BS or BS EN numbers? Reject if uncertain
- Check that the inlet is clean and undamaged – reject if not.
- Check that the gauges are in good condition, lenses attached and that the gauges read zero. Reject if not.
- Check for signs of jointing compound or tape sticking to the inlet or outlet threads – reject if present.
- Check for signs of heat or mechanical damage. Reject if present
- Check that the pressure adjusting screw turns freely – reject if it does not.
- Use the correct spanner for tightening up the inlet connection – do not use excessive torque or a hammer.
- Make sure that the pressure control knob is screwed fully out before opening the cylinder valve.
- Check for leaks.

3.4 Disconnection after use

Close the cylinder valve. Vent the gas in the regulator and/or system. Alternatively isolate the system and vent the regulator. The regulator should be vented by turning the adjusting knob fully clockwise so that no pressure is trapped inside the regulator. This is particularly important for two-stage regulators, which can trap high pressure gas inside the first stage. This trapped gas can vent spontaneously at any time. If the gas inside is flammable, corrosive, toxic or an oxidant, then take suitable measures when venting.

Close the regulator by turning the adjusting knob fully anticlockwise once more. Disconnect the low pressure side. Disconnect the regulator from the cylinder, and put it somewhere were it will not be damaged or get dirty. Replace the cylinder outlet seal and valve cap, if it had one.

NEVER

- Tamper with cylinders or their valves
- Repaint, change the markings or try to disguise damage to a cylinder
- Mix gases in a cylinder, or try to refill them yourself
- Scrap a cylinder that is not your own
- Use a cylinder as a roller or a support
- Pick up cylinders using magnetic devices
- Subject a cylinder to extremes of temperature
- Subject a cylinder to mechanical shock that might damage a valve or safety device.

3.5 Disposal of the Empties

Empty cylinders may be marked with chalk to indicate that they are empty (M/T), and taken to Stores for return to the gas supplier. DO NOT dispose of a cylinder any other way unless you are absolutely certain that it is your property.

Remember – you pay rent for cylinders, so do not keep a cylinder longer than you need, especially if it is a common gas.

3.6 Maintenance and Inspection

Continued safety requires vigilance! Check regularly that cylinders are tethered securely, that regulators are of the correct type, that hoses and connections are in good order.

Flashback arrestors should be replaced every five years. Pressure regulators should be examined thoroughly every five years, and may need to be replaced at that time. Pipework should be examined annually.

All gas systems where there is permanent metal pipework between the cylinder and the apparatus must be on the inspection schedule for our Insurers. Please ensure that Jane Blunt is kept informed about the whereabouts of any new gas lines.

3.7 Transport of Gases in Vehicles

The transportation of any compressed gas cylinder in a vehicle, whether a privately owned vehicle or not, is governed by the Carriage of Dangerous Goods by Road legislation. The rules are complex, but please contact the Safety Officer, who has a handbook that establishes how to do it legally. A University in this region was prosecuted under this legislation (and there were two further charges) after they had an accident with a pressure vessel, overfilled with gas, that they had transported by road.

3.8 Security

Because oxyacetylene equipment is readily portable, it is attractive to thieves and vandals and adequate security measures should be taken. However, sets should <u>not</u> be locked in unventilated storerooms or cupboards overnight. Any gas leak carries a serious risk of fire, and while they are more secure locked in such cupboards, they are a big fire risk. The local electrical equipment is unlikely to be suited to flammable atmospheres, and the emergency services will be unable to gain access to the equipment in the event of a fire breaking out in the building.

Children may tamper with cylinders that are accessible. Cylinders should be locked away if they are sited outside the building, so that the valves and regulators cannot be tampered with.

4 Contingencies

4.1 Fire

If fire does break out in the gas store, the cylinders may eventually explode on prolonged heating. The fire brigade should be alerted immediately (1-999). The buildings around the gas store (Link and Bragg) should immediately be evacuated in the first instance to the assembly areas. Subsequently people will need to go to a place of safety some distance away from the premises.

If it is possible, without taking personal risk, cylinders not immediately involved in the fire, and which have not been heated may be removed to a safe place.

Burning gas should not be extinguished unless the gas flow can be cut off immediately - it is safer to leave flammable gas burning than to risk building up an explosive mixture.

Cylinders that have been involved in a fire must be cooled. They should be sprayed with water from a safe position until the steaming from the surface stops. This is a job for the Fire Brigade. They will then need to be removed to a safe place and the supplier notified so that they may be disposed of safely.

This action is not sufficient in the case of acetylene cylinders, due to the unstable nature of the gas. Acetylene cylinders must be cooled until they remain wet, and then they may be approached to feel the surface of the cylinder. If the surface remains cold for at least one hour then the cylinder may be submerged in water, where it should be left for at least 12 hours before it is removed for disposal.

Should an acetylene cylinder become heated accidentally, or become hot as a result of excessive or severe backfire from the use of faulty equipment, the gas manufacturers recommend that it be dealt with promptly as follows:

‘Shut valve, detach regulator, remove cylinder outdoors at once, spray with water to cool, keep cool with water. Leave outdoors. Advise suppliers immediately, quoting cylinder number where known’.

4.2 Leaks

The valve on a cylinder must NEVER be removed or tampered with at any time. If there is a leak around the valve spindle it can be cured by nipping up with a spanner of the CORRECT size to fit the gland nut. If this fails to work, and the cylinder continues to leak, take it outdoors, provided it is safe to do so, and contact the gas supplier. Mark the cylinder to show that it is faulty. If it is not safe to remove it, consider evacuating the building (this eventuality should have been considered in your risk assessment.)

If a cylinder valve is found to be leaking, and cannot be closed with the application of moderate force, place the cylinder where the leaking gas will disperse safely, and make arrangements to return it to the suppliers, advising them of the problem. If there is a leak from the valve spindle, it is permissible to tighten the valve nut to a moderate extent with a spanner.