CODE OF PRACTICE 7

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

REVISION 7: 2014

Incorporating Corrigendum 1 – January 2017

British Compressed Gases Association

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BRITISH COMPRESSED GASES ASSOCIATION
Registered office: 4a Mallard Way, Pride Park, Derby, UK. DE24 8GX
Company Number: 71798, England

Website:
www.bcga.co.uk

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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 CP 7, Revision 7, 2014. It was approved for publication at BCGA Technical Committee 155. This document was first published on 01/02/2017. For comments on this document contact the Association via the website www.bcga.co.uk.

Corrigendum 1 – January 2017 – incorporates a correction to the text in Section 10.6, a new Section 10.7 and inclusion of Appendix 2.

CONTENTS

* 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

The following describes the function of the main items of equipment and explains the meaning of significant terms used in this Code. The references quoted in Section 14 should be consulted for more detailed and precise information.

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.

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.

Some blowpipes may, by an interchange of components, be adapted to carry out a wide range of duties.

Refer to Section 6.3.

Composite safety device (Flashback arrestor)

A unit which embodies 2 or more of these devices:

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

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. Flame arrestors shall conform to BS EN 730-1 (42).

Hose assemblies

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

Refer to Section 6.2.

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. 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 shall conform to BS EN ISO 5172 (46) and may be detachable units or integral with the blowpipe. They may also derive from assembly by the operator of matching parts. They may be located in the shank, neck, head or nozzle (nozzle mix) of the blowpipe.

Non-return valve	A device which prevents the passage of gas in the direction opposite to normal flow. Specifically a non-return valve shall be effective against the return of gas towards the cylinder. Refer to Section 6.4.
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 regulator	Device for regulating a generally variable inlet pressure to as constant as possible an outlet pressure. Refer to Section 6.1.
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 device which interrupts the gas flow in the event of a back pressure wave from the downstream side.
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. The various devices shall conform to BS EN 730 (42), Parts 1 & 2 or ISO 5175 (47) as appropriate.
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. Refer to Section 6.1.

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

1. INTRODUCTION

Fuel gases are mostly hydrocarbon based and each has its own unique properties. The choice of a fuel gas is based on its ability to burn in air or oxygen and will be dependant on the specific requirements of the job, as well as the location at which it is being used. There are several useful fuel gases of which acetylene and propane are the most common.

Acetylene is an extremely flammable gas and can burn in the presence of air or oxygen. This generates very high flame temperatures, which is the reason why acetylene is so effective for cutting and welding. The acetylene (C_2H_2) molecule, however, if initiated by heat exposure of a cylinder in a fire, or through excessive fill pressure, can also decompose breaking up into one hydrogen molecule and two carbon atoms. This reaction delivers much less energy than combustion but can, in some circumstances, be strong enough to rupture a cylinder. Additionally, whereas acetylene is very soluble in the solvents used in dissolved acetylene cylinders, hydrogen, when released through decomposition, is much less soluble; giving a significant and irreversible pressure rise within the cylinder, which can be sufficient to cause its rupture. For these reasons the maximum working pressure of an acetylene cylinder is kept relatively low at 19 bar. Consequently, manifolds connected to an acetylene cylinder are designed and constructed to operate at pressures between 1.5 and 25 bar. In use, acetylene is delivered to the end user at pressures up to 1.5 bar.

NOTE: The design of a dissolved acetylene cylinder is also important. Each cylinder is filled with a porous material, which is a very effective obstacle for energy and fluid flow. A solvent is then added to the porous material, (typically acetone or dimethylformamide (DMF)), and the acetylene gas is then dissolved in this solvent. The dissolved acetylene cylinder is thus a complex system comprising a number of components interacting with each other. This system keeps acetylene in a safe condition inside the cylinder.

As a consequence of this potential hazard, acetylene is subject to specific legislation. Following a major review of legislation in 2014, acetylene was placed under The Acetylene Safety (England and Wales and Scotland) Regulations (15). This revision complies with these new regulations.

The Acetylene Safety (England and Wales and Scotland) Regulations (15) require that all mobile systems shall be fitted with a purpose designed regulator for acetylene, a flashback arrestor incorporating a non-return valve and a pressure and/or temperature sensitive cut-off valve.

The manufacture of compressed acetylene gas; the compression of acetylene at pressures equal to or greater than 0.62 bar; or the filling of a cylinder with compressed acetylene gas cannot be carried out without a licence issued by the Health and Safety Executive (HSE). The licensee shall comply with the conditions of the licence and comply with the requirements of the Acetylene Safety (England and Wales and Scotland) Regulations (15), Schedule 1.

The content of this publication is in line with advice from the HSE. For more details refer to http://www.hse.gov.uk/fireandexplosion/acetylene.htm and leaflet HSE INDG 327 (33), *Working safely with acetylene.*

The Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) (10) requires that employers undertake a risk assessment and put in place suitable controls where an explosive atmosphere may occur, such as where oxidising or flammable gases are used or stored.

It is recommended that users of oxy-fuel gas processes ensure that all new installations, or modifications to existing installations, comply with this Code of Practice for the products or services involved.

It is pointed out that this code represents the BCGA's views of minimum requirements for safe practices, reference should be made to Section 14 for further details on specific standards or Regulations.

2. SCOPE

This Code of Practice gives the minimum safety standards for the use, inspection and maintenance of oxy-fuel gas welding, cutting and heating equipment incorporating individual portable or mobile cylinder gas supplies, each gas being controlled by a cylinder-mounted regulator.

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

The following documents provide specific information:

- BCGA CP 4 (51), *Industrial gas cylinder manifolds and gas distribution pipework (excluding acetylene).*

- BCGA CP 5 (52), *The design and construction of manifolds using acetylene gas from 1.5 – 25 bar.*

- BCGA CP 6 (53), *The safe distribution of acetylene in the pressure range 0 - 1.5 bar.*

- BCGA GN 7 (58), *The safe use of individual portable or mobile cylinder gas supply equipment.*

The UKLPG provide additional information on the safe use of liquefied petroleum gases (LPG). Refer to UKLPG User Information Sheet 28 (75), *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. Operators using equipment covered by this Code of Practice shall be trained in the correct procedures for the safe use of the equipment, refer to Section 12, and the emergency procedures to be carried out in the event of an incident, refer to Section 13.

3. KEY PROPERTIES OF THE GASES USED

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, in accordance with the Chemicals (Hazard

Information and Packaging for Supply) Regulations (CHIP) (13). The exact requirements for Safety Data Sheets are now included in the Registration, Evaluation, Authorisation and restriction of Chemicals (REACH) Regulations (18), Article 31, *Requirements for Safety Data Sheets*. Safety Data Sheets can be obtained for all gases and are to be available for all those handling the cylinder or using the gas.

NOTE: The CHIP (13) Regulations brings national legislation into line with the transitional arrangements set out in European Regulation (EC) No 1272/2008 (17) on the Classification, Labelling and Packaging of Substances and Mixtures (CLP). The CLP (17) Regulation entered into force across all EU member states, including the UK, on 20 January 2009. The CLP (17) Regulation has applied to substances that are placed on the market since 1 December 2010. It is not mandatory to use the CLP (17) classification system to classify chemical mixtures (preparations) until 1 June 2015. The CHIP (13) Regulations will be repealed from 1 June 2015, from when suppliers must comply with the CLP (17) Regulation.

Two of the most popular fuel gases are acetylene and propane. However, these gases have many different properties, and care should be taken to choose the correct gas for your particular application. BCGA Technical Information Sheet (TIS) 32 (69), *Acetylene or propane (for welding, cutting and allied processes),* provides further information.

As a flammable atmosphere may exist a risk assessment shall be carried out in compliance with DSEAR (10) and suitable controls put in place. If an explosive atmosphere may exist signage shall be displayed.

NOTE: Guidance on the preparation of Risk Assessments under DSEAR (10) is contained in BCGA GN 13 (60), *DSEAR Risk Assessment.* Additional guidance is provided by the HSE, refer to HSE L138 (25), *Dangerous substances and explosive atmospheres DSEAR 2002. Approved Codes of Practice and Guidance*, and HSE INDG 370 (34), *Controlling Fire & Explosion risks in the workplace. A brief guide to DSEAR.*

All gases, except oxygen and air, are potentially asphyxiating. The use of all gases in confined spaces is potentially hazardous. Additional safety precautions are detailed in Section 8.

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

3.1 Oxygen

(i) Vigorously supports combustion. Many materials which will not normally burn in air will readily burn in an oxygen-rich atmosphere.

(ii) May react violently as an oxidant e.g. with oils, greases, some solvents and some metals.

(iii) Colourless.

(iv) Odourless.

(v) Non-toxic, non-flammable.

3.2 Liquefied Petroleum Gas (LPG) – Propane, Butane, etc.

(i) Usually odorised to give characteristic smell.

(ii) Colourless.

(iii) Flammable and will ignite from a spark or by contact with hot metal.

(iv) For propane the flammability range in air is from 2.1 % to 9.5 %. For butane the flammability range in air is from 1.8 % to 8.4 %.

(v) Non-toxic, but asphyxiating by depletion of oxygen.

(vi) Is a fire and explosion hazard.

(vii) Heavier than air and will collect in pits, drains or trenches.

3.3 Acetylene

(i) Non-toxic, but asphyxiating by depletion of oxygen.

NOTE: Commercial supplies of acetylene do contain trace impurities which are toxic and which can also give rise to a slight odour. Precautions should be taken to avoid inhaling acetylene gas.

(ii) Garlic like odour.

(iii) Flammable and will ignite from a spark or by contact with hot metal.

(iv) The flammability range in air is from 2.2 % to 85 %.

(v) Is a fire and explosion hazard.

(vi) Has a distinct fire property which requires special precaution. The heat of a fire may initiate decomposition. Flashback or overheating of the cylinder may cause decomposition within the cylinder giving rise to high temperatures and possible explosion.

NOTE: Decomposition is an exothermic (heat creating) reaction.

(vii) Lighter than air (will collect in roof spaces, etc).

NOTE: Mixtures of acetylene and acetone vapour can be heavier than air.

(viii) Naturally colourless.

3.4 Hydrogen

(i) Naturally colourless.

(ii) Non-toxic.

(iii) Much lighter than air. May concentrate in roof spaces.

(iv) Burns with a very pale blue flame, often difficult to see.

(v) Do not carry out any valve clearance procedure by releasing gas. Refer to BCGA TIS 22 (67), *BCGA policy on connecting gas cylinders*.

(vi) Naturally odourless.

(vii) Asphyxiating by depletion of oxygen.

(viii) The flammability range in air is from 4 % to 75 %.

(ix) Extremely flammable and easily ignited. It will ignite from a spark or by contact with hot metal.

(x) Is a fire and explosion hazard.

3.5 Gas mixtures

These must be treated as if they exhibit the properties of all the component gases, unless their hazard classification demonstrates otherwise.

4. PROCESS HAZARDS

Key hazards are:

4.1 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.

4.2 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.

4.3 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.

4.4 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 subsequent explosion.

4.5 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.

4.6 Decomposition

The breakdown of acetylene into carbon and hydrogen in the absence of oxygen giving rise to high temperatures and pressures.

4.7 Oxygen ignition

The ignition of components or particles in contact with high-pressure oxygen. This is usually initiated by the presence of oil or grease. Oxygen systems shall always be completely free of oil or grease, and assembled from components which are known to be oxygen clean.

4.8 Oxygen enrichment

Excess of unconsumed oxygen from cutting processes is a source of enrichment and can therefore be dangerous. Refer to Section 8.3.

Good ventilation and careful use of cutting oxygen is essential to avoid accidents. Reference should be made to HSE Leaflet 8 (21), *Take care with oxygen, Fire and explosion hazards in the use of oxygen,* and HSE INDG 459 (35), *Oxygen use in the workplace. Fire and explosion hazards.*

4.9 Fumes

The products of combustion of all fuel gases are dangerous in high concentration, they will displace breathable air, and may contain toxic products, such as carbon monoxide. There are hazards from fumes in some applications, e.g. silver brazing, work on painted or galvanised metals, etc. 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) (9). Reference should be made to HSE Guidance Note EH 40 (20), *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 via the Welding Fume Team to try to influence attitudes and behaviours with respect to welding fume, particularly in encouraging the use of appropriate Personal Protective Equipment. BCGA has published additional advice on welding fumes within BCGA TIS 24 (68), *Welding fumes. Safety alert*. The Welding Fume Team has produced a website www.badairday.info which explains in detail the safety concerns associated with welding fume and which encourages appropriate safe behaviour.

4.10 Maintenance

Danger may occur as a result of misuse or lack of maintenance of equipment. Refer to Section 5.3.

5. PRESSURE SYSTEMS SAFETY REGULATIONS

The European Commission Pressure Equipment Directive (PED) (17) provides a legal structure whereby pressure equipment can be manufactured and sold throughout Europe. The PED (17) is implemented in the UK through the Pressure Equipment Regulations (6). The Pressure Equipment Regulations (6) cover the first placement on the market and putting into service of pressure equipment and assemblies. Thereafter, the in-service operation and inspection of pressure systems is covered by the Pressure Systems Safety Regulations (PSSR) (7).

HSE L122 (24), *Safety of pressure systems. Pressure Systems Safety Regulations 2000. Approved Code of Practice*, provides further guidance on the PSSR (7). It should be noted that the overall intention of the (PSSR) (7) is to prevent the risk of serious injury from stored energy as a result of the failure of a pressure system or part of it.

HSE has advised owners and users that portable oxy-fuel welding and cutting sets are unlikely to require a Written Schemes of Examination. Refer to HSE L122 (24) [paragraph 113]. However, HSE emphasises that, although gas welding sets are not considered to pose a risk from the release of stored energy, they do pose a risk of fire or explosion if they are not assembled, operated or maintained correctly. Under the Health and Safety at Work etc. Act (2), as well as the Provision and Use of Work Equipment Regulations (5) effective maintenance of gas welding and cutting equipment is essential to ensure safety. All users should carry out pre-use checks and carry out regular examinations of the equipment.

The equipment within the scope of this Code of Practice is covered by the PSSR (7). However, compliance with legislation relevant to liquid and gas cylinders is the responsibility of the supplier and filler of the cylinders and as such is not addressed in this Code of Practice. If the user has any questions over the application of the legislation to any transportable liquid or gas container they should be referred to the supplier of that container.

5.1 Provision of information and marking

The supplier or the 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 the safe operating limits within his responsibility.

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

(i) Safe operating limits for pressure and temperature

(ii) Operating instructions

(iii) Test certificates.

The above information may be included in the operating instructions supplied to the user or marked on the equipment.

5.2 Written Scheme of Examination

Written Schemes of Examination in accordance with the PSSR (7) are not required for oxy-fuel gas equipment used with individual portable or mobile cylinder supply. However the maintenance requirements of Section 5.3 apply.

5.3 Maintenance

Maintenance of equipment is a requirement of the PSSR (7) where failure to maintain could give rise to danger. It is the responsibility of the user to ensure that this is carried out (Regulation 12). Under the Health and Safety at Work etc. Act (2), as well as the Provision and Use of Work Equipment Regulations (5) there are requirements for the maintenance of equipment to ensure safety. In the case of cylinders fitted with a valve with integrated pressure regulator (VIPR) the responsibility for the routine replacement lies with the owner, typically the gas supplier.

It is essential that routine maintenance, as detailed in Table 1, taking into account manufacturers' / suppliers' recommendations, is carried out before use by the operator and at least annually.

Annual maintenance shall be carried out by a person who has been formally trained to demonstrate that he has:

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

and

(ii) Theoretical knowledge of 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.

It is the duty of the employer to ensure persons undertaking maintenance activities are adequately trained and to establish competency, refer to Section 12.

TABLE 1: Guidance on maintenance

EQUIPMENT	MAINTENANCE				
	EACH TIME THE EQUIPMENT IS CONNECTED TOGETHER As per the manufacturer's instructions, and to include Carry out a visual examination to determine suitability for service (e.g. gas, pressure rating, damage), oil or grease contamination.	**EACH TIME THE EQUIPMENT IS USED** (by the operator). Carry out a visual examination to determine suitability for service (e.g. gas, pressure rating, damage), oil or grease contamination.	**ANNUAL **** (This inspection may be more frequent dependant on conditions of use) To include, as per instructions for Each Time the Equipment is Connected Together, plus:	**REPLACEMENT / REFURBISHMENT INTERVALS** (May be more frequent dependant on conditions of use)	**REPLACEMENT / REFURBISHMENT GUIDELINE**
1. REGULATORS and their integral protective devices	Check condition of threads and sealing surfaces, oil or grease contamination. Leak test all joints at working pressure. Check that gauges on regulator zeroes correctly and rises smoothly when gas is turned on.	Leak test all joints at working pressure. Check that gauges on regulator zeroes correctly and rises smoothly when gas is turned on.	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. * NOTE: If regulators are refurbished this shall be in accordance with BCGA TIS 19 (66)	Replace with a new, or refurbished unit.
2. FLASHBACK ARRESTORS and their integral cut off valves.	Check condition of threads and sealing surfaces, oil or grease contamination. Leak test all joints at working pressure.	Leak test all joints at working pressure.	Check unit for flow restriction. Reverse flow to ensure correct operation of non-return valves. Where pressure sensitive cut off valves are fitted, they must 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.	5 years from date of manufacture or manufacturer's recommendations. *	Replace with a new, or refurbished unit.

3. HOSE ASSEMBLIES (including NON-RETURN VALVES)	Check threads and sealing surfaces. Check hoses for condition of cover (e.g. kinking twisting or cracking). Leak test of all joints at working pressure.	Check hoses for condition of cover (e.g. kinking twisting or cracking). Leak test of all joints at working pressure.	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.
4. BLOWPIPES	Check condition of the nozzle and inlet seatings for damage. Leak test all joints at working pressure.	Check condition of the nozzle and inlet seatings for damage. Leak test all joints at working pressure.	Test valve functions. Blank exits and leak test for internal malfunction.	Determined by local operating conditions.	Replace with a new, or refurbished unit.
5. VIPR (Valve with Integrated Pressure Regulator)	Check condition of threads and sealing surfaces, oil or grease contamination. Leak test all joints at working pressure. Check that pressure gauge on regulator zeroes correctly and rises smoothly when gas is turned on.	Leak test all joints at working pressure. Check that pressure gauge on regulator zeroes correctly and rises smoothly when gas is turned on.	Functional tests to ensure correct operation. Typically this will include a creep test to ensure regulator integrity.	This is the responsibility of the owner, typically the gas supplier.	This is the responsibility of the owner, typically the gas supplier.

* Regulator and flashback arrestor elastomers and seals will wear and deteriorate from their date of manufacture whether in gas service or not. Items stored out of gas service for 1 year or over should receive inspection as per the annual maintenance inspection. The owner / user is required to identify the date when equipment is due for inspection / maintenance. Refer to BCGA TIS 18 (65), *Gas equipment inspection / replacement date marking*.

** This should be carried out by a suitably trained person. Refer to Section 5.3.

6. SAFETY PRECAUTIONS – EQUIPMENT

Consideration should be given to the hazards and risks associated with the use of welding gases and equipment and the protective measures needed to control them. 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 safer use of compressed gases and describe the hazards associated with portable oxy-fuel gas equipment and the precautions for avoiding injury and damage to property.

Managers, supervisors and operators should study and give close attention to manufacturer's / suppliers' instructions for the correct and safe use of all equipment and materials used. Where necessary, any modifications, changes or repairs to primary gas equipment shall be done by a competent person or authorised third party and will require the primary gas equipment to be retested to ensure integrity and functionality are within manufacturer's original specification.

The BCGA, gas equipment manufacturers and gas suppliers recognise that some gas equipment is manufactured to a specification which is suitable for multiple gas use and is labelled as such. Examples of this gas equipment are inert gas pressure regulators (e.g. nitrogen, argon), flashback arrestors (e.g. hydrogen, propane and acetylene) and multi-use fuel gas hoses.

Equipment is generally marked and identified to show the gas service it has been designed for and the service for which it is intended. Once equipment has been used in a particular gas service its material properties will have been affected by that particular gas, by the pressure at which that gas is delivered to the equipment and by the way it is delivered. Over time this can result in wear and deterioration which is specific to that gas. This will have been allowed for in the design and manufacture of that equipment.

The subsequent use of this equipment in another gas service may result in adverse conditions being set up which would not have been considered in the original design. This might result in over-pressurisation, excessive decay of internal elastomers and excessive withdrawal rates from gas cylinders.

The BCGA recommends that once an equipment product has been used in a particular gas environment or service that it should remain in that gas 'type' service for the lifetime of the product.

All equipment supplied for and used with oxygen shall only be used with oxygen to ensure that safe operating conditions are met. Equipment not marked for oxygen service shall not be used with oxygen.

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.

Specialist oxygen compatible jointing tape is used in the manufacture of gas equipment. However jointing tape should not be used by end-users. If your equipment is worn or leaking contact your equipment provider, or gas supplier for advice.

Refer to BCGA TIS 22 (67) prior to connecting equipment to gas cylinders.

BCGA TIS 18 (65) provides information on some of the equipment marking schemes used by manufacturers.

6.1 Pressure regulators

Pressure regulators shall be chosen for their compatibility with the welding 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.

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. For further information refer to BCGA Safety Alert 1 (72), *The hazards of using incorrect regulators on acetylene gas cylinders*.

Oxygen regulators shall only be used in oxygen service.

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. They should not be stressed by rapid opening of the cylinder valve. Whether they are in store or in use, inlet and outlet connections must be kept free of grit, and any form of oil, grease or solvents. Contaminated units shall not be used and shall be removed from service.

Regulators having damaged pressure gauges, pressure indicators, inlet or outlet connections or threads, should not be used. A regulator with a known defect should be repaired by a competent person (typically the original supplier) or replaced.

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.

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 VIPR's they should conform to:

- BS EN ISO 22435 (50), *Gas cylinders. Cylinder valves with integrated pressure regulators. Specification and type testing*.

For regulators with greater than 20 bar working pressure it is recommended that the following is clearly and permanently marked on the pressure-regulator body or cover:

(i) Gas service.

(ii) Maximum inlet pressure.

(iii) Maximum outlet pressure.

(iv) The name or trademark of the manufacturer and / or distributor.

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

NOTE: There are many types of regulators in service for other gases, for example ultra high purity gases, information on these is provided in BCGA CP 18 (54), *The safe storage, handling and use of special gases*.

6.2 Hose and hose assemblies

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

(ii) Hose connections shall conform to BS EN 560 (40), *Gas welding equipment - Hose connections for equipment for welding, cutting and allied processes.*

(iii) Hose check valves shall conform to BS EN 730-2 (42), *Gas welding equipment. Safety devices.* Refer to Section 6.4.

(iv) Hose assemblies shall conform to BS EN 1256 (43), *Gas welding equipment. Specification for hose assemblies for equipment for welding, cutting and allied processes.*

(v) Quick action couplings shall conform to BS EN 561 (41), *Gas welding equipment. Quick-action coupling with shut-off valves for welding, cutting and allied processes*.

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. 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 2 and BS EN ISO 3821 (45).

Gas service	Colour
Oxygen	Blue
Compressed air, nitrogen, argon and carbon dioxide	Black
LPG, methane, natural gas and MPS	Orange
Acetylene, hydrogen[2] and other fuel gases (excludes LPG, methane, natural gas & MPS)	Red
Universal fuel gases (included in this table) except fluxed fuel gases[1]	Red / orange
Fluxed fuel gases[1]	Red – Flux
NOTES: 1. Universal fuel gas hoses (colour coded red /orange) are not to be used for fluxed fuel gas hoses. 2. The manufacturer shall be consulted on the suitability of the hose for use with hydrogen.	

Table 2: Hose colour codes

Correct hose connections, properly fitted and tested to BS EN 1256 (43) and retained by suitable clips or ferrules, are essential. Re-usable worm-drive clamps shall not be used.

Never 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. Siamese 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 Siamese hose can lead to failure in the other and lead to a potentially more dangerous situation.

Hoses should not be of greater length than is necessary for the work in hand. Where greater lengths are needed only occasionally, extension hoses, connected by means of hose couplers conforming to BS EN 560 (40) 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.

NOTE: Fitting more than one non-return valve within any gas line will reduce the flow.

Since a fire in a coiled hose is difficult to extinguish. Hose should not be coiled during operation, e.g. around cylinders, regulators or the handle of the trolley.

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 (refer to "Operator before use" check in Table 1). 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 Document 78 (78), *Leak detection fluids cylinder packages*.

6.3 Blowpipes

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

A very 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. Users are reminded that the use of safety devices in a gas supply line will call for an increase in supply pressure to compensate for the pressure losses caused by these devices.

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 supplier, and at least in accordance with Table 1.

6.4 Non-return valves

Non-return valves shall conform to BS EN 730 (42) Parts 1 or 2, or ISO 5175 (47), *Equipment used in gas welding, cutting & allied processes. Safety Devices for fuel gases and oxygen or compressed air. General specifications, requirements and tests*. Non-return valves shall be capable of preventing backflow of gases, both at low and high reverse pressures. Non-return valves may be damaged by flashbacks and require frequent testing to ensure that the gas will not reverse flow. Refer to Table 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 the standards referenced in Section 6.4.

6.5 Personal protective equipment

Personal Protective Equipment (PPE) is to be provided as required by the Personal Protective Equipment Regulations (8). 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 (9), 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 (22), *Personal Protective Equipment at Work*, provides guidance on the Personal Protective Equipment Regulations (8). EIGA Document 136 (79), *Selection of personal protective equipment*, provides guidance for selecting and using PPE at work.

Eye protection is essential at all times and is a legal requirement in factory premises to provide safeguard against heat, glare and flying sparks. Goggles should comply with BS EN 175 (38), *Personal protection. Equipment for eye and face protection during welding and allied processes*, and lenses with BS EN 169 (37), *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 (37). A backing lens should be used if the filter lens is not robust in accordance with BS EN 169 (37). Suitable clothing, preferably made from flame retardant material should be worn. Suitable leather gloves or gauntlets should be worn during operations or when handling metal.

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

For cylinder handling the use of protective gloves is essential. Safety shoes or boots with metatarsal protection are strongly recommended.

In certain locations, or site conditions, other additional protective clothing may be obligatory, for example, hard hats, ear defenders, breathing apparatus, etc.

7. PROVISION OF SAFETY DEVICES

Whilst the safe operation of oxy-fuel gas systems may be achieved by strict supervision of operatives who have received extensive training, it should be recognised that in practical situations incidents cannot be entirely avoided. Therefore, the following safety provisions shall be followed.

7.1 Safety devices

All safety devices shall conform to BS EN 730 (42), Parts 1 or 2, or ISO 5175 (47) and be suitable for the required conditions of service (type of gas used, maximum operating pressure and minimum operating flow, etc.). The incorporation of safety devices such as flashback arrestors shall in no way be considered to be a substitute for safe operating procedures.

7.2 Installation requirements

Oxy-fuel systems using acetylene shall be fitted with a flashback arrestor within one metre of the pressure regulator and with a non-return valve, to prevent the return of gas towards the cylinder.

Minimum requirement for all hose sizes and lengths:

(i) A non-return valve shall be fitted to each blowpipe connection.

(ii) A flashback arrestor with pressure **or** temperature sensitive cut-off valve shall be fitted in both the oxygen and fuel gas lines.

Recommended for additional safety, and especially if access to cylinders is difficult or they are remote from the operator, making them difficult to isolate, the following may be used:

(iii a) A flashback arrestor with a non-return valve shall be fitted to each blowpipe connection.

(iii b) A flashback arrestor with pressure **or** temperature sensitive cut-off valve shall be fitted in both the oxygen and fuel gas lines.

Or

(iv a) A non-return valve shall be fitted to each blowpipe connection.

(iv b) A flashback arrestor with pressure **and** temperature sensitive cut-off valve shall be fitted in both the oxygen and fuel gas lines.

NOTE: The use of additional flashback 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 flashback 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 3 and illustrated in Appendix 1.

REQUIREMENTS	**FIT TO BOTH BLOWPIPE INLETS**	**FIT BETWEEN REGULATOR OUTLET & BLOWPIPE IN BOTH GAS LINES**
Minimum	NV	FA + PV or TV
Recommended	FA + NV NV	FA + PV or TV FA + PV and TV
Key: NV Non-Return Valve FA Flame Arrestor PV Pressure Sensitive Cut-Off Valve TV Temperature Sensitive Cut-off Valve		

Table 3: Safety devices – Installation requirements.

NOTES:

1. All flashback arrestors are designed to arrest the flame at the point of installation.

2. 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.

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

8. SAFETY PRECAUTIONS – WORKING AREA

8.1 General

A responsible person shall carry out a Fire Safety Risk Assessment on all storage sites and work areas, the findings from which are to be incorporated into the Site Fire Safety Management Plan that is to be implemented and maintained. As necessary, advice should be sought from the local fire authority. 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 (11).

Fire fighting equipment as identified in the Site Fire Safety Management Plan shall be provided. The operator should ensure that fire extinguishers are readily available at all times when oxy-fuel gas equipment is in use.

Emergency procedures for dealing with a fire in the workplace are to be drawn up and included in the training programme. Refer to Section 12 and Section 13.

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.

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.

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 source of danger 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.

If 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. It is normal to maintain fire watch for 30 minutes after hot work finishes. Where oxy-fuel gases are used onboard ships additional information is provided in HSE Engineering Information Sheet 43 (36), *Storage and use of oxygen and fuel gases on board ships*.

There are hazards from fumes in some applications, e.g. silver brazing, work on painted or galvanised metals, etc. Staff at all levels should be aware of the potential hazards and

should ensure that all necessary action is taken such that operators are not exposed to risk, e.g. by providing adequate ventilation or protection. Fumes from cutting and welding processes can be dangerous. Refer to the Section 4.9. It will be necessary to assess the actual risk.

In working areas where the noise level is excessive ear protectors may be required. The Control of Noise at Work Regulations (12) 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 PPE is to be provided. Refer to Section 6.5.

Oxygen should not be used for any purpose whatsoever other than as a gas supply to the blowpipes. Because oxygen will react violently in the presence of oil and grease, equipment cleanliness is essential and, to avoid possible contamination, clothing, tools and the working area should be kept clean.

8.2 Confined spaces

Working in confined spaces is subject to the Confined Spaces Regulations (4). HSE Leaflet 101 (23), *ACOP Safe work in confined spaces*, provides detailed recommendations which should be followed whenever applicable. Refer also to HSE INDG 258 (30), *Confined spaces. A brief guide to working safely*. This may include the use of a Permit to Work, atmospheric monitoring to ensure the atmosphere is of a standard suitable to support life and / or to detect leakage of either flammable gas or oxygen. Constant and thorough ventilation should be assured. Oxygen shall never be used to freshen the air in a confined space, since this is extremely dangerous and will result in enrichment of the atmosphere.

Gas cylinders should not be taken into a confined space. 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. If an oxygen-deficient atmosphere is created the operator, or other persons entering the space, may be unaware of the danger. Danger areas may be highly localised, for instance, at the bottom of a tank where heavier gases,

such as process combustion products, have collected. The operator, not aware of the hazard, may be at risk of asphyxiation. When carrying out work in a confined space it may be necessary to have an assistant stationed outside who understands both the hazards associated with working in confined spaces and the equipment. BCGA GN 11 (59), *Reduced oxygen atmospheres. The management of risk associated with reduced oxygen atmospheres resulting from the use of gases in the workplace,* gives detailed guidance on this topic.

Where oxy-fuel gases are used onboard ships or other similar large fabrications additional information is provided in HSE Engineering Information Sheet 43 (36).

8.3 Oxygen enrichment

The normal oxygen content of the air is approximately 21 %. As this becomes enriched, notably above 23.5 % there is an increase in the speed with which materials will burn. At 30 % enrichment the typical characteristics of an oxygen-fed fire become apparent. The fire is in two phases - an initial flash followed by local burning at a number of points.

A fire resulting from oxygen enrichment will spread rapidly across combustible materials such as clothing and body hair and is extremely difficult to extinguish. Such fires could result in death or serious injury. A spark or a lit cigarette is sufficient as a source of ignition.

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, correct nozzle and cutting pressures are important and adequate ventilation is essential.

Oxygen levels greater than 23.5 % are deemed unsafe in which to work.

8.4 Work on vessels and tanks

Special precautions shall be taken when working on any plant or vessel which has previously held petrol, oil, spirits, paint or any other flammable, explosive or toxic material.

Such work is only to be undertaken by operators who are fully competent and aware of the hazards and of the precautions to be taken (refer to the Factories Act (1), Section 31). It is essential that expert advice be taken before first undertaking such work. For more comprehensive guidance refer to:

- HSE Guidance Note CS15 (28), *The cleaning and gas freeing of tanks containing flammable residues*;
- HSE INDG 314 (32), *Hot work on small tanks and drums*;
- UKLPG CP 17 (74), *Purging LPG vessels and systems*.

Before maintenance is carried out, a written Permit to Work for the particular type of work (cold work, hot work, entry of vessel, etc.) shall be issued by an authorised person to the individual(s) carrying out the work. All maintenance activities will require a risk assessment to determine if the system needs to be purged with inert gas, especially where

the use of heat or spark producing tools is necessary. Work shall only commence once tests have shown that the atmosphere is safe for the work to proceed.

HSE HSG 250 (27), *Guidance on permit-to-work systems. A guide for the petroleum, chemical and allied industries*, and EIGA Document 40 (77), *Work permit systems*, provide recommendations on how to plan and execute potentially hazardous jobs in a safe manner.

The following general headings, whilst not exhaustive, indicate some of the considerations necessary before starting work on any drum, plant or vessel which has contained potentially dangerous substances.

(i) Remove all residuals including any in the seams, etc.

(ii) Ensure that the atmosphere inside the workplace is non-flammable and, if possible, vent to open air.

(iii) If internal work is to be done, ensure thorough ventilation or that the operator is wearing a suitable respirator supplied with breathing quality air. Refer to BS EN 529 (39), *Respiratory protective devices. Recommendations for selection, use, care and maintenance. Guidance document*, and BS EN 12021 (49), *Respiratory equipment. Compressed gases for breathing apparatus*.

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

The requirements of the Confined Spaces Regulations (4) shall be followed. Refer to Section 8.2.

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

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

(vi) Post warning notices.

(vii) Never use oil drums as work supports.

9. CYLINDER HANDLING AND STORAGE

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

Many accidents are caused by cylinder mishandling and unsafe storage. The destructive potential arising from the uncontrolled release of gas from a high pressure cylinder can be considerable. BCGA TIS 15 (63), *Model risk assessment for the storage and use of oxy-acetylene cylinders*, can be used to assist in developing a site risk assessment.

There are specific regulations for transporting gas cylinders, refer to Section 9.3.

9.1 Cylinder handling

The Manual Handling Operations Regulations (3) require first that an assessment of manual handling operations is conducted. Following the assessments, appropriate training shall be provided. Where the assessment indicates that the work exceeds guideline limits, wherever practicable the operation should be mechanised or handling aids provided. BCGA GN 3 (57), *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 (3) relating to gas cylinders. BCGA TIS 17 (64), *Model risk assessment for manual handling activities in the industrial gas industry*, can be used to assist in developing a site risk assessment.

The following points are of note:

(i) When carrying out manual handling operations appropriate PPE, for example, gloves and foot protection, shall be used. Refer to Section 6.5.

(ii) Purpose-designed trolleys should be used for moving cylinders, wherever practicable.

(iii) For moving over even floors, and only for short distances, the familiar 'churning' method may be used.

(iv) A cylinder shall not be moved with the valve open.

(v) Cylinders shall not be moved with the regulators and hoses attached unless on a purpose designed trolley or carrier.

(vi) 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 EIGA SI 25 (80), *Crane transport of cylinder packages*.

(vii) 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.

(viii) Cylinders shall not be used as work-supports or rollers.

9.2 Cylinder storage

BCGA CP 44 (56), *The storage of gas cylinders*, defines the principles of safe practice for the storage of gases in cylinders and cylinder bundles. UKLPG provide additional information on the storage of LPG cylinders, refer to UKLPG CP 7 (73), *Storage of full and empty LPG cylinders and cartridges.*

The following points are of note:

(i) Always store cylinders in a dedicated, secure store.

(ii) Keep cylinders in a vertical position, restrained with, for example, chains or lashings.

(iii) Always store cylinders in an area with good ventilation.

(iv) Always store cylinders away from sources of ignition.

(v) In storage all cylinder valves shall be closed, on empty cylinders this will prevent the ingress of moisture or other contaminants.

9.3 Cylinder transportation

Gas cylinders comply with the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations (14). These regulations implement the European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR) (19), which provides a framework for dangerous goods to be carried 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 (62), *Guidance for the carriage of gas cylinders on vehicles*, additional advice is provided in BCGA Leaflet 1 (70), *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*.

10. PREPARATION FOR USE

10.1 Location of 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.

Cylinders should be restrained to avoid toppling. 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:

(i) Cylinders shall not be exposed to heat. Take care to prevent the heating of cylinders from the process, sparks and slag or any other external heat source.

(ii) Cylinders can be damaged by slag, sparks or falling metal, particularly if laid down.

(iii) Precautions shall be taken to ensure that no electric current, e.g. from arc welding processes, can reach the cylinders. Steel floors, structural members or metal benches can carry earth return currents.

10.2 Cylinders

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 owner

(normally the gas supplier). Prior to use check the cylinder label and confirm that it is the gas you require.

As an aid to identification cylinders may be painted in a specific colour. Within the UK acetylene cylinders are painted maroon (RAL 3007). However there is no mandatory requirement to paint other cylinders in a specific colour. Typically oxygen cylinders will be painted with a white shoulder, and hydrogen cylinders will be painted red (RAL 3000).

If you are unfamiliar with the hazards and properties of the gas read and follow the guidance on the safety data sheet. If required, seek further advice from your gas supplier.

Where it is not possible to identify the owner of the cylinder it may be necessary to employ a specialist organisation that has the technical and legal capability to collect and dispose of the cylinder. Detailed information on cylinder recovery and disposal is available on the BCGA website, under *Cylinder Recovery & Disposal*. Refer to Section 14.

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.

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 (67).

NOTE: BCGA TIS 22 (67) highlights the traditional method of clearing dust or other debris from the outlet port of a cylinder valve by momentary opening and closing of the cylinder valve to release a flow of gas. This procedure is only recommended for gas cylinders containing oxygen. All cylinder valves should be cleaned with a lint-free, clean, dry, and oil and grease-free cotton cloth.

10.3 Regulators

Before attaching a regulator to a cylinder, check:

(i) That the regulator has the manufacturers/suppliers name clearly visible and it is manufactured to the standards detailed in Section 6.1;

(ii) The regulator is within its expiry date. All regulators have a life, on expiry of which they require either replacement or refurbishment. Refer to Table 1.

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

(iv) The maximum cylinder pressure;

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

(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) That the cylinder valve outlet thread is mechanically compatible with the regulator inlet connection and is clean and free of dirt. Refer to BCGA TIS 22 (67);

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

(xi) The regulator is fitted in the correct orientation (suitable for the cylinder valve outlet, that is top outlet or side outlet);

(xii) The regulator pressure – adjusting screw is set to zero pressure position by turning the control knob fully anti-clockwise;

Only use the correct sized spanner when attaching a regulator.

When inspecting the regulator inlet connection for damage or contamination, if an 'O' ring is fitted to the inlet, check for damage and replace if necessary with an 'O' ring recommended by the regulator manufacturer.

NOTE: Do not use any form of jointing paste or tape between regulator and cylinder valve.

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.

10.4 Safety devices

Ensure that all threads and seats are in good condition before mounting a safety device 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.

10.5 Hose and hose assemblies

Before fitting the hoses to the safety device or regulator, as appropriate, examine all fittings, threads, connection seatings and clips. Also check for signs of cuts, abrasion, burns or general deterioration. Replace any hose / hose assemblies that show signs of any damage or whose condition is in any way unsatisfactory.

10.6 Blowpipes

Before fitting the hose to the blowpipe ensure all threads and seats are in good condition and carefully bleed a small amount of gas through the hose to remove any obstruction. Check that the blowpipe is suitable for the gas and application to be used. Ensure that all valves on the blowpipe are in the closed position.

10.7 Nozzles

Nozzle selection. It is essential to select the correct cutting nozzle. Cutting nozzles are specified to the type of fuel gas being used and sized to the material and thickness of the material to be cut.

In order to ensure there is a gas tight seal in the blowpipe / cutting torch head, always use nozzles which are compatible with that specific blowpipe / cutting torch, refer to Appendix 2.

NOTES:

1. Identify the manufacturer of the blowpipe / cutting torch. Individual manufacturers use different seat angles and lengths of fitting between the nozzle and head.
2. Using a nozzle manufacturers cutting 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.

Before lighting the blowpipe / cutting torch carry out a leak test of the nozzle fitting using an approved leak detection fluid. Replace any components which are found to be leaking. Procedure for a leak test:

(i) Fit an approved blank to the blowpipe / cutting torch head.

NOTE: Ensure the blank is compatible with the blowpipe / cutting torch head, in particular, check the angles align on the sealing faces.

(ii) Open the fuel gas control valve and leak test the joint at the blank.

(iii) Close fuel gas control valve.

(iv) Open oxygen control valve and leak test the joint at the blank.

(v) Close oxygen control valve.

(vi) Remove the blank and fit the nozzle for the application.

(vii) Open the fuel gas control valve and the oxygen control valve and check for leaks.

(viii) Close the fuel gas control valve and the oxygen control valve.

(ix) Replace any nozzle which is leaking (and re-test as necessary).

WARNING: Do not create a seal by placing your thumb, fingers or other body parts against the gas exit ports. This is highly dangerous.

NOTE: For further information on leak detection fluids refer to EIGA Document 78 (78).

10.8 Pressurising 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 regulators to give the required gas pressures and check the equipment for leaks using a suitable (ammonia free) leak detection fluid. Re-adjust pressures with the gas flowing.

NOTE: For further information on leak detection fluids refer to EIGA Document 78 (78).

10.9 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. 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.

10.10 Lighting up

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 avoid the fire hazard caused by an excess quantity of unburned fuel gas being discharged to the atmosphere, should the blowpipe fail to ignite immediately.

11. CLOSING DOWN PROCEDURE

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

(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.

12. TRAINING

All staff who are required to handle, use and store gas cylinders and associated equipment, shall have the necessary skills and knowledge to carry out their job safely and are to have received appropriate training, including induction and continuation training. It is the duty of the employer to ensure their persons are adequately trained and to establish competency.

It is recommended that the training programme is carried out under a formalised system where an acceptable level of competency has to be achieved. Such training shall be both theoretical and practical. Records shall be kept of the training provided and the competence level achieved. The training programme shall make provision for periodic re-training.

Recommendations for the training of personnel are described in EIGA Document 23 (76), *Safety training of employees*. BCGA GN 23 (61), *Identifying gas safety training requirements in the workplace*, provides information on the topics which should be covered when considering gases safety training.

This will include training on:

(i) The hazards and key properties of oxy-fuel gases. Refer to Section 3.

(ii) The gas cylinders.

(iii) Associated equipment and the pressure system(s).

(iv) Manual handling of gas cylinders. Refer to Section 9.1.

(v) Correct storage of gas cylinders. Refer to Section 9.2

(vi) Ventilation and monitoring systems, including gas detection.

(vii) Actions in the event of an emergency. Refer to Sections 13.

13. EMERGENCY PROCEDURES

The user should have a site-specific emergency procedure in place for fire situations in compliance with The Regulatory Reform (Fire Safety) Order (11). Refer to Section 8.1.

BCGA Leaflet 6 (71), *Cylinders in fires*, provides guidance on dealing with gas cylinders involved in a fire.

The most common incidents to occur are ignitions of leakages of fuel gas from hose connections or defective hose. If this occurs the cylinder valve should be closed, if it is safe to

do so, and the fire extinguished as quickly as possible. If this action is not possible, the fire may be first extinguished by prompt use of a dry powder or CO_2 extinguisher, followed by the closing of the cylinder valve to avoid re-ignition.

If the fire is in the vicinity of the regulator, it may be possible to release the pressure adjusting screw on the regulator with a gloved hand. If this action would involve injury to the operator, the fire may be extinguished by prompt use of a dry powder or CO_2 extinguisher.

If it is not possible to extinguish the fire with the use of an extinguisher, further attempts should not be made. Evacuate the area if this has not already been done because of the danger of explosion.

As soon as a fire occurs the Fire and Rescue Service (or alternatively the works' fire brigade) shall be alerted, even if attempts are being made to handle the situation and it has been dealt with by the time the emergency service arrives.

Since it is not possible to offer detailed advice on every possible incident, the following are examples of the more common difficulties that may arise and of suitable related action. Users are urged to seek fuller advice from their supplier in respect of local conditions or operations.

13.1 Key actions for dealing with gas cylinders in the event of fire

For gas cylinders directly involved in a fire:

- KEEP AWAY, do NOT approach or attempt to move the cylinder or open the valve.
- Sound the alarm.
- Evacuate the area.
- 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.

13.2 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.

13.3 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.

13.4 Fire damaged gas cylinders

Do not use any fire-damaged cylinders. Quarantine any fire-damaged cylinders in a safe place. Mark or label fire-damaged cylinders to clearly show that they have been in a fire. Inform your gas supplier whenever a cylinder is involved in a fire. After the fire is out and the area has been declared safe by the Fire and Rescue Service, the gas supplier will arrange collection of fire damaged cylinders at a mutually convenient date.

Contact numbers for the gas supplier are available on the product Safety Data Sheet. Refer also to BCGA Leaflet 6 (71).

14. REFERENCES

Document Number		Title
1.		The Factories Act 1961.
2.		The Health and Safety at Work etc. Act 1974.
3.	SI 1992: No 2793	Manual Handling Operations Regulations 1992.
4.	SI 1997: No 1713	The Confined Spaces Regulations 1997.
5.	SI 1998: No. 2306	The Provision and Use of Work Equipment Regulations 1998.
6.	SI 1999: No. 2001	The Pressure Equipment Regulations 1999.
7.	SI 2000: No. 128	The Pressure Systems Safety Regulations 2000 (PSSR).
8.	SI 2002: No 1144	Personal Protective Equipment Regulations 2002.
9.	SI 2002: No 2677	Control of Substances Hazardous to Health Regulations 2002 (COSHH).
10.	SI 2002: No 2776	The Dangerous Substances and Explosive Atmosphere Regulations 2002 (DSEAR).
11.	SI 2005: No. 1541	The Regulatory Reform (Fire Safety) Order 2005.
12.	SI 2005: No. 1643	The Control of Noise at Work Regulations 2005
13.	SI 2009: No. 716	The Chemicals (Hazard Information and Packaging for Supply) Regulations 2009. (CHIP 4)
14.	SI 2009 No. 1348	The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 (as amended).
15.	SI 2014: No. 1639	The Acetylene Safety (England and Wales and Scotland) Regulations 2014.
16.	EC Directive 97/23EC	The Pressure Equipment Directive (PED)
17.	EC Regulation No 1272/2008	Classification, Labelling and Packaging of Substances and Mixtures (CLP).
18.	EC Regulation No 1907/2006	Registration, evaluation, authorisation and restriction of chemicals (REACH).
19.	ECE/TRANS/215	European Agreement concerning the international carriage of dangerous goods by road (ADR).
20.	HSE EH 40	Workplace exposure limits.

Document Number		Title
21.	HSE Leaflet 8	Take care with oxygen. Fire and explosion hazards in the use of oxygen.
22.	HSE Leaflet 25	Personal Protective Equipment at Work.
23.	HSE Leaflet 101	Safe work in confined spaces. Confined Space Regulations 1997. Approved Code of Practice, regulations and guidance.
24.	HSE Leaflet 122	Safety of pressure systems. Pressure Systems Safety Regulations 2000. Approved Code of Practice.
25.	HSE Leaflet 138	Dangerous substances and explosive atmospheres DSEAR 2002. Approved Codes of Practice and Guidance.
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 Guidance Note CS 15	The cleaning and gas freeing of tanks containing flammable residues.
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 459	Oxygen use in the workplace. Fire and explosion hazards.
36.	HSE EIS 43	Storage and use of oxygen and fuel gases on board ships.
37.	BS EN 169	Personal eye protection. Filters for welding and related techniques. Transmittance requirements and recommended use.
38.	BS EN 175	Personal protection. Equipment for eye and face protection during welding and allied processes.
39.	BS EN 529	Respiratory protective devices. Recommendations for selection, use, care and maintenance. Guidance document.
40.	BS EN 560	Gas welding equipment. Hose connections for equipment for welding, cutting and allied processes.

Document Number		Title
41.	BS EN 561	Gas welding equipment. Quick-action coupling with shut-off valves for welding, cutting and allied processes.
42.	BS EN 730	Gas welding equipment. Safety devices: Part 1. Incorporating a flame (flashback) arrestor. Part 2. Not incorporating a flame (flashback) arrestor.
43.	BS EN 1256	Gas welding equipment. Specification for hose assemblies for equipment for welding, cutting and allied processes.
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.	ISO 5175	Equipment used in gas welding, cutting & allied processes. Safety Devices for fuel gases and oxygen or compressed air. General specifications, requirements and tests.
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 12021	Respiratory equipment. Compressed gases for breathing apparatus.
50.	BS EN ISO 22435	Gas cylinders. Cylinder valves with integrated pressure regulators. Specification and type testing.
51.	BCGA Code of Practice 4	Industrial gas cylinder manifolds and distribution pipework (excluding acetylene).
52.	BCGA Code of Practice 5	The design and construction of manifolds using acetylene gas from 1.5 - 25 bar.
53.	BCGA Code of Practice 6	The safe distribution of acetylene in the pressure range 0 - 1.5 bar.
54.	BCGA Code of Practice 18	The safe storage, handling and use of special gases.
55.	BCGA Code of Practice 31	The safe storage and use of cylinders in mobile workshops and service vehicles.
56.	BCGA Code of Practice 44	The storage of gas cylinders.

Document Number		Title
57.	BCGA Guidance Note 3	Safe cylinder handling and the application of the manual handling operations regulations to gas cylinders.
58.	BCGA Guidance Note 7	The safe use of individual portable or mobile cylinder gas supply equipment.
59.	BCGA Guidance Note 11	Reduced oxygen atmospheres. The management of risk associated with reduced oxygen atmospheres resulting from the use of gases in the workplace.
60.	BCGA Guidance Note 13	DSEAR Risk Assessment.
61.	BCGA Guidance Note 23	Identifying gas safety training requirements in the workplace.
62.	BCGA Guidance Note 27	Guidance for the carriage of gas cylinders on vehicles.
63.	BCGA Technical Information Sheet 15	Model risk assessment for the storage and use of oxy-acetylene cylinders.
64.	BCGA Technical Information Sheet 17	Model risk assessment for manual handling activities in the industrial gas industry.
65.	BCGA Technical Information Sheet 18	Gas equipment inspection / replacement date marking.
66.	BCGA Technical Information Sheet 19	Refurbishment of handheld blowpipes and regulators used with compressed gases for welding, cutting and related processes.
67.	BCGA Technical Information Sheet 22	BCGA policy on connecting gas cylinders.
68.	BCGA Technical Information Sheet 24	Welding fumes. Safety alert.
69.	BCGA Technical Information Sheet 32	Acetylene or propane (for welding, cutting and allied processes).
70.	BCGA Leaflet 1	The carriage of small quantities of gas cylinders on vehicles.
71.	BCGA Leaflet 6	Cylinders in fires.

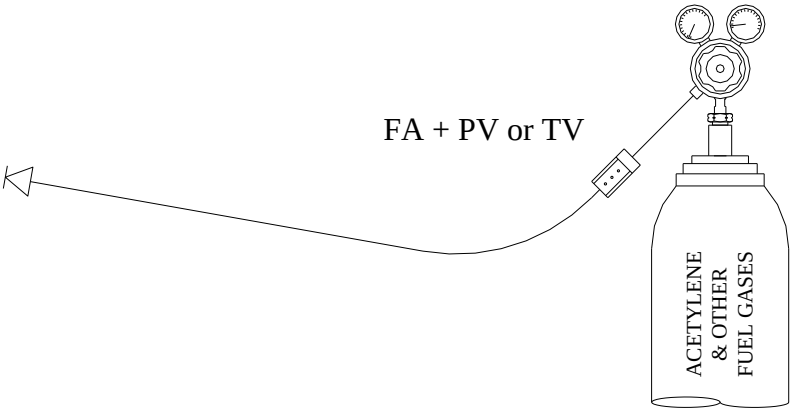
Document Number		Title
72.	BCGA Safety Alert 1	The hazards of using incorrect regulators on acetylene gas cylinders.
73.	UKLPG Code of Practice 7	Storage of full and empty LPG cylinders and cartridges.
74.	UKLPG Code of Practice 17	Purging LPG vessels and systems.
75.	UKLPG User Information Sheet 28	Safe use of propane and butane cylinders & cartridges.
76.	EIGA IGC Document 23	Safety training of employees.
77.	EIGA IGC Document 40	Work permit systems.
78.	EIGA IGC Document 78	Leak detection fluids cylinder packages.
79.	EIGA IGC Document 136	Selection of personal protective equipment.
80.	EIGA Safety Information 25	Crane transport of cylinder packages.

Further information can be obtained from:

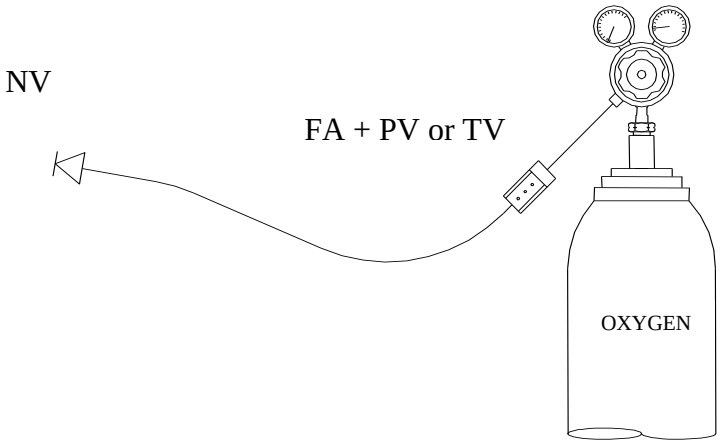
UK Legislation	www.legislation.gov.uk
Health and Safety Executive (HSE)	www.hse.gov.uk
British Standards Institute (BSI)	www.bsigroup.co.uk
International Organization for Standardization (ISO)	www.iso.org
European Industrial Gases Association (EIGA)	www.eiga.eu
British Compressed Gases Association (BCGA)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

MINIMUM REQUIREMENT FOR ALL HOSE SIZES AND LENGTHS

Refer to Section 7.2 and Table 3.



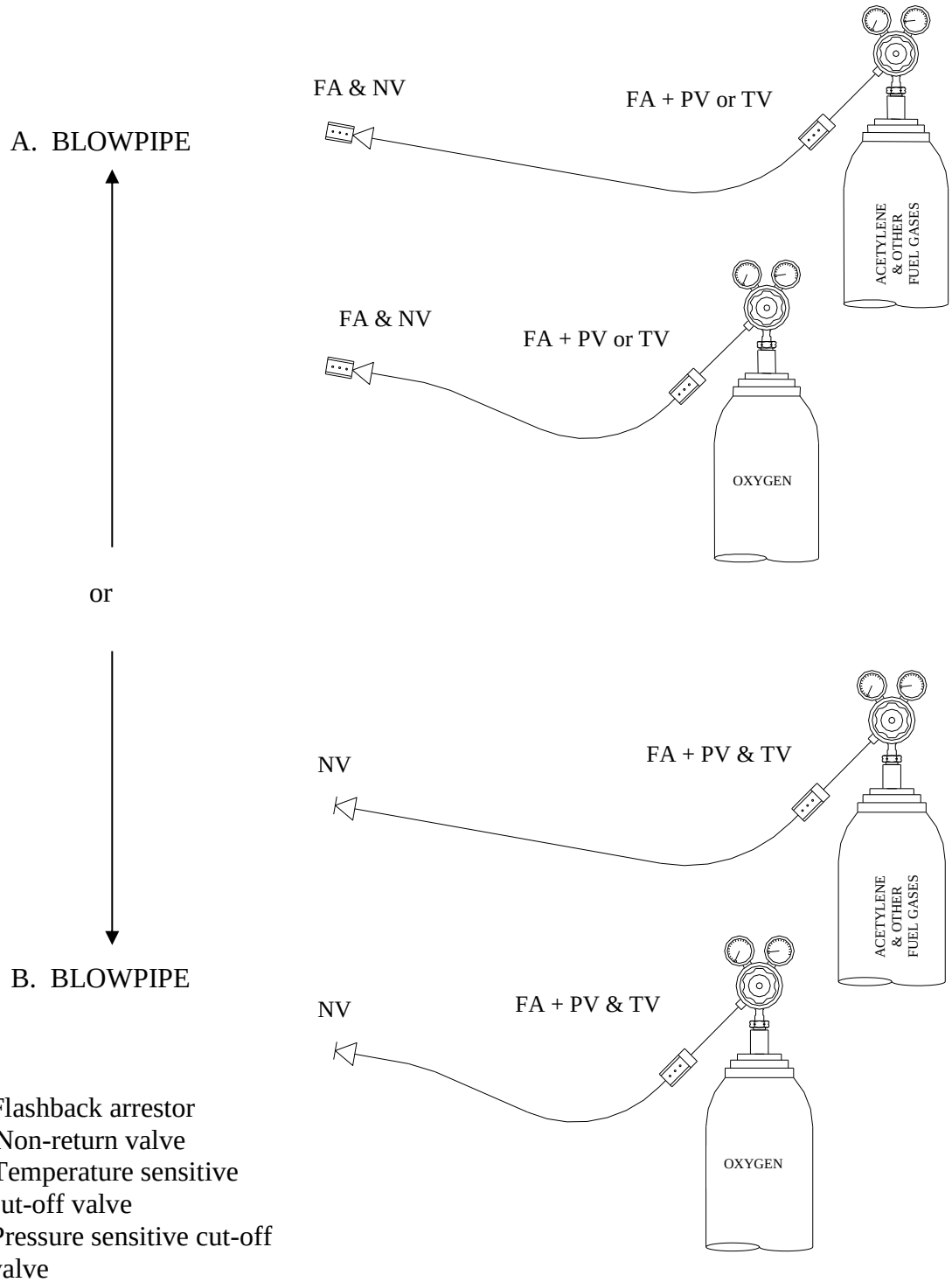
BLOWPIPE



KEY:

FA Flashback arrestor
NV Non-return valve
TV Temperature sensitive cut-off valve
PV Pressure sensitive cut-off valve

RECOMMENDED INSTALLATION PROVIDING INCREASED SAFETY



KEY:

FA	Flashback arrestor
NV	Non-return valve
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 10.7.

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 A2-1 shows the cone angle to be used for three-seat cutting nozzles. Dimensions not given are left to the manufacturer's discretion.

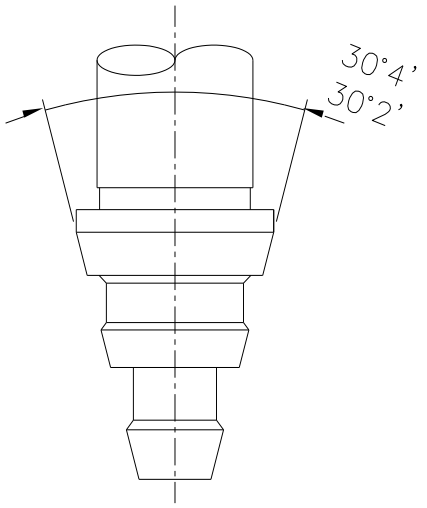


Figure A2-1: Cone angle for three-seat cutting nozzles.

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