

**This leaflet is for people who use  
compressed gases for welding,  
cutting and similar processes.**

**It provides information on the fire  
and explosion hazards.**

**Safety in**

**GAS  
WELDING**

**cutting and  
similar processes**



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## Introduction

Oxy/fuel gas equipment has many uses - welding, cutting, heating, straightening, and descaling. The equipment is versatile, easy to move about and relatively inexpensive. As a result, it is used widely in garages, machine shops, engineering workshops, plant maintenance and construction.

It is so widely used that sometimes people forget about the dangers. Many people are injured each year by the incorrect or careless use of oxy/fuel gas equipment. Some people die.

This leaflet describes the hazards associated with portable or mobile oxy/fuel gas equipment and the precautions for avoiding injury and damage to property. More detailed guidance is given in the publications listed at the end of the leaflet.

# Risk assessment

**E**mployers are legally required to assess the risks in the workplace and take all reasonably practicable precautions to ensure the safety of workers and members of the public. Before using oxy/fuel gas equipment, a careful assessment of the risks should be carried out. This is particularly important if work is being carried out in unfamiliar surroundings.

### **Permit-to-work**

Many companies operate a written permit system for hot work. The permit details the work to be carried out, how and when it is to be done, and the precautions to be taken. A written permit system is likely to result in a higher standard of care and supervision.

Oxy/fuel gas equipment should not be used unless it has been authorised by a suitably experienced manager or supervisor who has knowledge of the site, the work to be carried out, the risks involved and the precautions to be taken.

### **Training**

No one should use oxy/fuel gas equipment unless they have received adequate training in:

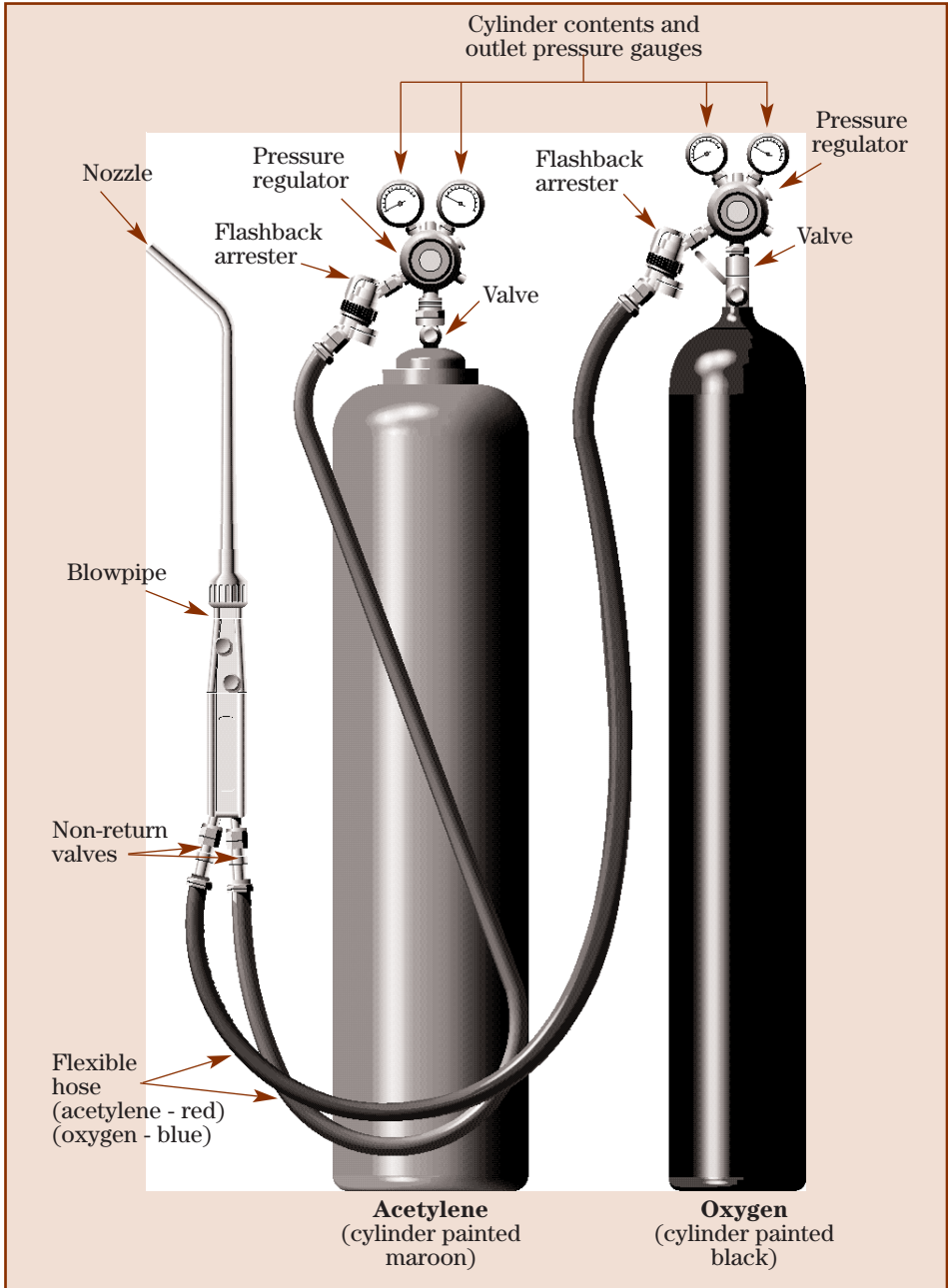
- \* the safe use of the equipment;
- \* the precautions to be taken;
- \* the use of fire extinguishers;
- \* the means of escape, raising the fire alarm and calling the fire brigade.

## Oxy/fuel gas equipment

All oxy/fuel gas processes operate in the same way. A fuel gas such as propane or acetylene is mixed with oxygen in a blowpipe (often called a 'torch') to produce a flame that is hot enough for the purpose.

The main components of oxy/fuel gas equipment are:

- \* cylinders of oxygen and fuel gas (propane or acetylene);
- \* a means to shut off or isolate the gas supply, usually the cylinder valves;
- \* a pressure regulator fitted to the outlet valve of the gas cylinder, used to reduce and control gas pressure;
- \* a flashback arrester to protect cylinders from flashbacks and backfires;
- \* flexible hoses to convey the gases from the cylinders to the blowpipe;
- \* non-return valves to prevent oxygen reverse flow into the fuel line and fuel flow into the oxygen line;
- \* a blowpipe or other burner device where the fuel gas is mixed with oxygen and ignited.



**Figure 1** Typical equipment used in gas welding and similar processes

### Hazards

The main hazards are from fire and explosion. These are caused by:

- \* careless handling of a lighted blowpipe resulting in burns to the user or others;
- \* using the blowpipe too close to combustible material;
- \* cutting up or repairing tanks or drums which contain or may have contained flammable materials;
- \* gas leaking from hoses, valves and other equipment;
- \* misuse of oxygen;
- \* backfires and flashbacks.

### Lighted blowpipes

A lighted oxy/fuel blowpipe is a very dangerous piece of equipment. Many users are burned, sometimes quite badly, by their own blowpipes. They may also injure other people and set flammable materials on fire.

#### **Preventing injury**

The following precautions will help to prevent injury:

- \* work in a safe location away from other people;
- \* wear protective clothing, gauntlets and eye protection;
- \* shut off the blowpipe when not in use. Do not leave a lighted blowpipe on a bench or the floor as the force of the flame may cause it to move;
- \* clamp the workpiece, do not hold it by hand;
- \* keep hoses away from the working area to prevent contact with flames, heat, sparks or hot spatter;

## Fire

The flame from an oxy/fuel gas blowpipe is a very powerful source of ignition. Many fires have been caused by the careless use of oxy/fuel blowpipes. The flame will quickly ignite any combustible material it comes into contact with: wood, paper, cardboard, textiles, rubber, plastics. Many processes also generate sparks and hot spatter which can ignite these materials.

### Preventing fire

The following precautions will help to prevent fire:

- \* move the workpiece to a safe location for carrying out the hot work process;
- \* remove any combustible materials (such as flammable liquids, wood, paper, textiles, packaging or plastics) from within about 10 metres of the work;
- \* ventilate spaces where vapours could accumulate, such as vehicle pits or trenches;
- \* protect any combustible materials that cannot be moved, from close contact with flame, heat, sparks or hot slag. Use suitable guards or covers such as metal sheeting, mineral fibre boards or fire retardant blankets;
- \* check that there are no combustible materials hidden behind walls or partitions which could be ignited, particularly if prolonged welding or cutting is planned. Some wall panels contain flammable insulation materials;
- \* use guards or covers to prevent hot particles passing through openings in floors and walls (doorways, windows, etc);
- \* maintain a continuous fire watch during the period of the work, and for at least an hour afterwards;
- \* keep fire extinguishers nearby.



## Explosion

### Tanks and drums

**F**lammable liquids and vapours such as petrol, diesel, fuel oil, paints, solvents, glue, lacquer and cleaning agents are found in many places of work. If a welding blowpipe or burner is used on a tank or drum containing flammable material (solid, liquid or vapour), the tank or drum can explode violently.

People have been killed and seriously injured by such explosions. Tanks and drums that are 'empty' usually still have residues in the bottom, and in seams and crevices. Just a teaspoon of flammable liquid in a drum can be enough to cause an explosion when heated and turned into vapour.

You must never use an oxy/fuel gas blowpipe on a drum or tank that has contained or may have contained flammable material unless you know it has been made safe.

If it contains flammable material, it will need thorough cleaning or inerting (see the HSE guidance note CS15 *The cleaning and gas freeing of tanks containing flammable residues*). It may be safer for a specialist company to carry out the work. If in doubt, ask.

### Tyres

Similarly, you must never weld or flame cut wheels to which tyres are fitted. The heat may generate flammable vapour from any oil or lubricating fluid on the inner rim of the wheel. This vapour, confined by the tyre may be enough to cause an explosion, if ignited. These explosions are very violent and can kill. Always remove the tyre.

### Gas leaks

There is a risk of fire and explosion if oxy/fuel gas equipment is allowed to leak. Acetylene and other fuel gases are highly flammable, and form explosive mixtures with air and oxygen. Even small leaks can have serious consequences, particularly if they are leaking into a poorly ventilated room or confined space where the gases can accumulate. A leak of flammable gas could cause a flashfire or explosion.

Gas leaks are often the result of damaged or poorly maintained gas control equipment, hoses, blowpipes and valves, poor connections and not closing valves properly after use.

#### Preventing leaks

The following precautions will help to prevent leaks:

- \* keep hoses clear of sharp edges and abrasive surfaces or where vehicles can run over them;
- \* do not allow hot metal or spatter to fall on hoses;
- \* handle cylinders carefully. Keep them in an upright position and fasten them to prevent them from falling or being knocked over. For example, chain them in a wheeled trolley or against a wall;
- \* always turn the gas supply off at the cylinder when the job is finished;
- \* maintain all equipment and keep in good condition;
- \* regularly check all connections and equipment for faults and leaks.

### Checking for leaks

You should take suitable precautions when checking for gas leaks. You should use a proprietary leak detecting spray or solution suitable for use with oxy/fuel systems. Soapy water or solutions containing grease should not be used on oxygen equipment.

When the leak is found, you should repair or replace the component immediately. Any detergent should be flushed off with clean water to remove any corrosive salts. You must never look for gas leaks with a naked flame.

If a cylinder leaks when the valve is closed, the cylinder should be taken outside to a ventilated area, away from sources of ignition (naked flames, sparks, electric lights and motors, etc) and unauthorised access. You should notify the supplier immediately.

### Ventilation

Small leaks may not be detected immediately. If they leak over a period of time into a poorly ventilated room or confined space, a dangerous concentration of gas may accumulate. To prevent gas accumulating:

- \* always provide adequate ventilation during welding and cutting operations;
- \* store gas cylinders outside whenever possible or in a well-ventilated place;
- \* avoid taking gas cylinders into poorly ventilated rooms or confined spaces.

## Misuse of oxygen

Oxygen leaks also increase the fire risk. In particular, if clothing is contaminated with oxygen, it will catch fire easily and burn very fiercely resulting in severe injury. Even fire retardant clothing will burn if contaminated with oxygen.

Also oxygen can cause explosions if used with incompatible materials. In particular, oxygen reacts explosively with oil and grease.

You should always take the following precautions:

- \* never allow oil or grease to come into contact with oxygen valves or cylinder fittings;
- \* never use oxygen with equipment not designed for it. In particular, check that the regulator is safe for oxygen and for the cylinder pressure.

## Backfire and flashback

**B**ackfires and flashbacks are usually caused by defective or incorrectly operated equipment.

### Backfires

A backfire is when the flame burns back into the blowpipe often with a sharp bang. This may happen when the blowpipe is held too close to the workpiece, or if the nozzle is blocked or partly blocked. The flame may go out or it may re-ignite at the nozzle. Sometimes the flame burns back into the blowpipe, and burning continues at the mixing point. Backfires do not usually cause serious injury or damage but they indicate a fault in the equipment.

If a backfire does occur:

- \* shut off the blowpipe valves, oxygen first and then the fuel gas;
- \* shut off the oxygen and fuel gas cylinder valves;
- \* cool the blowpipe with water, if necessary;
- \* check the equipment for damage or faults, particularly the nozzle.

### Flashbacks

Flashbacks are commonly caused by a reverse flow of oxygen into the fuel gas hose (or fuel into the oxygen hose), producing an explosive mixture in the hose. The flame can then burn back through the blowpipe, into the hose and may even reach the pressure regulator and the cylinder. The consequences of a flashback are potentially very serious. They can result in damage or destruction of equipment, and could even cause the cylinder to explode. This could end in serious injury to personnel and severe damage to property.

### Preventing flashbacks

The following precautions will help to prevent flashbacks:

- \* use the correct lighting up procedure. Purge the hoses before lighting the blowpipe to remove any potentially explosive gas mixtures. Use a spark ignitor and ignite the gas quickly after turning it on;
- \* ensure the blowpipe is fitted with spring-loaded non-return valves to prevent a backflow of gas into the hoses;
- \* use the correct gas pressures and nozzle size for the job. In particular, the acetylene pressure must not exceed 0.62 bar (9 psi);
- \* maintain the equipment in good condition.

These measures will reduce the risk of a flashback but will not completely eliminate it. Non-return valves will not stop a flashback once it has occurred. As the consequences of a flashback are potentially very serious, cylinders should be protected.

### Protecting cylinders from flashbacks

To protect a cylinder, you should fit flashback arresters onto the regulator, on both the fuel and oxygen supply. Arresters may be fitted on the blowpipe but these do not give protection from a fire starting in the hose. For long lengths of hose, you should fit arresters on both the blowpipe and the regulator.

The fitting of a flashback arrester should not be considered as a substitute for safe working practice.

If a flashback does occur:

- \* immediately close the cylinder valves, both fuel gas and oxygen, if it is safe to do so. The flame should go out when the fuel gas is shut off. If the fire cannot be put out at once, evacuate the area and call the emergency fire services;
- \* the blowpipe, hoses, regulators, flashback arresters and other components may have been damaged. Check carefully and replace if necessary before reuse. If in doubt, consult the supplier.

### **Acetylene cylinders**

You should pay particular attention to any acetylene cylinder which has been involved in a flashback or has been affected by fire. There is a risk that the acetylene could start to decompose, and the cylinder could explode within a few minutes. If an acetylene cylinder becomes hot or starts to vibrate, you must evacuate the building immediately and call the emergency fire services.

# References

More detailed advice may be found in the following publications:

*The safe use of compressed gases in welding, flame cutting and allied processes* HSG139 HSE Books 1997 ISBN 0 7176 0680 5

*The safe use of oxy-fuel gas equipment (individual portable or mobile cylinder supply)* 2nd revised edition BCGA code of practice CP7 British Compressed Gases Association 1996

*The safe distribution of acetylene in the pressure range 0-1.5 bar (0-22 lbf/in<sup>2</sup>)* revised edition BCGA code of practice CP6 British Compressed Gases Association 1998

*The cleaning and gas freeing of tanks containing flammable residues* CS15 HSE Books 1997 ISBN 0 7176 1365 8

*Safe work in confined spaces. Confined Spaces Regulations 1997. Approved Code of Practice, Regulations and guidance* L101 HSE Books 1997 ISBN 0 7176 1405 0

*Take care with oxygen: fire and explosion hazards in the use of oxygen* HSE8(rev2) HSE Books 1999 Single copies free; also available in priced packs of 10, ISBN 0 7176 2474 9

*Permit-to-work systems* INDG98 HSE Books 1997 Single copies free; also available in priced packs of 15, ISBN 0 7176 1331 3

While every effort has been made to ensure the accuracy of the references listed in this publication, their future availability cannot be guaranteed.

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This leaflet contains notes on good practice which are not compulsory but which you may find helpful in considering what you may need to do.

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