CODE OF PRACTICE 7

THE SAFE USE OF OXY-FUEL GAS EQUIPMENT (INDIVIDUAL PORTABLE OR MOBILE CYLINDER SUPPLY)

REVISION 8: 2018

British Compressed Gases Association

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PREFACE

The British Compressed Gases Association (BCGA) was established in l971, formed out of the British Acetylene Association, which existed since l901. BCGA members include gas producers, suppliers of gas handling equipment and users operating in the compressed gas field.

The main objectives of the Association are to further technology, to enhance safe practice, and to prioritise environmental protection in the supply and use of industrial gases, and we produce a host of publications to this end. BCGA also provides advice and makes representations on behalf of its Members to regulatory bodies, including the UK Government.

Policy is determined by a Council elected from Member Companies, with detailed technical studies being undertaken by a Technical Committee and its specialist Sub-Committees appointed for this purpose.

BCGA makes strenuous efforts to ensure the accuracy and current relevance of its publications, which are intended for use by technically competent persons. However this does not remove the need for technical and managerial judgement in practical situations. Nor do they confer any immunity or exemption from relevant legal requirements, including by-laws.

For the assistance of users, references are given, either in the text or Appendices, to publications such as British, European and International Standards and Codes of Practice, and current legislation that may be applicable but no representation or warranty can be given that these references are complete or current.

BCGA publications are reviewed, and revised if necessary, at five-yearly intervals, or sooner where the need is recognised. Readers are advised to check the Association's website to ensure that the copy in their possession is the current version.

This document has been prepared by BCGA Technical Sub-Committee 3. This document replaces BCGA Code of Practice 7, Revision 7: 2014, incorporating Corrigendum 1. It was approved for publication at BCGA Technical Committee 159. This document was first published on 24/10/2018. For comments on this document contact the Association via the website www.bcga.co.uk.

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* Throughout this publication the numbers in brackets refer to references in Section 14. Documents referenced are the edition current at the time of publication, unless otherwise stated.

TERMINOLOGY AND DEFINITIONS

Blowpipe — A piece of equipment in which separate supplies of oxygen and fuel gas are mixed in the appropriate proportions to obtain the required flame.

Composite safety device — A unit which embodies a flame arrestor and 1 or more of these devices:

- Non-return valve
- Temperature sensitive cut-off valve
- Pressure sensitive cut-off valve

Bundle (of cylinders) — An assembly of cylinders that are fastened together and which are interconnected by a manifold and carried as a unit. The total water capacity shall not exceed 3000 litres except that bundles intended for the carriage of toxic gases of Class 2 (groups starting with letter T according to ADR (17) 2.2.2.1.3) shall be limited to 1000 litres water capacity.

Confined space — Any place, including room, chamber, tank, vat, silo, pit, trench, pipe, sewer, flue, well, or other similar space in which, by virtue of its enclosed nature, there arises a reasonably foreseeable specified risk.

It has two defining features:

(i) It is a place which is substantially, (though not always entirely) enclosed.

(ii) There will be a reasonably foreseeable risk of serious injury from; flammable or toxic atmosphere, oxygen deficient or enriched oxygen atmosphere.

[as defined in the *Confined Spaces Regulations* (3)]

Cylinder — A transportable pressure receptacle of a water capacity not exceeding 150 litres.

NOTE: This includes the gas cylinder, the valve and all accessories permanently fitted to the gas cylinder.

Flame arrestor — A device which arrests a flame front (caused by flashback or decomposition) and which is suitable for the most severe type of flame which may occur, i.e. detonation.

Hose assemblies — The means by which the gases are conveyed from the regulator to the blowpipe.

Hot work — Includes any process that generates a source of ignition (for example, naked flames, heat, sparks) arising from working methods such as welding, flame cutting, grinding and using disc cutters.

May — Indicates an option available to the user of this Code of Practice.

Mixing systems	That part of the blowpipe to which gases are separately conducted and in which the mixing of gases takes place.
Non-return valve	A self-actuating valve which prevents the passage of gas in the opposite direction to the normal gas flow. Specifically a non-return valve shall be effective against the return of gas towards the cylinder.
Nozzle	That part of the blowpipe, which provides the final control of velocity and gas profile as a gas or gases emerge to the atmosphere.
Pressure	Within this Code of Practice the 'bar' is used as the unit of pressure. 1 bar = 100 kPa = 10^5 N/m^2 = 14.5 lbf/in^2 Pressures used are gauge pressures except where otherwise stated.
Pressure receptacle	A collective term that includes cylinders, tubes, pressure drums, closed cryogenic receptacles, metal hydride storage systems, bundles of cylinders and salvage pressure receptacles.
Pressure regulator	Fitted to the outlet of the gas cylinder valve, the pressure regulator reduces the pressure of the gas from the cylinder pressure to the lower pressure required for the operation of the process equipment.
Pressure relief valve	A valve, which automatically vents gas to the atmosphere in order to prevent a build-up of pressure in a system when the pressure exceeds a predetermined value. The pressure relief valve automatically reseats when the conditions causing the over-pressure are corrected.
Pressure sensitive cut-off device	A valve which automatically stops the gas flow in the event of a slow or sudden back-pressure from the downstream side of the cut-off valve. The valve remains closed until manually reset.
Safety device	A device which, when correctly used and placed, prevents any damage or injury from misuse or malfunction of the blowpipe or associated equipment.
Shall	Indicates a mandatory requirement for compliance with this Code of Practice and may also indicate a mandatory requirement within UK law.
Should	Indicates a preferred requirement but is not mandatory for compliance with this Code of Practice.
Temperature sensitive cut-off device	A device which stops the gas flow when a predetermined temperature is reached.

Valve with integrated pressure regulator (VIPR)	A device intended to be permanently fitted to a gas cylinder connection and comprising a shut-off valve system and a pressure reduction system.
Working pressure (for a gas cylinder)	The settled pressure of a compressed gas at a reference temperature of 15 °C in a full pressure receptacle. NOTE: This is the ADR (17) definition which refers to the fill pressure inside the cylinder.

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THE SAFE USE OF OXY-FUEL GAS EQUIPMENT (INDIVIDUAL PORTABLE OR MOBILE CYLINDER SUPPLY)

1. INTRODUCTION

This Code of Practice has been prepared by the British Compressed Gases Association (BCGA) to provide guidance on the safe use of oxy-fuel gas equipment, each gas being supplied from a cylinder and individually controlled by a cylinder-mounted pressure regulator.

Gas cylinders are designed and constructed to safely contain a gas under pressure. Used with the correct downstream pressure equipment they provide an efficient and effective means of delivering a gas to the end process.

Oxy-fuel gas equipment has many uses, including welding, cutting, heating, straightening, and descaling. The equipment is versatile and relatively easy to move and use, however, it also has its hazards and consequently its use is governed by several Regulations.

Due to the properties of gases, compliance will be required with the *Health and Safety at Work etc. Act* (1), which may include:

- *The Construction (Design and Management) Regulations* (CDM) (14), which govern the way construction projects of all types and sizes are planned;

- *The Provision and Use of Work Equipment Regulations* (PUWER) (4) which governs the safe use of work equipment;

- *The Pressure Systems Safety Regulations* (PSSR) (6), which covers the safe design and use of pressure systems and whose aim is to prevent serious injury from the hazard of stored energy (pressure) as a result of the failure of a pressure system or one of its component parts;

- *The Dangerous Substances and Explosive Atmospheres Regulations* (DSEAR) (9) which are concerned with protection against risks from fire, explosion and similar events arising from dangerous substances used or present in the workplace;

- *The Control of Substances Hazardous to Health Regulations* (COSHH) (8) which governs how to either prevent or reduce workers' exposure to substances that are hazardous to their health.

The Health and Safety Executive (HSE) provide advice on welding health and safety at: http://www.hse.gov.uk/welding/index.htm

Premise owners and users of gaseous equipment should ensure their insurer is aware that there are gases on-site and that they have adequate insurance to cover their activities, that they

choose and use appropriate gases, and that they look after their gas cylinders in a safe and responsible way.

This code of practice is intended for use in conjunction with current guidance and information produced by the Health and Safety Executive (HSE) and other related bodies and trade associations.

2. SCOPE

This Code of Practice gives a guide to the minimum safety standards required for the assembly, examination, inspection, maintenance and use of individual portable or mobile cylinder oxy-fuel gas equipment, each gas being supplied from a cylinder and individually controlled by a cylinder-mounted pressure regulator

The UKLPG provide additional information on the safe use of liquefied petroleum gases (LPG). As an example, refer to UKLPG User Information Sheet 28 (78), *Safe use of propane and butane cylinders & cartridges*.

The safety standards laid down are the minimum for safe working practice and the importance of the skill and competence of operators, supervisors and managerial staff is stressed.

It does not apply to cutting machine operations and any other form of use of cylinder gas supply for any other process.

It does not apply to fixed gas distribution systems or other portable or mobile cylinder gas supply equipment for which you should refer to:

- BCGA CP 4 (52), *Industrial gas control and distribution systems (excluding acetylene).*
- BCGA CP 5 (53), *The design and construction of manifolds using acetylene gas from 1.5 bar to 25 bar.*
- BCGA CP 6 (54), *The safe distribution of acetylene in the pressure range 0 to 1.5 bar.*
- BCGA CP 47 (58), *The safe use of individual portable or mobile cylinder gas supply equipment*.

3. AWARENESS OF THE PROPERTIES OF GASES USED

Each gas (whether pure or a mixture) has its own distinctive properties.

On a gas cylinder the label identifies the contents and provides basic information on safe use and the hazard(s) associated with the product.

Safety Data Sheets provide detailed information on the properties of a gas as well as advice on handling and storage. They can be obtained for all gases and are to be available for the user of the gas. It is a legal requirement that the gas supplier provides a Safety Data Sheet to the customer whenever a product is supplied for the first time.

All gases have their hazards, and appropriate control measures, identified by risk assessment, shall be provided to protect all persons who may be affected by an escape, leak or accumulation of gases into the workplace. Refer to BCGA Guidance Note (GN) 11 (60), *The management of risk when using gases in enclosed workplaces.*

If additional information is required contact your gas supplier for advice.

4. LEGISLATION

The *Health and Safety at Work etc. Act* (1), places duties on organisations and employers to protect the health and safety of employees and / or members of the public. The duties include the provision and maintenance of plant and systems of work that are, so far as is reasonably practicable, safe and without risks to health. This includes the use of pressure equipment.

There are several Regulations which are relevant to the use of pressure equipment in oxy-fuel applications.

The *Pressure Equipment (Safety) Regulations* (15), which implement the European Union Pressure Equipment Directive (PED) (16), provide a legal structure whereby pressure equipment can be manufactured and sold throughout Europe and covers the first placement on the market and putting into service of pressure equipment and assemblies.

The *Provision and Use of Work Equipment Regulations* (PUWER) (4) which requires that work equipment should not result in health and safety risks, regardless of its age, condition or origin. The PUWER (4) requires that the employer selects suitable equipment and carries out appropriate maintenance, inspection, identifies any specific risks and provides suitable information, instructions and training.

The HSE provide further guidance on the PUWER (4) within HSE L22 (20), *Safe use of work equipment. Provision and Use of Work Equipment Regulations 1998. Approved Code of Practice and guidance*.

Gas pressure equipment operating above 0.5 bar is regulated by the *Pressure Systems Safety Regulations* (PSSR) (6). The PSSR (6) requires such equipment to be examined and maintained. It should be noted that the overall intention of the PSSR (6) is to prevent serious injury from the hazard of stored energy, as a result of the failure of a pressure system or one of its component parts. The primary responsibility for compliance with these regulations lies with the user of the pressure equipment and it is the users' responsibility to enlist any assistance required to comply with the Regulations.

The HSE provide guidance on the PSSR (6) in HSE L122 (23), *Safety of pressure systems. Pressure Systems Safety Regulations 2000. Approved Code of Practice and guidance.*

The *Acetylene Safety (England and Wales and Scotland) Regulations* (13) require that all acetylene mobile systems shall be fitted with a pressure regulator and various safety devices which are specifically designed and constructed for use with acetylene.

The Construction (Design and Management) Regulations (CDM) (14) may apply in some circumstances. For further information refer to HSE L153 (25), *Managing health and safety in construction. Construction (Design and Management) Regulations 2015. Guidance on Regulations.*

The *Dangerous Substances and Explosive Atmospheres Regulations* (DSEAR) (9) places obligations on site operators who use gas cylinders, especially oxidising or flammable gases, and are concerned with protection against the risks from fire, explosion or substances corrosive to metals. Gases that are under pressure (for example, gas in a cylinder) may present a risk of explosion if not correctly handled in the workplace. Substances that can corrode metals could cause structural damage reducing integrity of structures if not suitably contained. DSEAR (9) places a formal requirement on employers to assess the risks for substances if classified for these properties and put in place suitable control and mitigation measures. BCGA provide a generic risk assessments, refer to BCGA GN 13 (61), *DSEAR Risk Assessment*.

For further information refer to HSE L138 (24), *Dangerous substances and explosive atmospheres Dangerous Substances and Explosive Atmospheres Regulations 2002 Approved Code of Practice and guidance*.

The Control of Substances Hazardous to Health Regulations (COSHH) (8). Requires employers to either prevent or reduce workers' exposure to substances that are hazardous to their health.

For further information refer to HSE L5 (19), *Control of substances hazardous to health. The Control of Substances Hazardous to Health Regulations 2002 (as amended). Approved Code of Practice and guidance*.

The Management of Health and Safety at Work Regulations (5), as well as other legislation, such as the *Confined Spaces Regulations* (3), require employers to conduct risk assessments for their activities.

The *Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations* (12), is applicable for individual gas cylinders, including their valves and permanently fitted accessories. These regulations govern the safe filling, transport and the inspection and maintenance requirements. The owner of a gas cylinder, who is normally the gas supplier, is responsible for compliance.

5. EXAMINATION, INSPECTION AND MAINTENANCE

For gas cylinders, the owner, who is normally the gas supplier, has responsibility for inspection and maintenance. In the case of gas cylinders fitted with a valve with an integral pressure regulator (VIPR), the responsibility for the serviceability of the VIPR is also with the owner of the cylinder. If the user has any queries over the inspection, maintenance or

serviceability of a gas cylinder or its permanently fitted valve and accessories, then they should contact the owner of the cylinder for advice.

To ensure all other pressure equipment remains safe and serviceable throughout its operational life it shall be subject to regular inspection and maintenance. Pressure equipment shall also be subject to examination where a Written Scheme of Examination is in place. All examination, inspection and maintenance shall take into account the manufacturers' / suppliers' recommendations. Such a regime shall ensure pressure equipment complies with the PUWER (4) and PSSR (6) Regulations. For detailed information refer to BCGA CP 39 (56), *In-service requirements of pressure equipment (gas storage and gas distribution systems).*

PUWER (4) requires that work equipment that is in-service is inspected and maintained at regular intervals to ensure that it is safe for continued use and remains in good repair regardless of its age, condition or origin.

PSSR (6) requires that the owner of a mobile system (which does not include the gas cylinders, as these are managed under the *Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations* (12)), shall ensure that the system is properly maintained in good repair, so as to prevent danger. PSSR (6) requires pressure systems to undergo a thorough examination in accordance with a Written Scheme of Examination, unless a specific exclusion applies. The need for a Written Scheme of Examination shall be formally assessed in accordance with the PSSR (6), Regulation 8.

HSE guidance is that owners and users, in consultation with a competent person, have to decide if a Written Scheme of Examination is required. HSE provide an example of a portable oxy-fuel gas welding set being unlikely to require a written scheme of examination [HSE L122 (23), Clause 113]. However, it is emphasised that such equipment will still require inspection and maintenance to comply with PUWER (4).

Where assessment of the potential risk of using oxy-fuel gas pressure equipment results in a recognition that injury could result from a failure of the system, then a Written Scheme of Examination shall be drawn up by a Competent Person, as defined in the PSSR (6). Such a Scheme could use the information in Appendix 1, provided it included information about the nature and frequency of the required examination of all protective devices and parts of the system where a defect would give rise to danger. When a Written Scheme of Examination is implemented for the equipment, written records shall be maintained by the User covering the Scheme itself and the records of examinations carried out by the Competent Person under the Scheme.

It is the duty of the employer to ensure persons undertaking examination, inspection or maintenance activities are competent to do so. For further guidance refer to BCGA GN 23 (62), *Gas safety. Information instruction and training*.

Appendix 1 provides guidance on the recommended inspection and maintenance requirements for typical pressure equipment used in the gas delivery pressure system.

With reference to Appendix 1, the following checks shall be carried out:

- An '*assembly*' check. To be carried out when assembling the equipment.

The equipment is assembled in accordance with the manufacturer's instructions, and checked during and after assembly. To include a check that all appropriate equipment is installed in the correct order, any maintenance activities necessary are completed, a visual inspection for correct assembly and to determine suitability for service, for example, compatibility with the gas, pressure rating, direction of flow, damage, oil, grease or other contamination.

- A '*before use'* inspection check. To be carried out by the user prior to the use of the equipment. The purpose being to check the equipment is serviceable and ready to use.

Typically a visual examination to determine suitability for service, for example, gas, pressure rating, damage, oil, grease or other contamination, and, where appropriate, that the relevant equipment is in-date to the manufacturer's specification.

Any damaged, contaminated or out-of-date equipment shall not be used. This equipment shall be replaced.

- An '*after use'* inspection check. To be carried out by the user on completion of use of the equipment. The purpose being to check that any faults that occur in-service are rectified or reported / recorded.

Any damaged or contaminated equipment shall be replaced.

- An '*annual'* inspection with any associated maintenance. To consist of an in-depth inspection and maintenance check. The purpose being to ensure the equipment remains serviceable for continued use.

The risk assessment will determine the control measures required for the frequency of inspection. Inspections should be carried out at least annually or more frequently, dependant on the findings of the risk assessment, based on service conditions, the local environment and the conditions of use.

To include checks that individual components remain within their allowed life, all components operate over their full design range and that they are still fit-for their intended purpose.

The inspection shall be carried out by a person who has:

(i) sufficient practical experience of oxy-fuel and related gas equipment,

and can demonstrate a theoretical knowledge of:

(ii) the functioning of the equipment, the properties of gases used, the potential defects and hazards which may occur and their importance to the integrity and safety of the equipment.

(iii) relevant current legislation, standards and industry documents.

This should be acquired through formal training, for further information on the competency of personnel refer to BCGA GN 23 (62).

Written records of the last inspection carried out shall be retained. These records shall identify the individual assets which have been inspected. This may include localised tagging, labelling etc.

- *'Examination'* where required by, and in accordance with, a Written Scheme of Examination. To be carried out by a competent person.

BCGA no longer support refurbishment of components, such as regulators or handheld blowpipes, by the user. It is recommended that the user purchases a new component, or if refurbishment is necessary, then the component is returned back to the manufacturer for refurbishment to take place. Refer to BCGA TIS 19 (68), *Refurbishment of components used with compressed gases for welding, cutting and related processes*.

6. SIGNIFICANT HAZARDS

The significant hazards when using oxy-fuel gases and equipment are:

6.1 Backfire

The return of the flame into the blowpipe neck or body with a popping sound, the flame being either extinguished or re-ignited at the nozzle.

6.2 Sustained backfire

The return of the flame into the blowpipe neck or body with continued burning within the neck or mixer.

NOTE: This manifests itself either as 'popping' or 'squealing' with a small pointed flame issuing from the nozzle orifice, or as a rapid series of minor explosions inside an overheated nozzle.

6.3 Intermittent backfire

A rapid succession of backfires with the flame re-igniting at the nozzle. This may be accompanied by a noise resembling machine gun fire.

6.4 Flashback

Return of a flame through the blowpipe body into the hoses and the regulators. It may also reach a gas cylinder causing heating and possible ignition which may lead to a rupture of the cylinder.

6.5 Backflow

Flowing back of gas at a higher pressure into the hose of a gas at lower pressure (this can be caused by the nozzle exit becoming blocked or restricted). Backflow produces the conditions under which a flashback can occur.

6.6 Decomposition

In an acetylene cylinder, the breakdown of acetylene into carbon and hydrogen in the absence of oxygen giving rise to high temperatures and pressures.

NOTE: Decomposition cannot be caused by cold mechanical impact. Decomposition will only occur when the cylinder has been subject to temperatures greater than 350 °C.

6.7 Ignition within an oxygen system

Oxygen systems shall always be completely free of oil or grease, and assembled from components which are known to be oxygen clean.

Contaminants, such as oils and greases, can ignite in the presence of high pressure oxygen. This may be caused by high internal temperatures or by sudden pressure increases, for example, by rapidly opening valves.

6.8 Oxygen leakage

Leakage or an excess of unconsumed oxygen from, for example, a cutting processes, may lead to increased levels of oxygen, especially in a confined space. Oxygen enrichment will increase the risk and severity of a fire. Refer to Section 9.5.

6.9 Fuel gas leakage

Fuel gases are flammable. Any leakage of a fuel gas will create a combustible atmosphere which will increase the risk of fire.

Fuel gases contain no oxygen. Leakage or an excess of unconsumed fuel gas may lead to a decrease in levels of oxygen in the local atmosphere, especially in a confined space, which can lead to asphyxiation. Refer to Section 9.5.

6.10 Fumes

The fume given off by welding and hot cutting processes is a varying mixture of airborne gases and very fine particles which, if inhaled, are hazardous, especially in high concentration. Inhalation can be a cause of cancer, chronic obstructive pulmonary disease (COPD) and an increased susceptibility to pneumonia. The fume will displace breathable air, and may contain toxic products, such as carbon monoxide. There are hazards from specific fumes in some applications, e.g. silver brazing, work on painted or galvanised metals, etc.

This fume will affect all persons in the local area, not just those directly involved in the process. Fume can have an immediate, as well as a long term effect on the health of those affected. Staff at all levels need to be aware of the potential hazards. It will be necessary to assess the actual risk in order to comply with the *Control of Substances Hazardous to Health Regulations* (COSHH) (8). Reference should be made to HSE Guidance Note EH 40 (18), *Workplace exposure limits.* Additional guidance can be found in the HSE Leaflet INDG 136 (29), *Working with substances hazardous to health. A brief guide to COSHH*.

The BCGA has engaged with the HSE and others to try to influence attitudes and behaviours with respect to welding fume, particularly in encouraging the use of appropriate workplace protection, such as local exhaust ventilation, as well as Personal Protective Equipment, refer to Section 9.1.

The Welding Fume Health Partnership has produced a website www.badairday.info which explains in detail the safety concerns associated with welding fume and which encourages appropriate safe behaviour.

BOHS, the Chartered Society for Worker Health Protection, campaigns to prevent occupational lung disease in the manufacturing sector and provides advice for welders at: http://www.breathefreely.org.uk/breathefreelymanufacturing.html

For information on local exhaust ventilation refer to HSE HSG 258 (30), *Controlling airborne contaminants at work. A guide to local exhaust ventilation (LEV).*

BCGA has published additional advice on welding fumes within BCGA TIS 24 (70), *Welding fumes. Safety alert*.

6.11 Noise

In working areas where the noise level is excessive ear protectors may be required. *The Control of Noise at Work Regulations* (11) require employers to prevent or reduce risks to health and safety from exposure to noise at work. Action has to be taken when noise reaches specific values. These values relate to the levels of exposure to noise averaged over a working day or week, and the maximum noise (peak sound pressure) to which personnel are exposed in a working day.

The values are:

- Lower exposure action value:
    - Daily or weekly exposure of 80 dB
    - Peak sound pressure of 135 dB
- Upper exposure action value:
    - Daily or weekly exposure of 85 dB
    - Peak sound pressure of 135 dB
- Exposure limit values (which cannot be exceeded):
    - Daily or weekly exposure of 87 dB
    - Peak sound pressure of 140 dB

Employers are required to carry out a risk assessment to determine the noise levels. The risk assessment is to be recorded and, as necessary, an action plan put in place. If the noise exposure cannot be reduced by other means then appropriate personal protective equipment is to be provided. Refer to Section 9.1.

6.12 Manual handling

Gases supplied in cylinders can be in compressed, liquefied or dissolved form. The cylinders vary in weight, size and shape. These physical characteristics present potential manual handling hazards. Appropriate risk assessment, training and handling aids are required. Refer to Section 8.2.

7. EQUIPMENT

Oxy-fuel gas equipment will generally consist of gas cylinders for oxygen and a fuel gas, pressure regulators, safety devices, such as non-return valves and flame arrestors, and a flexible hose assembly which will supply the output of a mixed gas via a blowpipe. Often this equipment will be mounted on a handling trolley.

Always refer to the manufacturers' / suppliers' instructions for the correct and safe use of all equipment and materials used. Any modifications, changes or repairs to gas equipment shall be done by a competent person, or authorised third party, and will require the gas equipment to be retested to ensure integrity and functionality are within manufacturer's original specification.

All equipment should conform to appropriate standards.

All equipment which is in contact with a gas shall be compatible with that gas. For example, refer to:

- BS EN ISO 11114 (49). *Transportable gas cylinders. Compatibility of cylinder & valve materials with gas contents. Part 1, Metallic materials. Part 2, Non-metallic materials.*

Specialist jointing tape may be used by some manufacturers of gas equipment. However, jointing tape should not be used by end-users. If your equipment is worn or leaking, replace it. Your equipment provider or gas supplier can provide further advice.

Equipment is generally marked and identified to show the gas service it has been designed for and the service for which it is intended. However, some gas equipment is manufactured to a specification which is suitable for multiple gas use and is labelled as such.

Only equipment designed and cleaned for oxygen service shall be used with oxygen to ensure that safe operating conditions are met. Equipment not marked for oxygen service shall not be used with oxygen. Oxygen equipment shall only be used in oxygen service.

The *Acetylene Safety (England and Wales and Scotland) Regulations* (13) require that any equipment used for acetylene shall be designed and marked for that purpose.

Under no circumstances shall oil and grease be used on components in oxygen, inert or fuel gas service. When installing or connecting equipment ensure your hands are free from oil and grease.

Refer to the manufacturer / supplier to determine the life of your equipment. BCGA TIS 18 (67), *Date marking of gas accessories*. provides information on some of the equipment marking schemes used by manufacturers.

HSE HSG 139 (26), *The safe use of compressed gases in welding, flame cutting and allied processes*, and HSE INDG 297 (31), *Safety in gas welding, cutting and similar processes*, provides guidance for the use of compressed gases for welding, flame cutting and related processes. They promote the safe use of compressed gases and describe the hazards

associated with portable oxy-fuel gas equipment and precautions for avoiding injury and damage to property.

7.1 Pressure regulators

Fitted to the outlet of the gas cylinder valve, or bundle output valve, the pressure regulator reduces the pressure of the gas from the cylinder pressure to the lower pressure required.

A pressure regulator shall be chosen for its compatibility with the gas. Regulators are designed to be used with a specific gas and once in a specific gas service a regulator shall not be used with any other gas. Oxygen regulators shall only be used in oxygen service. Acetylene and propane are both widely used as fuel gases. However, these gases have quite different properties, which are taken into account in the design and manufacture of the gas regulators. Due to the different properties, each gas requires a specific design of gas regulator that has been manufactured from materials compatible with and type-tested for use with that gas.

The use of an incorrect regulator for acetylene can cause an explosion. The *Acetylene Safety Regulations* (13) require that the regulator shall be specifically designed and constructed for use with acetylene. For further information refer to BCGA Safety Alert 1 (76), *The hazards of using incorrect regulators on acetylene gas cylinders*.

Each regulator shall be suitable for the maximum cylinder pressure. Regulators are designed for use within a specific pressure range. Do not attach a regulator to a cylinder that is at a pressure higher than that for which the regulator is designed and labelled.

Regulators may be designed to be adjustable in respect of outlet pressure or, for single purpose applications, may be pre-set. Pressure reduction within the regulator may be in one or two stages (single or two-stage regulators). Pressure regulators may be supplied with a pressure gauge or indicator to show the cylinder contents and a pressure gauge or flow meter to indicate the outlet pressure or flow.

Pressure regulators are to be positioned as close as is reasonably practicable to the cylinder. Cylinder outlet valves are designed with either a top outlet or a side outlet. Where a regulator is attached to the cylinder outlet valve only a regulator configured with a top inlet, or a side inlet, as appropriate, shall be fitted.

Pressure regulators should be treated as precision instruments and should not be jarred or knocked.

Regulators which are contaminated, life-expired or damaged shall not be used. BCGA no longer recommend the repair of damaged components, refer to BCGA TIS 19 (68), *Refurbishment of components used with compressed gases for welding, cutting and related processes*.

Outlet pressures should not be set in excess of those needed for the operation in hand. The regulator pressure-adjusting screw shall be set to the zero pressure position when the regulator is not in use by turning the control knob fully anti-clockwise.

Whether they are in store or in use, pressure regulators shall be kept free of dust, debris, oil, grease, solvents or any other contaminants.

When not in use, protective covers should be placed over the gas ports. They should be stored in clean, dry conditions.

All regulators up to 20 bar working pressure shall conform to:

- BS EN ISO 2503 (44), *Gas welding equipment. Pressure regulators and pressure regulators with flow-metering devices for gas cylinders used in welding, cutting and allied processes up to 300 bar (30 MPa);* or

- BS EN ISO 7291 (48), *Gas welding equipment. Pressure regulators for manifold systems used in welding, cutting and allied processes up to 30 MPa (300 bar).*

These standards state that pressure-adjusting screws shall be captive to prevent inter-changeability between regulators.

In the case of valves with integrated pressure regulators (VIPR) they should conform to:

- BS EN ISO 22435 (51), *Gas cylinders. Cylinder valves with integrated pressure regulators. Specification and type testing*.

The following information should be clearly and permanently marked on the pressure regulator body or cover:

- Gas service. In many cases the gas service will be identified by the manufacturer. Where there is an option to use a regulator designed for a range of gases, the user should label the regulator at first use;

- Maximum inlet pressure;

- Maximum outlet pressure;

- The name or trademark of the manufacturer and / or distributor;

- A date mark showing either the date of manufacture or a date when the regulator is to be replaced or refurbished.

Regulators for industrial use shall not be CE marked in accordance with the European Directives.

For preparing a pressure regulator for use refer to Section 9.9.

7.2 Safety devices

The incorporation of safety devices shall in no way be considered to be a substitute for safe operating procedures.

All safety devices shall conform to BS EN ISO 5175 (47), *Gas welding equipment. Safety devices*, and be suitable for the required conditions of service (type of gas used, maximum operating pressure and minimum operating flow, etc.).

A flame arrestor is a device which extinguishes a flame front (for example, caused by a flashback) at the point of installation (often referred to as a flashback arrestor). A composite safety device may incorporate several individual safety devices such as a flame arresting element, a non-return valve, a quick acting shut-off device, for example, a temperature sensitive shut off valve and/or a pressure sensitive shut-off valve.

Flame arrestors may incorporate resettable or non-resettable features. If the flame arrestor continually needs resetting, seek advice from the supplier.

- A temperature sensitive cut-off valve will not cut off the gas until heated to a sufficient level. This may require several flashbacks or internal burning. After cut off they cannot be reset. After investigation and rectification of cause of flashback they shall be replaced.

- A pressure sensitive cut-off valve will automatically cut off the gas flow immediately. After cut off, and following investigation and rectification of the cause of flashback, they can be reset.

Flame arrestors are marked with the direction of gas flow, a manufacture or an inspection / replacement date and the manufacturing standard.

A flame arrestor, a non-return valve and a quick acting shut-off device is mandatory when acetylene is the fuel gas

Additional information is available in EIGA Safety Information 5 (83), *Flashback and flashback arrestors in welding applications*.

Non-return valves shall be capable of preventing backflow of gases, both at low and high reverse pressures. They are marked with the direction of flow.

Non-return valves may be damaged by flashbacks and require frequent testing to ensure that the gas will not reverse flow. Refer to Section 5 and Appendix 1.

NOTE: Historically, a type of non-return valve known as a ‘hose protector’, which operated by means of a floating plate or disc, was in common use. These will not prevent backflow at low pressures and do not conform to BS EN ISO 5175 (47).

For preparing a safety device for use refer to Section 9.10.

7.3 Hose and hose assemblies

The hose provides a flexible connection between the pressure regulator, safety devices and the process equipment. A hose assembly consists of a hose tail inserted into the end of a flexible hose and secured by a suitable hose clamp.

Hoses shall be of a composition compatible with the gas with which they are to be used. Hoses shall not be used for gases or at pressures other than those for which they have been designed.

Hose materials shall conform to BS EN ISO 3821 (45), *Gas welding equipment. Rubber hoses for welding, cutting and allied processes.*

Hose connections shall conform to BS EN 560 (41), *Gas welding equipment - Hose connections for equipment for welding, cutting and allied processes.*

Hose connections are fitted with left-hand threads for flammable gases and right-hand threads for oxygen.

Assembled hoses shall be tested to BS EN 1256 (43), *Gas welding equipment. Specification for hose assemblies for equipment for welding, cutting and allied processes,* with hose fittings retained by suitable clips or ferrules. Re-usable worm-drive clamps shall not be used.

Non return valves shall conform to BS EN ISO 5175-2 (47). Refer to Section 7.2.

NOTE: Non return valves are often referred to as 'Hose check valves'.

Quick action couplings shall conform to BS EN 561 (42), *Gas welding equipment. Quick-action coupling with shut-off valves for welding, cutting and allied processes.*

Hoses for welding equipment have identification marks and are colour coded. In the case of twin hoses, each of the individual hoses shall be coloured. Refer to Table 1 and BS EN ISO 3821 (45).

Gas	Hose colour	Thread
Oxygen	Blue	Right hand
Inert gases (compressed air, nitrogen, argon and carbon dioxide)	Black	Right hand
LPG, methane, natural gas and MPS[2]	Orange	Left hand
Acetylene, hydrogen[1] and other flammable gases (excludes LPG, methane, natural gas & MPS)	Red	Left hand
Universal fuel gases (included in this table)	Red / orange	Left hand
NOTE: 1. The manufacturer shall be consulted on the suitability of the hose for use with hydrogen. 2. Methylacetylene-propadiene mixtures		

Table 1: Hose assemblies – colours and threads.

Do not tape hoses together. Tape can cover damage to the hose outer layer. To reduce trip hazards hoses can be joined together by hose clips (plastic or metal) specifically designed for that purpose. Conjoined hose can be used provided that the hose and the assembly conform to the required standards. It is important to remember that failure in one hose can lead to failure in the other and lead to a potentially more hazardous situation.

Hose lengths shall be kept to the minimum necessary. Where greater lengths are needed only occasionally, extension hoses, connected by means of hose couplers conforming to BS EN 560 (41) can be used. The extension being dismantled when the need for it has passed.

WARNING: Copper pipe or copper fittings shall not be used to couple hoses carrying acetylene.

The good condition of the hoses is of vital importance to safety. Hoses shall be protected from heat, mechanical damage, traffic, sparks, hot splatter, slag and oil or grease. Always discard hoses when the general condition shows signs of deterioration.

Localised repairs are not recommended, however where repairs are carried out then it is essential to use the correct style of hose-splicer and associated fittings. Following a modification or repair the hose assembly shall be re-tested and certified to BS EN 1256 (43). Leak test with an approved leak test solution

NOTE: For further information on leak detection fluids refer to EIGA 78 (81), *Leak detection fluids cylinder packages*.

For preparing a hose assembly for use refer to Section 9.11.

7.4 Blowpipes

Blowpipes shall conform to BS EN ISO 5172 (46), *Gas welding equipment. Blowpipes for gas welding, heating and cutting. Specifications and test.*

NOTE: Blowpipes are sometimes referred to as torches, lamps, blowtorches, guns, shanks, burners, handles, etc.

The blowpipe will receive the individual gases and mix the gases together. Some blowpipes may, by an interchange of components, be adapted to carry out a wide range of duties.

A number of gas mixing systems can be employed either in the shank, between the shank and the blowpipe nozzle or in the nozzle and these may call for different working procedures.

The mixer may require the provision of gases at approximately equal pressures (an equal pressure mixer), or may require relatively higher oxygen pressure in relation to that of the fuel gas (an injector mixer). A mixer may be matched to a range of nozzle orifice sizes or to only one.

Mixers may be detachable units or integral with the blowpipe. They may also derive from assembly by the operator of matching parts.

The wide range of equipment in use makes it imperative that operators refer to the supplier's operating instructions in respect of nozzle selection, pressure settings, lighting and extinguishing procedures. In the case of combined service blowpipes, the correct assembly and operation of the blowpipe for its various duties and fuel gases is an important area to study.

The use of safety devices in a gas supply line may require an increase in supply pressure to compensate for the pressure losses caused. Since these losses vary between different makes or types of safety devices and their conditions, it is not possible for the blowpipe manufacturer to provide specific information. The user should refer to the supplier of the device or devices for information on pressure loss and the pressure compensation required.

The maintenance of blowpipes shall be carried out as recommended by the manufacturer / supplier, and at least in accordance with Appendix 1.

For preparing a blowpipe for use refer to Section 9.12.

8. CYLINDER STORAGE AND HANDLING

Unsafe storage and cylinder mishandling have the potential to cause incidents. BCGA TIS 15 (65), *Model risk assessment for the storage and use of oxy-acetylene cylinders*, can be used to assist in developing a site risk assessment.

It is essential that proper information, instruction and training is given to all staff who are involved in the storage and handling of gas cylinders, refer to Section 12.

There are specific regulations for transporting gas cylinders, refer to Section 8.3.

8.1 Cylinder storage

Gas cylinders and cylinder bundles shall be stored in accordance with BCGA CP 44 (57), *The storage of gas cylinders*, which defines the principles of safe practice for storage.

All gas cylinder stores should follow these basic principles:

- the store is in an external location;
- the store is in a secure location and has adequate security;
- the store and the local area has good ventilation;
- cylinders are away from sources of ignition or combustible material (which is not a necessary part of the store);

- cylinders are not exposed to excessive heat. Take care to prevent the heating of cylinders from the process or any other external heat source;

- the storage area has appropriate safety signs and warning notices displayed;

- cylinders are stored in a vertical position, properly restrained to avoid them falling over;

- in a store, all cylinders have their valves closed. This includes empty cylinders as this prevents the ingress of moisture or other contaminants. If available, fit protective covers.

8.2 Cylinder handling

Gases supplied in cylinders can be in compressed, liquefied or dissolved form. The cylinders vary in weight, size and shape. These physical characteristics present potential manual handling hazards. Appropriate risk assessment, training and handling aids are required.

The *Manual Handling Operations Regulations* (2) require that before any manual handling takes place an assessment of manual handling operations is conducted. Following the assessment, appropriate training should take place. Where the assessment indicates that the work exceeds guideline limits, wherever practicable the operation should be mechanised or handling aids provided.

BCGA GN 3 (59) *Safe cylinder handling and the application of the manual handling operations regulations to gas cylinders*, defines the principles of safe practice for handling and moving cylinders and provides a basic understanding of the *Manual Handling Operations Regulations* (2) relating to gas cylinders. BCGA TIS 17 (66), *Model risk assessment for manual handling activities in the industrial gas industry*, can be used to assist in developing a site risk assessment.

HSE provide guidance in HSE INDG 390 (35), *Choosing a welding set? Make sure you can handle it.*

When handling gas cylinders:

- always wear appropriate personal protective equipment, for example, eye, hand and foot protection. Safety shoes or boots with metatarsal protection are strongly recommended. Refer to Section 9.1;

- purpose designed trolleys should be used for moving cylinders wherever practicable;

- do not lift cylinders by using the valve protection device unless they have been designed for that purpose. Do not use ropes, chains or slings to suspend cylinders unless the supplier has installed appropriate lifting attachments such as lugs. Suitable cradles, platforms or pallets to hold the cylinders may be used for lifting. Refer to BCGA TIS 38 (73), *Moving gas cylinders and bundles within the workplace*;

- subject to risk assessment, for moving over even, level floors and only for short distances, by competent operators, the 'churning' method may be considered;

- cylinders shall not be rolled along the ground since this may damage or even open the valve and will also damage identifying marks and symbols;

- cylinders shall not be moved with the valve open;

- cylinders shall not be moved with the regulators and hoses attached, unless secured on a purpose designed trolley or carrier;

- cylinders shall not be used as work-supports or rollers.

8.3 Cylinder transportation

The transportation of any gas cylinder shall comply with the *Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations* (12). These regulations implement the *European Agreement Concerning the International Carriage of Dangerous Goods by Road* (ADR) (17), which provides a framework for dangerous goods to be carried nationally and internationally in road vehicles subject to compliance with standards for the packaging and labelling of the dangerous goods, and appropriate construction and operating standards for the vehicles and crew. Gases are classified as Class 2 dangerous goods.

BCGA provide specific guidance for transporting gas cylinders in BCGA GN 27 (63), *Guidance for the carriage of gas cylinders on vehicles*, additional advice is provided in BCGA Leaflet 1 (74), *The carriage of small quantities of gas cylinders on vehicles.*

Where gas cylinders are transported in mobile workshops and other specialist vehicles refer to BCGA CP 31 (55), *The safe storage and use of cylinders in mobile workshops and service vehicles*.

9. PREPARATION FOR USE

Before commencing any activity, risk assessments shall be carried out in accordance with the *Management of Health and Safety at Work Regulations* (5). All potential hazards shall be assessed and appropriate control measures put in place. BCGA provide a generic risk assessment, refer to BCGA TIS 15 (65), *Model risk assessment for the storage and use of oxy-acetylene cylinders*.

The Control of Substances Hazardous to Health Regulations (COSHH) (8) requires employers to either prevent or reduce workers' exposure to substances that are hazardous to their health. Be aware of the properties of each gas, refer to Section 3. Protection will be required against welding fume, refer to Section 6.10. Appropriate personal protective equipment shall be provided and worn, refer to Section 9.1. For further information refer to HSE L5 (19).

If the work area may be classified as a confined space then a specific confined space risk assessment shall be carried out in accordance with the *Confined Spaces Regulations* (3). Additional precautions are necessary, refer to Section 9.3.

As oxidant and flammable gases are on-site and in use, a responsible person shall carry out a Fire Safety Risk Assessment, the findings from which are to be incorporated into the Site Fire Safety Management Plan, refer to Section 9.2.

Where there is the potential for a flammable or an explosive atmosphere to occur, a specific risk assessment shall be carried out in accordance with DSEAR (9). A DSEAR (9) risk assessment may be required for hot work on containers, refer to Section 9.4.

All persons handling and using gaseous cylinders and pressure equipment shall have received adequate information, instruction, training and, as appropriate, supervision. The employer is responsible for ensuring that each individual is competent to carry out each task safely and correctly. Refer to Section 11.

The supplier or employer of a person who puts into service, modifies or repairs a mobile system, or components of it, shall provide sufficient information to enable the user of a pressure system to determine how to operate and maintain it safely.

Such information for equipment for use with individual portable or mobile cylinder supply may include the following:

- safe operating limits for pressure and temperature;
- operating and maintenance instructions.

The correct location of cylinders, correct assembly of equipment and correct operation will all contribute to minimising the risk of an incident involving gas cylinders. For information on:

- choosing a fuel gas, refer to Section 9.6;
- locating cylinders, refer to Section 9.7;
- identifying and preparing a cylinder, refer to Section 9.8;
- assembling a pressure regulator, refer to Section 9.9;
- incorporating safety devices, refer to Section 9.10;
- assembling hose assemblies, refer to Section 9.11;
- assembling blowpipes, refer to Section 9.12;
- choosing a nozzle, refer to Section 9.13;
- pressurising the system, refer to Section 9.14;

- purging the system, refer to Section 9.15;

- lighting up, refer to Section 9.16.

Whenever oxy-fuel is in use thorough ventilation of the work area and the controlled use of the fuel gas and oxygen is essential.

The fuel gas and the oxygen should not be used for any purpose whatsoever other than as a gas supply to the blowpipes. Oxygen will react violently in the presence of oil and grease and both gases can increase the risk of a fire.

Equipment cleanliness is essential and, to avoid possible contamination, clothing, tools and the working area should be kept clean.

Standard operating procedures for the handling and use of gas cylinders and the use of oxy-fuel equipment shall be prepared and used.

Emergency operating procedures shall be prepared and used, refer to Section 12.

BCGA TIS 29 (71), *Oxy-fuel gas equipment. Selection and assembly*, highlights the fundamental health and safety practices for selecting and assembling oxy-fuel equipment.

HSE provide information in HSE INDG 297 (31).

9.1 Personal protective equipment

Personal Protective Equipment (PPE) is to be provided as required by the *Personal Protective Equipment Regulations* (7). PPE may only be considered as a control to achieve an acceptable level of residual risk after other levels of control have been addressed. A risk assessment will determine the requirement for the use of hazard controls, including PPE. Where PPE is required a PPE Assessment shall be carried out. Due regard is to be given to the requirements of the *Control of Substances Hazardous to Health* (COSHH) *Regulations* (8), any relevant equipment publications, manufacturers information and the product Safety Data Sheet. The PPE shall be selected for a particular task and location and must be appropriate and chosen to effectively reduce the overall risk. Thus there are different PPE requirements for differing products, different tasks and possibly different personnel.

HSE L25 (21), *Personal Protective Equipment at Work*, provides guidance on the *Personal Protective Equipment Regulations* (7). EIGA 136 (82), *Selection of personal protective equipment*, provides guidance for selecting and using PPE at work.

Eye protection is essential at all times when using oxy-fuel equipment. Goggles should comply with BS EN 175 (39), *Personal protection. Equipment for eye and face protection during welding and allied processes*, and lenses with BS EN 169 (38), *Personal eye protection. Filters for welding and related techniques. Transmittance requirements and recommended use.* The outer lens should be replaced before any build-up of welding spatter, dirt or scratches impedes the operator's vision. Recommendations on the correct shade of filter lens to use are found in BS EN 169 (38). A backing lens should be used if the filter lens is not robust.

Safety glasses should be used when connecting or disconnecting gas cylinders.

Suitable leather gloves or gauntlets should be worn during operations or when handling metal.

For cylinder handling the use of protective equipment for hands, feet and eyes is essential. Safety shoes or boots with metatarsal protection are strongly recommended.

In areas where the noise level is excessive ear protection may be required. Refer to Section 6.11.

In certain locations, or site conditions, other personal protective equipment may be obligatory, for example, hard hats, fire resistant clothing, breathing apparatus, etc.

9.2 Fire protection

As oxidant and flammable gases increase the fire risk when on-site and/or in use, a responsible person shall carry out a Fire Safety Risk Assessment, the findings from which are to be incorporated into the Site Fire Safety Management Plan. Each site should keep a record of the location of its hazardous store(s), this is to be made available to the emergency services in the event of an incident. Refer to *The Regulatory Reform (Fire Safety) Order* (10).

Where there is the potential for a flammable or an explosive atmosphere to occur, a specific risk assessment shall be carried out in accordance with the *Dangerous Substances and Explosive Atmospheres Regulations* (DSEAR) (9). DSEAR (9) places a formal requirement on employers to assess the risks for substances if classified for these properties and put in place suitable control and mitigation measures. BCGA provide a generic risk assessments, refer to BCGA GN 13 (61).

For further information refer to:

- HSE L138 (24), *Dangerous substances and explosive atmospheres Dangerous Substances and Explosive Atmospheres Regulations 2002. Approved Code of Practice and guidance.*

- HSE INDG 370 (34), *Controlling Fire & Explosion risks in the workplace. A brief guide to DSEAR.*

Fire- fighting equipment / facilities as identified in the Site Fire Safety Management Plan shall be provided. The operator shall ensure that fire extinguishers are readily available at all times when oxy-fuel gas equipment is in use. A dry powder or CO_2 extinguisher is recommended.

Emergency procedures for dealing with a fire in the workplace are to be drawn up and included in the information, instruction and training provided. Refer to Section 11 and Section 12.

Since there are obvious fire hazards, the work area and its surroundings should be kept free of flammable and combustible materials as far as is practicable. The floor should

be swept clear of flammable debris and dust. All flammable materials within the range of possible sparks should be removed.

If it is not possible to maintain a safe distance from flammable materials, suitable fire resisting screening should be used.

Work should not be carried out on wooden floors or close to wooden joists without using suitable protection. If possible, wooden floors and walls should be dowsed with water before work is started. Sparks falling through gaps in floorboards or inadvertent heating of thermal insulation, i.e. polyurethane foam, are a particular hazard since the material may start smouldering and may take some time to develop into a fire. It is therefore essential to carry out subsequent inspection of the area, at frequent intervals, until satisfied that the risk of fire has passed.

Where the consequences of a fire are severe, for example, work inside ships, you may need to appoint a fire watch during and after the work finishes. A fire watch should be maintained for a minimum of 30 minutes after hot work finishes. Where oxy-fuel gases are used on-board ships additional information is provided in HSE Engineering Information Sheet 43 (37), *Storage and use of oxygen and fuel gases on board ships*.

9.3 Work in confined spaces

Working in confined spaces is subject to the *Confined Spaces Regulations* (3). A specific confined space risk assessment shall be carried out. For further information refer to HSE L101 (22), *ACOP Safe work in confined spaces*, and to HSE INDG 258 (30), *Confined spaces. A brief guide to working safely*.

When working in a confined space, as part of the specific confined space risk assessment, determine the requirement for:

- the use of a Permit to Work.

  A written Permit to Work for the particular type of work (hot work, entry into a vessel, etc.) shall be issued by an authorised person to the individual(s) carrying out the work. HSE HSG 250 (27), *Guidance on permit-to-work systems. A guide for the petroleum, chemical and allied industries*, and EIGA 40 (80), *Work permit systems*, provide guidance on how to plan and execute potentially hazardous jobs in a safe manner;

- atmospheric monitoring (refer to Section 9.5) to:

  - ensure the atmosphere is of a standard suitable to support life;

  - detect leakage of a flammable gas, which can cause asphyxiation and/or increase the risk from hot work causing a fire;

  - detect leakage of oxygen, leading to oxygen enrichment, therefore increasing the risk from hot work causing a fire.

- constant and thorough ventilation.

WARNING: Oxygen shall never be used to freshen the air in a confined space as this will increase the hazard of oxygen enrichment of the atmosphere;

- the need to take gas cylinders into a confined space. Where this cannot be avoided then appropriate control measures shall be put in place;

- additional personal protection equipment, refer to Section 9.1;

- a system of communication.

When carrying out work in a confined space an assistant (sentry) should be stationed outside to monitor and communicate with all personnel inside the confined space and, as necessary, to take the appropriate emergency actions;

- emergency operating procedures (including emergency rescue).

Work in a confined space will require specific emergency operating procedures to be prepared, and for all individuals who are involved, such as Supervisors, Operators and Sentries, to be fully informed and trained on their individual responsibilities.

Emergency operations may require specialist equipment to be provided.

Equipment shall not be left in a confined space after the actual work has been completed or at times when work has ceased for more than a few minutes.

Where oxy-fuel gases are used on board ships or other similar large fabrications additional information is provided in HSE Engineering Information Sheet 43 (37), *Storage and use of oxygen and fuel gases on board ships*.

Further information on the hazards associated with changes to the local atmosphere and the actions required in an emergency are available in BCGA GN 11 (60).

9.4 Hot work on containers

Additional precautions shall be taken when carrying out hot work on, or near, any plant, vessel, tank or container which has previously held hazardous products, such as, petrol, oil, spirits, paint or other combustible, flammable, explosive or toxic material. The introduction of an ignition source may cause a fire, which may lead to an explosion.

A container may appear empty, however seams, creases and folds in the container may still harbour sufficient liquid residue to give rise to an explosive vapour and so the risk of ignition and injury remains. Even where the contents of a container may not have been classified as flammable under normal conditions, the extreme temperatures which can be generated during hot work can heat the vessel contents sufficiently to cause them to ignite. There is also a risk that a container may have held a variety of hazardous products which may not be indicated on the markings on the container.

Where there is the potential for a flammable or an explosive atmosphere to occur, a specific risk assessment shall be carried out in accordance with DSEAR (9), refer to Section 9.2.

A written Permit to Work for the particular type of work (hot work, entry into a vessel, etc.) shall be issued by an authorised person to the individual(s) carrying out the work. HSE HSG 250 (27) and EIGA 40 (80), provide guidance on how to plan and execute potentially hazardous jobs in a safe manner.

Before undertaking hot work the hazard should be reduced by using methods such as gas-freeing, cleaning or inerting. It is essential that expert advice be taken before first undertaking such work and that the container is certified gas and residue free. Work shall only commence once tests have shown that the atmosphere is safe for the work to proceed. For more comprehensive guidance refer to:

- HSE INDG 314 (32), *Hot work on small tanks and drums*;
- UKLPG CP 17 (77), *Purging LPG vessels and systems*.

Where entry is required into a container, refer to Section 9.3 for confined spaces, and Section 9.5 for changes to the internal atmosphere.

All employees engaged in hot work shall have received adequate information, instruction and training in the risks involved and the precautions required, refer to Section 11.

The following general headings, whilst not exhaustive, indicate some of the considerations necessary before starting work on any container which has contained potentially hazardous substances.

- Remove all hazardous product residuals including any in the seams, etc.
- Ensure that the atmosphere inside the work area is non-flammable and, if possible, vent to open air.
- If internal work is to be done, ensure thorough ventilation or that the operator is wearing appropriate PPE (refer to Section 9.1), for example, a respirator supplied with breathing quality air. Refer to BS EN 529 (40), *Respiratory protective devices. Recommendations for selection, use, care and maintenance. Guidance document*, and BS EN 12021 (50), *Respiratory equipment. Compressed gases for breathing apparatus*.

  WARNING: Never use oxygen for ventilation or for the supply to the respirator.

  Internal work is likely to meet the conditions for being a confined space, as such the requirements of the *Confined Spaces Regulations* (3) shall be followed. Refer to Section 9.3.

- Always have a properly trained assistant to the operator stationed outside, in readiness for emergency actions.

- Never approach with naked lights until satisfied that thorough cleaning and ventilation have been completed.

- Post warning notices.

- Do not use the containers, for example, oil drums, as work supports.

9.5 Changes to the workplace atmosphere

The normal oxygen content of the air is approximately 21 %. When using oxy-fuel equipment, changes to the local atmosphere can occur. Any change to the normal atmospheric conditions can create a hazardous situation.

When using oxy-fuel equipment the fumes generated may contribute to a change in the local atmosphere, as well creating fine particles and potentially toxic by-products which are hazardous to health, refer to Section 6.10.

A leakage of a flammable gas can reduce the local oxygen content, which increases the risk of asphyxiation and / or will create a combustible atmosphere which will increase the risk of fire.

A leakage of oxygen can lead to oxygen enrichment, increasing the risk of an ignition source causing a fire.

An enriched atmosphere can arise from unconsumed cutting oxygen. Even with correct cutting conditions some unconsumed oxygen from the cutting oxygen stream is released into the atmosphere. To keep this to a minimum, the use of the correct nozzle and cutting pressures is important.

Oxygen levels greater than 23.5 % are deemed unsafe in which to work. A fire resulting from oxygen enrichment will spread rapidly across combustible materials such as clothing and body hair and is extremely difficult to extinguish.

WARNING: It is never safe to search for gas leaks with a naked flame.

BCGA GN 11 (60) provides detailed guidance, also refer to HSE INDG 459 (36), *Oxygen use in the workplace. Fire and explosion hazards.*

9.6 Choosing a fuel gas

There are a range of fuel gases available. Fuel gases are mostly hydrocarbon based and each will have its own unique properties. Your choice of fuel gas is fundamental to the quality, safety, efficiency and cost-effectiveness of your fabrication processes.

Sometimes the wrong gas is chosen for use and this can increase the risk of a hazardous situation. Often this is due to incorrect information (from a lack of knowledge) or generic policies adopted on a particular site. When choosing a fuel gas the specific requirements of each task and the location of hot work should always be considered.

When choosing a fuel gas the following characteristics of each gas should be taken into account:

- the properties of the flame required. For example, flame temperature, chemical composition, heat intensity and heat distribution;

- the number of cylinders required to be on site. Fuel gases consume oxygen at different rates, and your choice may require you to have a greater number of cylinders on site. Extra cylinders will increase the fire risk and the manual handling requirements;

- the density of the gas. A gas that is heavier than air will drop into lower spaces, whereas a gas that is lighter than air will rise and more readily disperse in the air;

- the location at which it is being used. When working, for example, in confined spaces, tunnels or on top of a building, a lighter than air gas that will rise and readily disperse is a safer option.

Acetylene and propane are the most common fuel gases used. For further information refer to:

- HSE INDG 327 (33), *Working safely with acetylene*.

- BCGA Technical Information Sheet (TIS) 32 (72), *Acetylene or propane (for welding, cutting and allied processes).*

9.7 Location of gas cylinders

In order to ensure safe operation of the equipment it is essential to locate the cylinders in a safe place relative to the work about to be carried out. They are to be located in a position with good ventilation, where they will be protected from sources of ignition, excessive heat, contamination (especially by oils and greases) and mechanical damage.

The cylinders should be within view of the operator wherever possible.

Where cylinders are close to the work area these additional safety points should be taken into consideration:

- cylinders shall not be exposed to heat. Take care to prevent the heating of cylinders or damage to the cylinders from the process, sparks and slag or any other external heat source;

- precautions shall be taken to ensure that no electric current, for example, from arc welding processes, can reach the cylinders. Steel floors, structural members or metal benches can carry earth return currents.

When not required for use gas cylinders should be kept in a gas cylinder store, refer to Section 8.1.

9.8 Gas cylinders

Ensure you have the correct gas product. Prior to use check and confirm that it is the gas you require. The primary method for identifying the gas contents of a cylinder is the label. If the label is defaced or missing the cylinder is not to be used and is to be returned to the gas supplier. Additional information is available on the Safety Data Sheet. Refer to Section 3 and, as necessary, seek further advice from your gas supplier.

As an aid to identification, cylinders may be painted in a specific colour. Within the UK acetylene cylinders are painted maroon. Typically oxygen cylinders will be painted with a white shoulder, and hydrogen cylinders will be painted red. For further information refer to BCGA TIS 6 (64, *Gas cylinder identification. Label and colour code requirements*.

The number of cylinders in the work area should be kept to a minimum. If a cylinder is not required for use then it should be returned to the gas cylinder store.

For information on handling gas cylinders, refer to Section 8.2.

Should there be any visible trace of oil or grease on an oxygen cylinder valve, the cylinder shall be put aside for return to the owner. Contaminated cylinders shall be suitably marked to prevent accidental re-issue.

Cylinders are normally designed to be used in the vertical position. Acetylene and liquefied gases, such as propane, shall always be used in the vertical position. Cylinders shall be restrained to avoid toppling.

Before connecting a regulator onto the cylinder outlet valves, ensure the cylinder valve outlet is clean, dry, and free from damage and dirt. Refer to BCGA TIS 22 (69), *BCGA policy on connecting gas cylinders*.

9.9 Pressure regulators

For information on pressure regulators refer to Section 7.1.

Before attaching a regulator to a cylinder, check:

(i) That the gas inside the cylinder is correctly identified and that the regulator is suitable for that specific gas.

(ii) That the cylinder valve outlet thread is mechanically compatible with the regulator inlet connection and is undamaged, clean and free of contamination. Refer to BCGA TIS 22 (69).

(iii) That the regulator is suitable for the maximum cylinder pressure (regulator inlet pressure);

(iv) That the regulator is manufactured to the standards detailed in Section 7.1;

(v) The regulator is within its expiry date. Typically 5 years or to the manufacturer's recommendation, refer to Appendix 1.

(vi) The regulator has a suitable outlet pressure for the application;

(vii) That the regulator is in a serviceable condition.

(viii) The gauges are not damaged nor show signs of over pressurisation.

(ix) If the Regulator is fitted with an 'O' ring seal. Check for damage and replace if necessary with an 'O' ring recommended by the regulator manufacturer.

(x) That the regulator outlet thread is in good condition.

(xi) Check the cylinder outlet valve and the regulator are closed. The regulator pressure – adjusting screw is set to zero pressure position by turning the control knob fully anti-clockwise;

Fit the pressure regulator to the cylinder. Only use the correct sized spanner when attaching a regulator. Do not use any form of jointing paste or tape between regulator and cylinder valve. Check that:

(xii) The regulator is fitted in the correct orientation:

- suitable for the cylinder valve outlet, that is top outlet or side outlet;

- the gauges and controls naturally face the front so that they are visible and accessible to the operator;

If the cylinders are mounted on a trolley, the fuel gas regulator outlet should be pointing away from the oxygen cylinder so that any rupture of the fuel gas hose will not cause burning gas to play on to the oxygen cylinder.

9.10 Safety devices

For information on safety devices refer to Section 7.2.

The *Acetylene Safety Regulations* (13) require that all acetylene mobile systems shall be fitted with a flame arrestor within one metre of the pressure regulator, and incorporate a non-return valve and a quick acting shut-off device.

The minimum requirement for all hose sizes and lengths is:

(i) A non-return valve (hose check valve) shall be incorporated into the assembled hose prior to each blowpipe inlet connection.

(ii) A three function flame arrestor shall be fitted in both the oxygen and fuel gas lines as close to the regulator as possible.

For additional safety to (i) and (ii), and especially if access to cylinders is difficult or they are remote from the operator, making them difficult to isolate, the following safety devices may be added:

(iii) A blowpipe mounted flame arrestor with a minimum of a non-return valve and a flame arresting element.

Or

(iv) A blowpipe mounted flame arrestor with a minimum of a non-return valve and a flame arresting element and replace the three function flame arrestor with a four function flame arrestor (which incorporates a pressure sensitive cut-off) as close to the regulator as possible.

NOTE: The use of additional flame arrestors will provide increased safety. However in such cases, the flow capacity of the system will be less than the rated flow of each individual flame arrestor. Therefore, care should be taken to ensure flow capacity is adequate for the correct and safe use of the equipment in accordance with the supplier's operating instructions.

The requirements are summarised in Table 2 and illustrated in Appendix 2.

REQUIREMENTS	FIT TO BOTH BLOWPIPE INLETS	FIT BETWEEN REGULATOR OUTLET & BLOWPIPE IN BOTH GAS LINES
Minimum (i) & (ii)	NV (Hose)	NV + FA + TV
Additional safety (iii)	NV (Hose) + NV + FA	NV + FA + TV
Additional safety (iv)	NV (Hose) + NV + FA	NV + FA + TV + PV

Key:

NV (Hose)	Non Return Valve (Hose check valve)
NV	Non-Return Valve
FA	Flame Arresting Element
PV	Pressure Sensitive Cut-Off Valve
TV	Temperature Sensitive Cut-off Valve

Table 2: Safety devices – Installation requirements.

9.11 Hose assemblies

For additional information on hose assemblies refer to Section 7.3.

Ensure that all threads and seats are in good condition in accordance with manufacturers' / suppliers' instructions. Take particular care to install the device in the correct orientation such that the direction of flow is correct.

Before attaching a hose assembly, check:

- it is compatible with the gas, the gas pressure, and as appropriate, has the correct colour code and either a left or right handed thread, refer to Table 1;

- all fittings, threads, connection seatings and clips are serviceable;

- for signs of excessive wear, cuts, abrasion, burns, contamination or general deterioration.

Replace any hose assemblies that are unserviceable or whose condition is in any way unsatisfactory.

When the equipment is in use the hose assembly should not be coiled around cylinders, regulators or the handle of the trolley. In a fire a coiled hose is difficult to extinguish.

As necessary, protect the hose assemblies from heat, mechanical damage, traffic, sparks, hot splatter, slag and oil or grease.

9.12 Blowpipes

For information on blowpipes refer to Section 7.4.

Before fitting the blowpipe to the hose assembly, check:

- the blowpipe is suitable for the gas and application;

- all threads and seats are in good condition;

- all valves on the blowpipe are in the closed position.

9.13 Nozzles

Nozzle selection. It is essential to select the correct nozzle. Nozzles are specified to the type of fuel gas being used and sized to the material and its thickness.

In order to ensure there is a gas tight seal in the blowpipe, always use nozzles which are compatible with that specific blowpipe, refer to Appendix 3.

NOTES:

1. Identify the manufacturer of the blowpipe. Individual manufacturers use different seat angles and lengths of fitting between the nozzle and head.

2. Using a manufacturer's nozzle data chart enables the selection of the correct nozzle and size for the application and gives the operator the required pressures and gas consumption data for that process.

9.14 Pressurising the system

Before pressuring the system ensure that all regulator pressure adjustment knobs are fully unwound and downstream equipment valves are closed.

Slowly open each cylinder valve in turn. Where the valve is not fitted with a handwheel, use only the gas supplier's recommended cylinder key and ensure that once the valve is open, the cylinder key is left fitted to the valve. Normally a valve is sufficiently open after one and a half turns. Never open a valve completely so that the spindle is tight against the back. Leave at least half a turn to let others know that the valve is open.

Adjust the pressure regulators to give the required gas pressures.

Check the equipment for leaks using a suitable leak detection fluid. For further information on leak detection fluids refer to EIGA 78 (81).

Re-adjust pressures with the gas flowing.

9.15 System purging

Before attempting to light the blowpipe, purge each hose separately to establish only oxygen or fuel gas in the appropriate hose, closing each blowpipe valve after the relevant hose has been purged.

Purging should be continuous. Typically 3 to 5 seconds for a standard (5 m) hose. Longer times are required for longer hose lengths.

This operation should take place in a well-ventilated space away from any source of ignition.

It is essential that the procedure of purging gas systems shall take place following each period of non-use.

NOTE: The majority of flashback incidents occur due to poor purging practices.

9.16 Lighting up

Always ignite the fuel gas before introducing the oxygen stream. The nozzle should be pointing upwards for lighter than air gases (for example, acetylene), downwards for heavier than air gases (for example, propane).

Light the blowpipe and adjust it in accordance with the supplier's instructions. It is recommended that a spark lighter or pilot flame is used for this purpose. Should there be any signs of leakage, fluctuations of gas supply, gas starvation or mis-shaped flames, the equipment should be shut down until the fault has been corrected.

Care should be taken to prevent a fire caused by an excess quantity of unburned fuel gas and/or oxygen being discharged to the atmosphere, should the blowpipe fail to ignite immediately.

10. CLOSING DOWN PROCEDURE

When closing down for short periods such as meal breaks, etc., carry out steps (i) to (v) of the following list. For longer periods, and particularly if equipment is left unattended, then carry out the full routine of steps (i) to (viii).

(i) Extinguish the blowpipe in accordance with the manufacturer's operating instructions.

(ii) Extinguish any pilot lights.

(iii) Close both cylinder valves.

(iv) Open blowpipe to vent hoses separately to a safe area. Check that the pressure gauges on the regulators return to zero. Re-close blowpipe valves.

(v) Fully unwind the regulator pressure-adjusting knob to zero delivery position (by turning anti-clockwise).

(vi) Visually check equipment for damage.

(vii) Return equipment and cylinders to a place of safe storage, reporting any damage at the same time.

(viii) Make a final check to ensure that the cylinder valves are properly closed and that there is no leakage of gas.

When working in a confined space, only Step (i) shall be carried out before the blowpipe is removed from the confined space. Steps (ii) to (viii) can only then be carried out. Blowpipes shall be removed from the confined space when work has ceased for more than a few minutes.

11. INFORMATION, INSTRUCTION AND TRAINING

All personnel directly involved in the assembly, operation and maintenance of oxy-fuel pressure equipment shall have the necessary skills and knowledge to carry out their job safely and shall receive appropriate information, instruction and training, including induction and continuation / refresher training. Such training shall be both theoretical and practical. It is the duty of the employer to ensure their persons are adequately trained and to establish competency. It is recommended that a training programme is carried out under a formalised system. Records shall be kept of the information, instruction and training provided and of the competence level achieved. The programme shall make provision for periodic competence re-assessment.

This will include training on:

- the hazards and properties of oxy-fuel gases. Refer to Section 3;
- the gas cylinders;
- associated equipment and the pressure system(s);
- manual handling of gas cylinders. Refer to Section 8.2;

- correct storage of gas cylinders. Refer to Section 8.1;
- ventilation and monitoring systems, including gas detection;
- actions in the event of an emergency. Refer to Section 12.

Recommendations for the training of personnel are detailed in BCGA GN 23 (62). For additional information refer to EIGA Document 23 (79), *Safety training of employees*.

12. EMERGENCY PROCEDURES

The user shall have fire-fighting equipment / facilities as identified in the Site Fire Safety Management Plan provided and a site-specific emergency procedure in place for fire situations in compliance with The *Regulatory Reform (Fire Safety) Order* (10). Refer to Section 9.2.

BCGA Leaflet 6 (75), *Cylinders in fires*, provides guidance on dealing with gas cylinders involved in a fire.

Correct location of cylinders, correct assembly of equipment and correct operation will all contribute to minimising the risk of an incident involving gas cylinders.

If a gas leak occurs and / or ignites (flammable gases) in the presence of an operator, if safe to do so, isolate by turning off the cylinder valve.

The most common incidents to occur are leakages of fuel gas from hose connections or a defective hose, which then ignites. If this occurs, if safe to do so, close the cylinder valve and extinguish the fire. If it is not possible to close the valve first, then extinguish the fire and then close the valve to avoid re-ignition. If the fire is in the vicinity of the regulator, it may be possible to close the pressure adjusting screw on the regulator.

If a fire continues carry out the actions in Section 12.1.

12.1 For cylinders involved in fires

- KEEP AWAY, DO NOT approach or attempt to move the cylinder or operate the valve.
- Raise the alarm.
- Evacuate the immediate area and keep others away.
- Contact the Fire and Rescue Service.

Keep well clear until the Fire and Rescue Service arrive and then follow their instructions.

Inform the Fire and Rescue Service immediately of the location, the quantity and type of any gas cylinders involved in the fire. Also tell them the location of other gas cylinders on the premises.

Cylinders which are not directly involved in the fire and which have not become heated, should be moved as quickly as possible to a safe place, provided that this can be done without undue risk. Make sure that cylinder valves are closed.

12.2 Sustained backfire

Close both blowpipe valves, oxygen valve first.

(i) Check that regulator pressure settings were correct and that the cylinders are not empty.

(ii) If necessary, cool the blowpipe by immersion in water and then check that the nozzle, mixer and blowpipe connections are tight.

(iii) Purge both hoses individually and ensure that correct gas flows have been re-established.

(iv) Relight the blowpipe with care and make sure that the shape and general behaviour of the flame is correct.

(v) Should there be a recurrence, then the equipment shall be withdrawn from service for full examination by a person with appropriate experience and knowledge.

12.3 Flashback / self-extinguishing backfire

(i) Immediately close both blowpipe valves, oxygen valve first.

(ii) Close both cylinder valves.

(iii) Ascertain the cause of the incident and examine all equipment thoroughly for damage. In particular, check to see if the pressure or temperature-sensitive cut-off valve has closed.

When using acetylene, check all equipment for signs of soot, which will indicate the extent of flashback.

Monitor the acetylene cylinder for any signs of it becoming warm after a flashback. If a hotspot is detected, or the cylinder begins to vibrate, immediately evacuate the area and call the Fire and Rescue Service.

(iv) Replace any damaged equipment.

Before attempting any steps towards relighting, ensure that the cut-off valve, if fitted, is reset or replaced as necessary.

(v) Carry out all preparation procedures specified in Section 11 and be particularly vigilant during the first few minutes after relighting.

12.4 Fire damaged gas cylinders

Following an incident the Fire and Rescue Service will inform you when it is safe to approach the gas cylinders. Do not use any cylinders which have been involved in a fire. Some may have obvious damage but others may have had their mechanical properties affected by heat, unnoticeable to the naked eye. Inform your gas supplier whenever a cylinder has been involved in a fire or if it is suspected that it has been affected by excessive heat. Your gas supplier will provide advice on what to do next, which will vary depending upon the circumstances

Contact numbers for the gas supplier are available on the product Safety Data Sheet. Refer also to BCGA Leaflet 6 (75).

13. SECURITY

Gas cylinders and the gases they contain are hazardous. When not in use they should be located in a secure store, refer to Section 7.1.

When in use at the workplace they should be accountable and be subject to routine management checks.

If gas cylinders are empty, or no longer required, then they should be returned to the gas supplier at the earliest opportunity.

Additional advice is available from your gas supplier and the BCGA.

14. REFERENCES

	Document Number	Title
1.		The Health and Safety at Work etc. Act 1974.
2.	SI 1992: No 2793	Manual Handling Operations Regulations 1992.
3.	SI 1997: No 1713	The Confined Spaces Regulations 1997.
4.	SI 1998: No. 2306	The Provision and Use of Work Equipment Regulations 1998. (PUWER).
5.	SI 1999: No 3242	The Management of Health and Safety at Work Regulations 1999.
6.	SI 2000: No. 128	The Pressure Systems Safety Regulations 2000 (PSSR).
7.	SI 2002: No 1144	Personal Protective Equipment Regulations 2002.

Document Number		Title
8.	SI 2002: No 2677	Control of Substances Hazardous to Health Regulations 2002 (COSHH).
9.	SI 2002: No 2776	The Dangerous Substances and Explosive Atmosphere Regulations 2002 (DSEAR).
10.	SI 2005: No. 1541	The Regulatory Reform (Fire Safety) Order 2005.
11.	SI 2005: No. 1643	The Control of Noise at Work Regulations 2005
12.	SI 2009 No. 1348	The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 (as amended).
13.	SI 2014: No. 1639	The Acetylene Safety (England and Wales and Scotland) Regulations 2014.
14.	SI 2015: No. 51	The Construction (Design and Management) Regulations 2015 (CDM)
15.	SI 2016 No. 1105	The Pressure Equipment (Safety) Regulations 2016
16.	EU Directive 2014/68/EU	Directive 2014/68/EU of the European Parliament and of the Council of 15 May 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of pressure equipment. (PED)
17.	ECE/TRANS/257	European Agreement concerning the international carriage of dangerous goods by road (ADR) (as amended)
18.	HSE EH 40	Workplace exposure limits.
19.	HSE L5	Control of substances hazardous to health. The Control of Substances Hazardous to Health Regulations 2002 (as amended). Approved Code of Practice and guidance.
20.	HSE L22	Safe use of work equipment. Provision and Use of Work Equipment Regulations 1998. Approved Code of Practice and guidance.
21.	HSE L25	Personal Protective Equipment at Work.
22.	HSE L101	Safe work in confined spaces. Confined Space Regulations 1997. Approved Code of Practice, regulations and guidance.
23.	HSE L122	Safety of pressure systems. Pressure Systems Safety Regulations 2000. Approved Code of Practice.
24.	HSE L138	Dangerous substances and explosive atmospheres DSEAR 2002. Approved Codes of Practice and Guidance.

Document Number		Title
25.	HSE L153	Managing health and safety in construction. Construction (Design and Management) Regulations 2015. Guidance on Regulations.
26.	HSE HSG 139	The safe use of compressed gases in welding, flame cutting and allied processes.
27.	HSE HSG 250	Guidance on permit-to-work systems. A guide for the petroleum, chemical and allied industries.
28.	HSE HSG 258	Controlling airborne contaminants at work. A guide to local exhaust ventilation (LEV).
29.	HSE INDG 136	Working with substances hazardous to health. A brief guide to COSHH.
30.	HSE INDG 258	Confined spaces. A brief guide to working safely.
31.	HSE INDG 297	Safety in gas welding, cutting and similar processes.
32.	HSE INDG 314	Hot work on small tanks and drums.
33.	HSE INDG 327	Working safely with acetylene.
34.	HSE INDG 370	Controlling Fire & Explosion risks in the workplace. A brief guide to DSEAR.
35.	HSE INDG 390	Choosing a welding set? Make sure you can handle it.
36.	HSE INDG 459	Oxygen use in the workplace. Fire and explosion hazards.
37.	HSE EIS 43	Storage and use of oxygen and fuel gases on board ships.
38.	BS EN 169	Personal eye protection. Filters for welding and related techniques. Transmittance requirements and recommended use.
39.	BS EN 175	Personal protection. Equipment for eye and face protection during welding and allied processes.
40.	BS EN 529	Respiratory protective devices. Recommendations for selection, use, care and maintenance. Guidance document.
41.	BS EN 560	Gas welding equipment. Hose connections for equipment for welding, cutting and allied processes.
42.	BS EN 561	Gas welding equipment. Quick-action coupling with shut-off valves for welding, cutting and allied processes.
43.	BS EN 1256	Gas welding equipment. Specification for hose assemblies for equipment for welding, cutting and allied processes.

Document Number		Title
44.	BS EN ISO 2503	Gas welding equipment. Pressure regulators and pressure regulators with flow-metering devices for gas cylinders used in welding, cutting and allied processes up to 300 bar (30 MPa).
45.	BS EN ISO 3821	Gas welding equipment. Rubber hoses for welding, cutting and allied processes.
46.	BS EN ISO 5172	Gas welding equipment. Blowpipes for gas welding, heating and cutting. Specifications and tests.
47.	BS EN ISO 5175	Gas welding equipment. Safety devices. Part 1: Devices incorporating a flame (flashback) arrestor. Part 2: Devices not incorporating a flame (flashback) arrestor.
48.	BS EN ISO 7291	Gas welding equipment. Pressure regulators for manifold systems used in welding, cutting and allied processes up to 30 MPa (300 bar).
49.	BS EN ISO 11114	Transportable gas cylinders. Compatibility of cylinder & valve materials with gas contents. Part 1: Metallic materials. Part 2: Non-metallic materials.
50.	BS EN 12021	Respiratory equipment. Compressed gases for breathing apparatus.
51.	BS EN ISO 22435	Gas cylinders. Cylinder valves with integrated pressure regulators. Specification and type testing.
52.	BCGA Code of Practice 4	Industrial gas cylinder manifolds and distribution pipework (excluding acetylene).
53.	BCGA Code of Practice 5	The design and construction of manifolds using acetylene gas from 1.5 to 25 bar.
54.	BCGA Code of Practice 6	The safe distribution of acetylene in the pressure range 0 to 1.5 bar.
55.	BCGA Code of Practice 31	The safe storage and use of cylinders in mobile workshops and service vehicles.
56.	BCGA Code of Practice 39	In-service requirements of pressure equipment (gas storage and gas distribution systems).
57.	BCGA Code of Practice 44	The storage of gas cylinders.
58.	BCGA Code of Practice 47	The safe use of individual portable or mobile cylinder gas supply equipment.

Document Number		Title
59.	BCGA Guidance Note 3	Safe cylinder handling and the application of the manual handling operations regulations to gas cylinders.
60.	BCGA Guidance Note 11	The management of risk when using gases in enclosed workplaces.
61.	BCGA Guidance Note 13	DSEAR Risk Assessment.
62.	BCGA Guidance Note 23	Gas safety. Information, instruction and training.
63.	BCGA Guidance Note 27	Guidance for the carriage of gas cylinders on vehicles.
64.	BCGA Technical Information Sheet 6	Gas cylinder identification. Label and colour code requirements.
65.	BCGA Technical Information Sheet 15	Model risk assessment for the storage and use of oxy-acetylene cylinders.
66.	BCGA Technical Information Sheet 17	Model risk assessment for manual handling activities in the industrial gas industry.
67.	BCGA Technical Information Sheet 18	Date marking of gas accessories.
68.	BCGA Technical Information Sheet 19	Refurbishment of components used with compressed gases for welding, cutting and related processes.
69.	BCGA Technical Information Sheet 22	BCGA policy on connecting gas cylinders.
70.	BCGA Technical Information Sheet 24	Welding fumes. Safety alert.
71.	BCGA Technical Information Sheet 29	Oxy-fuel gas equipment. Selection and assembly.
72.	BCGA Technical Information Sheet 32	Acetylene or propane (for welding, cutting and allied processes).
73.	BCGA Technical Information Sheet 38	Moving gas cylinders and bundles within the workplace.
74.	BCGA Leaflet 1	The carriage of small quantities of gas cylinders on vehicles.
75.	BCGA Leaflet 6	Cylinders in fires.

Document Number		Title
76.	BCGA Safety Alert 1	The hazards of using incorrect regulators on acetylene gas cylinders.
77.	UKLPG Code of Practice 17	Purging LPG vessels and systems.
78.	UKLPG User Information Sheet 28	Safe use of propane and butane cylinders & cartridges.
79.	EIGA Document 23	Safety training of employees.
80.	EIGA Document 40	Work permit systems.
81.	EIGA Document 78	Leak detection fluids cylinder packages.
82.	EIGA Document 136	Selection of personal protective equipment.
83.	EIGA Safety Information 5	Flashback and flashback arrestors in welding applications.

Further information can be obtained from:

UK Legislation	www.legislation.gov.uk
Health and Safety Executive (HSE)	www.hse.gov.uk
British Standards Institute (BSI)	www.bsigroup.co.uk
International Organization for Standardization (ISO)	www.iso.org
European Industrial Gases Association (EIGA)	www.eiga.eu
British Compressed Gases Association (BCGA)	www.bcga.co.uk
The UK LPG trade association (UKLPG)	www.uklpg.org
The Chartered Society for Worker Health Protection (BOHS)	www.bohs.org

GUIDANCE ON INSPECTION AND MAINTENANCE

EQUIPMENT	INTERVALS				
	AT ASSEMBLEY	**BEFORE USE**	**AFTER USE**	**ANNUAL**	**REPLACEMENT / REFURBISHMENT INTERVALS**
REGULATORS and their integral protective devices *Sections 7.1, 9.9*	Check compatible with the gas. Ensure within life for use. Check the regulator inlet pressure is compatible with the maximum cylinder pressure. Ensure the Pressure Adjustment control is firmly fixed to the body and operates freely. Check the inlet and outlet connections sit square to the regulator's body. Check condition of threads and sealing surfaces. Ensure no signs of PTFE tape. Check both gauges on regulator naturally face the front and are undamaged.	Check body for any signs of soot, oil, grease or other contamination. Check compatible with the gas. Ensure the Pressure Adjustment control is firmly fixed to the body and operate freely. Ensure the regulator gauges start at zero prior to use. Ensure the pressure rises on the high pressure gauge when opening the cylinder outlet valve. Check the low pressure gauge rises smoothly when setting the gas pressure. Leak test all joints at working pressure.	Check for any damage, contamination, defects or faults. Check that gauges return to zero during the venting process.	Full visual inspection. Check life dates. Functional tests to ensure correct operation. Typically this will include a creep test to ensure regulator integrity.	5 years from date of manufacture or manufacturer's recommendations. Replace with a new, or refurbished unit NOTE 1. NOTE 2.

	Ensure both gauge needles reset to zero. No oil, grease or other contamination. Leak test all joints at working pressure.				
FLAME ARRESTORS and their integral cut off valves. *Sections 7.2, 9.10*	Check correct type fitted. Check manufacturing standard. Ensure within life for use. Check condition of threads and sealing surfaces. Check the direction of flow is correct. No oil, grease or other contamination. Leak test all joints at working pressure. Check the pressure sensitive cut-off valve button is not restricted / damaged / tied down.	Ensure flame arrestors are fitted. Leak test all joints at working pressure.	Check for any damage, contamination, defects or faults.	Check unit for leaks, flow restrictions and reverse flow to ensure correct operation of non-return valves. Where pressure sensitive cut off valves are fitted, they shall operate at a pressure of no greater than 1.2 bar. If of a pressure sensitive type, check shut-off in the tripped condition in the direction of flow. Check life dates.	5 years from date of manufacture or manufacturer's recommendations. Replace with a new, or refurbished unit. NOTE 1. NOTE 2.

HOSE ASSEMBLIES *Sections 7.3, 9.11* (including NON-RETURN VALVES) *Sections 7.2, 9.10.*	Check the manufacturing standard. Check suitability of hose colour, internal bore size and length Check threads and sealing surfaces. Check hoses condition for damage (e.g. kinking twisting or cracking). Ensure HCV and Nut & Tails are fitted using correct ferrules and are located in the correct place. Leak test of all joints at working pressure.	Ensure all the gas hose is unwound from gas cylinder trolley prior to use. Check hoses condition for damage (e.g. kinking twisting or cracking). Leak test of all joints at working pressure.	Check for any damage, contamination, defects or faults.	Reverse hose to ensure the correct operation of non-return valve where fitted. Bend hose in a tight radius to ensure reinforcement is not visible and there is no sign of collapse or distortion.	Determined by local operating conditions. Replace as required. NOTE 2
BLOWPIPES *Sections 7.4, 9.12*	Check compatible with the gas. Check the condition of the body, head and pipes. Check blowpipe nut is undamaged and is not oval. Ensure the blowpipe taps are undamaged and operate freely.	Ensure the blowpipe nozzle is correct for the type of gas being used. Check the condition of the body, head and pipes. Ensure the blowpipe taps are undamaged and operate freely.	Check for any damage, contamination, defects or faults.	Test valve functions. Blank exits and leak test for internal malfunction.	Determined by local operating conditions. Replace with a new, or refurbished unit NOTE 2

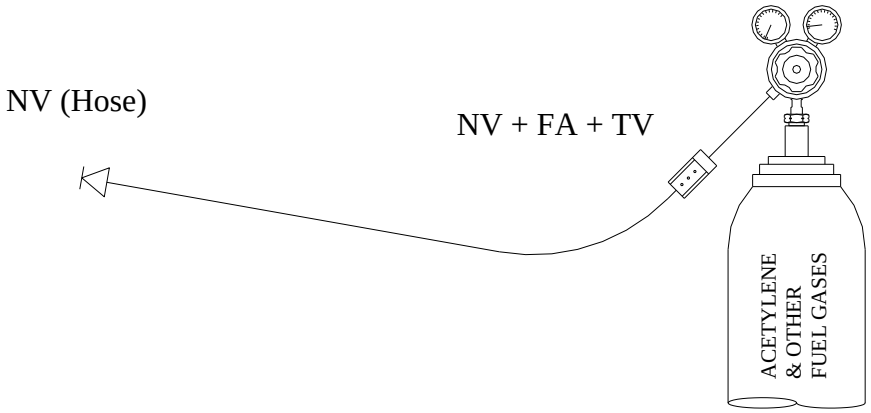
	Check nozzle and inlet seatings for damage. Leak test all joints at working pressure.	Check nozzle and inlet seatings for damage. Leak test all joints at working pressure.			

NOTE 1: Components such as elastomers, seals and diaphragms, will wear and deteriorate from their date of manufacture whether in gas service or not. Items stored out of gas service for one year or over should receive checks in accordance with the annual requirements.

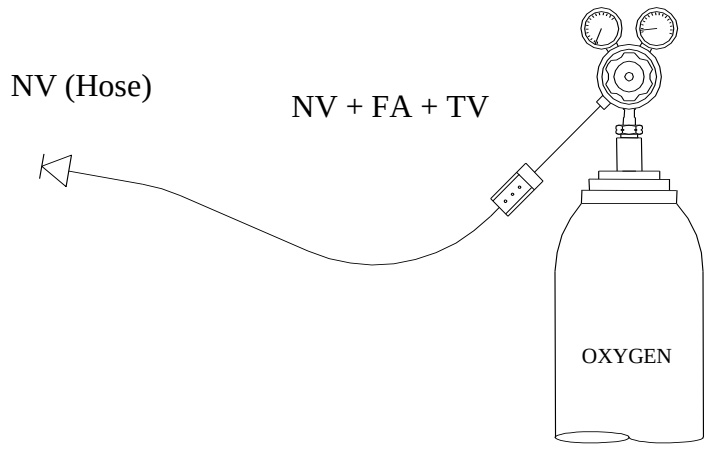
NOTE 2: Some equipment is marked to either identify the date it was manufactured or the date when it needs replacement or refurbishment. Refer to BCGA TIS 18 (67), *Date marking of gas accessories*.

MINIMUM REQUIREMENT FOR ALL HOSE SIZES AND LENGTHS

Refer to Section 9.10 and Table 2.



BLOWPIPE

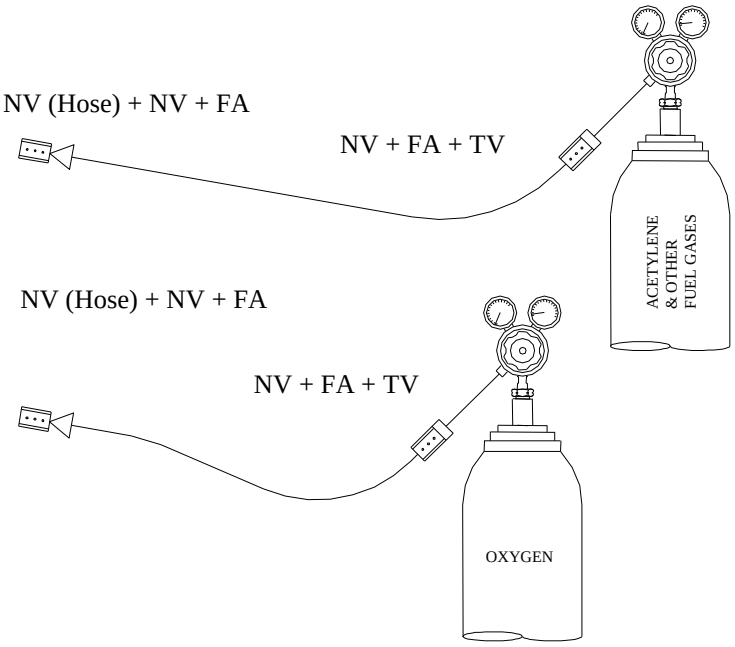


KEY:

NV (Hose)	Non-return valve (Hose check valve)
NV	Non-return valve
FA	Flame arresting element
TV	Temperature sensitive cut-off valve

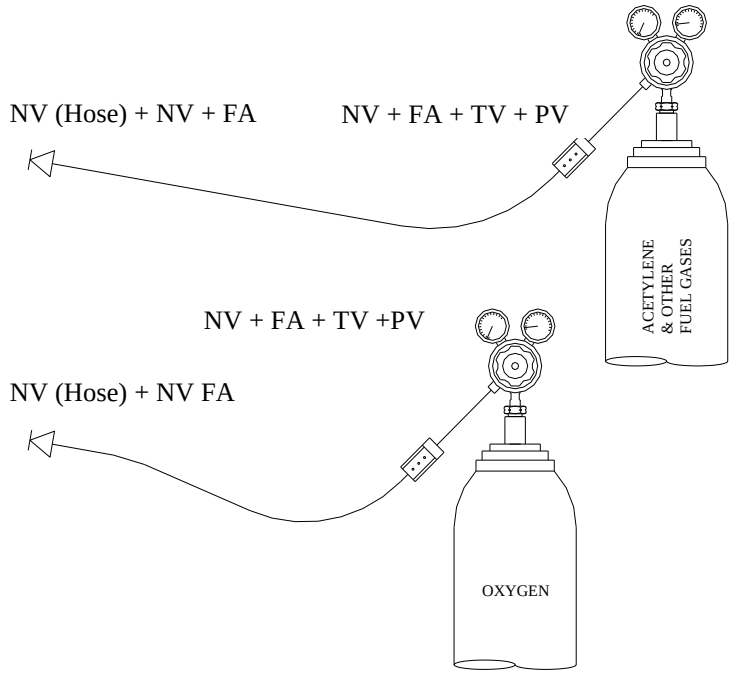
FOR ADDITIONAL SAFETY

A.



or

B.



KEY:

NV (Hose) Non-return Valve (Hose check valve)
NV Non-return valve
FA Flame arresting element
TV Temperature sensitive cut-off valve
PV Pressure sensitive cut-off valve

THREE-SEAT CUTTING NOZZLES - DIMENSIONS

This Appendix specifies the cone angle for three-seat cutting nozzles required for compatibility with the main UK brands of oxy-fuel gas cutting blowpipes. Refer to Section 9.13.

This angle, although standardised by the main UK brands, is not standardised throughout the world or within Europe, and is not detailed in BS EN ISO 5172 (46). Users are warned that problems with head seat leaks can result from using non-compatible equipment.

Figure A3-1 shows the cone angle to be used for three-seat cutting nozzles. Dimensions not given are left to the manufacturer's discretion.

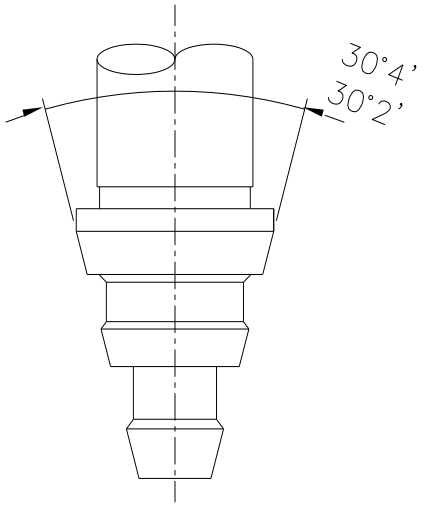


Figure A3-1: Cone angle for three-seat cutting nozzles.

British Compressed Gases Association

www.bcga.co.uk