Australian Standard™

The safe use of portable and mobile oxy-fuel gas systems for welding, cutting, heating and allied processes

Standards Australia

This Australian Standard was prepared by Committee ME-002, Gas Cylinders. It was approved on behalf of the Council of Standards Australia on 31 August 2001 and published on 28 September 2001.

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The safe use of portable and mobile oxy-fuel gas systems for welding, cutting, heating and allied processes

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee ME-002, Gas Cylinders.

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee ME-002, Gas Cylinders. After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian, rather than an Australian/New Zealand Standard.

The objective of this Standard is to enable owners and operators to understand the functions of equipment used in portable and mobile oxy-fuel systems for welding, cutting, heating and allied processes. It also provides guidelines for the use oxy-fuel systems and the maintenance functions to be carried out. Finally, there is information for safety of personnel should an emergency arise during the period of oxy-fuel system equipment use.

Included in the Standard are general details of the properties of the most common gases used in oxy-fuel systems.

Reticulated systems and fixed piping, together with equipment such as permanently mounted flame-cutting machines, are outside the scope of this Standard.

During the development of this Standard, acknowledgment is made to the following documents:

BCGA-CP7 The safe use of oxy-fuel gas equipment (individual portable or mobile cylinder supply)

BS EN 730 Gas welding equipment — Equipment used in gas welding, cutting and allied processes, safety devices for fuel gases and oxygen or compressed air — General specifications, requirements and tests.

Government authorities and regulations may affect the use of this Standard, and users of this Standard should be aware of this possibility.

It should be noted that compliance with this Standard may not necessarily fulfil all legal obligations.

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STANDARDS AUSTRALIA

Australian Standard

The safe use of portable and mobile oxy-fuel gas systems for welding, cutting, heating and allied processes

1 SCOPE

This Standard specifies selection, operation and maintenance procedures for oxy-fuel gas hand-held or portable equipment used in welding, cutting, heating and allied processes.

This Standard applies to equipment supplied from portable or mobile gas cylinders, inclusive of manifolded packs of cylinders. Cylinder mounted regulators, which may be easily removed by the users, control the downstream pressure for this equipment. The connection between the regulator and the downstream equipment is welding hose.

Reticulated systems and fixed piping, together with equipment such as permanently mounted flame-cutting machines, are outside the scope of this Standard.

2 REFERENCED DOCUMENTS

AS	
1335	Hose and hose assemblies for welding, cutting and allied processes
2030	The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases
2030.1	Part 1: Cylinders for compressed gases other than acetylene
4267	Pressure regulators for use with industrial compressed gas cylinders
4289	Oxygen and acetylene gas reticulation systems
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3 DEFINITIONS

For the purpose of this Standard, the definitions given in AS 2030.1 and those below apply.

3.1 Backfire

Momentary retrogression of the flame into the mixed gas passages of the blowpipe, accompanied with a loud or popping noise, and with or without flame extinction.

3.2 Backflow

Flow of gas from one of the inlet gas passages of the blowpipe at higher pressure into the other gas passages at lower pressure, including possibly the hose.

3.3 Decomposition

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

3.4 Flashback

Retrogression of the flame into the upstream gas passages of the blowpipe, possibly including the hose, and with the risk of a subsequent explosion.

3.5 Flashback arrestor

A safety device incorporating as a minimum, a flame arrestor and additionally any other safety devices. See AS 4603.

3.6 Intermittent backfire

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

3.7 Sustained backfire

Backfire resulting in a continuing internal flame in or near the blowpipe mixer passages, with resulting hissing or squealing sound. A small pointed flame may be visible at the tip or nozzle. If allowed to persist, an explosion may result with severe damage to the blowpipe.

4 GASES (SOME PROPERTIES)

4.1 General

A summary of the properties and characteristics of the more common gases used in welding, cutting, heating and allied processes is given in this Clause (4). Some industrial gases may be flammable, oxidizing, toxic or corrosive, and users need to take special precautions in handling them. Material safety data sheets, normally available from the gas suppliers, for each of the gases stored and used shall be easily accessible at all gas installation sites and points of use.

4.2 Oxygen

Cylinder colour is black. Oxygen has no smell, and is generally considered non-toxic at atmospheric pressure. It will not burn, but supports and accelerates combustion. Oxygen should never be called ‘air’. Materials not normally considered combustible may be ignited by sparks and will burn readily in oxygen-rich atmospheres. Oils, greases and solvents or any hydrocarbon containing substances or liquids may react violently in contact with oxygen (i.e. explode). Metals may also burn. Proper advice should be sought, e.g. from gas suppliers and equipment manufacturers, before using any materials, especially lubricants and thread sealing tapes, for oxygen service. Only equipment marked ‘for oxygen only’ should be used with oxygen.

4.3 Acetylene

Cylinder colour is claret. Acetylene has a distinctive garlic smell. It is non-toxic, but asphyxiation is possible through depletion of oxygen. It is lighter than air and not likely to collect in ducts and drains, but could collect in roof spaces. It requires minimum energy to ignite in air or oxygen. A concentration of as little as 2.5% in the air can burn. Acetylene is a potential fire and explosion hazard. Mechanical shock to the cylinder due to mishandling or overheating when under high pressure may cause decomposition, giving rise to high temperatures and possible detonation even in the absence of oxygen. Copper alloys containing more than 70% copper or 43% silver must never be used with acetylene.

4.4 LP Gas (liquefied petroleum gas), propane, butane

Cylinder colour is aluminium. Usually a mixture of gases with propane as the main constituent. Standard LP Gas has been odourized and has a fish-like smell. It is non-toxic, but may cause asphyxiation through depletion of oxygen. A concentration of as little as 2% in the air can burn. LP Gas will ignite and burn instantly from a spark or piece of hot metal. It is heavier than air and will collect in ducts, drains, etc, and in low lying areas. It is a fire and explosion hazard, and requires minimum energy to ignite in oxygen.

4.5 Hydrogen

Cylinder colour is signal red. Hydrogen has no smell and is non-toxic. Hydrogen is much lighter than air. A concentration of as little as 4% in the air can burn. It is a fire and explosion hazard and has very low ignition energy. It burns with a very pale blue flame which may be difficult to see under some working conditions.

Cracking the hydrogen cylinder to release hydrogen under pressure to clean the valve shall not be undertaken as this action can cause the hydrogen gas to self-ignite.

5 GAS CYLINDER STORAGE AND HANDLING

5.1 General

This Clause sets out requirements for the storage and handling of compressed oxygen and dissolved acetylene. They are based on long experience concerning the safe handling of cylinders containing industrial gases at high pressure. It does not list every possible safeguard and common sense and extreme caution on the part of the individual is recommended. Reference to both AS 4289 and AS 4332 is recommended for guidance in the storage and handling of compressed gas cylinders.

5.2 Cylinders in use

When cylinders are in use they shall be positioned securely in the work place before any equipment is connected to them.

Care shall be taken in their work place position, as cylinders sustain damage when exposed to hot slag, sparks and falling objects.

Cylinders that are heat-damaged shall not be used. Such cylinders shall be removed from the work area marked ‘heat damaged’, quarantined and referred to the gas supplier.

Precautions shall be taken to ensure that no electric current, e.g. from electric welding processes can impinge on cylinders. Steel floor inserts, structural members or metal benches may carry earth return currents.

5.3 Storage and segregation of cylinders

Reference to AS 4289 and AS 4332 is recommended.

Cylinder storage areas should be well ventilated and away from sources of heat. External storage is preferred. Protection from weather is desirable, but not at the expense of ventilation.

Cylinders should always be stored vertically, and secured against falling over.

Full cylinders should be stored separately from the empty cylinders.

Cylinders of different gases, whether full or empty, should be segregated from each other, except when used in a trolley for welding, cutting, heating and allied processes.

Oxygen and fuel gases shall be stored separately from toxic and corrosive gases.

The appropriate dangerous goods and ‘no smoking’ signs shall be displayed on the storage compound.

5.4 Cylinder transportation

Transportation of cylinders in closed cars or vans is not recommended. However, if they have to be transported in this manner, the closed cars or vans shall be properly ventilated at all times.

5.5 Cylinder handling

Purpose designed trolleys shall be used for moving cylinders. When cylinders are moved, all cylinders shall be secured and the cylinder valves closed.

Cylinders shall not be rolled along the ground in a horizontal position since this can cause the cylinder valve to open and discharge with subsequent serious damage to the valve and cylinder, together with possible serious injury to personnel.

5.6 Lifting cylinders

When cylinders are lifted, care shall be taken that the correct lifting equipment is used. AS 4289 provides some advice.

5.7 Cylinder valve seats and outlets

Valve seats and outlets should be protected by keeping all kinds of dirt and contamination away from cylinders, especially during connection and disconnection. Grit, loose fibres and other dirt may lodge on connectors and on valve seats causing leaks or will be picked up by high-velocity gas streams causing ignitions in regulators. Organic matter, such as oil, grease and hydrocarbon fluids, may ignite spontaneously in high pressure oxygen.

Open cylinder valves slowly using their handwheel or a suitable key for key-operated valves. Do not overtighten the spindle when shutting off the valve as this will destroy the soft seating material in the valve. If the valve spindle is too stiff to turn with the handwheel or the correct key, do not increase the leverage on the spindle. The cylinder, in this case, shall be returned to the gas supplier.

6 EQUIPMENT SPECIFICATION

6.1 General

Due to the hazards encountered during the use of oxy-fuel mixtures, all equipment and assemblies of equipment shall be designed, manufactured, assembled and used with due regard to the effects of overpressure, backflow of gases, backfire, flashback, acetylene decomposition, fire and the generation of fumes.

6.2 Alternative construction

Equipment using forms of construction different from those detailed in this Clause (6) of the Standard may be accepted if it can be demonstrated that an equivalent degree of safety and performance is obtained. Such evidence shall be provided by the manufacturer of the equipment.

6.3 Portable manifolds or packs

Portable manifolds or packs of up to four cylinders of each gas should be used where the use of single cylinders would result in excessive gas draw-off rates, e.g. to prevent solvent entrapment in the gas, the flow rate of acetylene should not exceed one-seventh of the capacity of the cylinder or pack.

Portable manifolds or packs and their components shall comply with AS 4289.

NOTE: Fixed manifolds are outside the scope of this Standard.

6.4 Pressure regulators

A pressure regulator shall be attached to the outlet connection of each cylinder or, if used, portable manifolds or manifolded pack of cylinders.

Regulators shall comply with AS 4267 and shall not be used with any gas or at a higher pressure other than those for which they are designed and labelled. The maximum outlet pressure of the regulator shall not exceed the maximum rated pressure of any downstream equipment.

Acetylene and LP Gas regulators shall only be used with the gas for which they are designed to avoid hazardous occurrences, e.g. maximum outlet pressure differences.

NOTE: AS 4267 specifies different designations, gas identification requirements and colour coding for acetylene and LP Gas regulators.

Regulators having damaged pressure gauges, inlet or outlet connections shall not be used.

6.5 Hoses

Hoses and their fittings shall comply with AS 1335. Hoses shall not be used for gases and pressures other than those for which they have been designed.

NOTE: The minimum working pressure specified in AS 1335 is 1200 kPa or higher. This pressure is marked on the hose. Commonly available hose is rated 1200 kPa.

Only hose which is in good condition and showing no signs of damage shall be used.

Hoses shall be positioned to avoid heat, mechanical damage, traffic, sparks, slag and oil and grease.

The maximum hose length shall be fifteen (15) metres for each gas, or such distance which will allow the operator of the hand-held equipment to be in sight of all the supply cylinders, whichever is the smaller. Hoses shall be single length.

NOTE: Where single lengths not practicable, lengths of hose up to a total length of 15 metres may be joined using only fittings that comply with AS 4267.

Colour coding of hoses is specified in AS 1335. In particular, different colours are specified for acetylene (red) and LP Gas (orange) and these hoses shall not be interchanged.

6.6 Blowpipes

Blowpipes shall be capable of performing safely the functions given within this Standard, when used in accordance with the manufacturer's operating instructions.

Blowpipes may have an integral gas mixing device or rely on a separate attachment to perform the gas mixing function (see Clause 6.7).

NOTES:

1 Currently there is no Australian Standard for blowpipes. Some overseas National Standards may provide useful guidance, however, caution should be used as there may be differences in specifications like hose connectors, safety features, common gas names, colour coding and labelling from Australian Standards.

2 In other Standards the term 'torch', of American origin, is the equivalent of this Standard's 'blowpipe'.

The following requirements shall apply to blowpipes:

(a) The inlet connections shall be suitable for welding hose (see AS 4267 and AS 1335).

(b) The control valves shall be clearly marked 'oxygen' and 'fuel', e.g. by the full names or by the abbreviations 'O' and 'F' and colour coded blue for oxygen and red for fuel.

(c) The product identification and name or identification mark of the manufacturer or supplier shall be clearly and permanently marked on the blowpipe body.

(d) Operating instructions shall be supplied with the blowpipe, including intended function, recommended operating pressures and maximum flows and suitable equipment to be connected downstream of the blowpipe.

(e) For blowpipes without an integral mixer, the operating instructions shall specify the suitable equipment which can be connected to its outlet connection.

6.7 Mixers and downstream attachments

Mixers shall be designed to mix the oxygen and fuel gas streams with due consideration to flashback and potential backflow of gases, e.g. by testing them to a National or Industry Standard.

NOTE: Currently there is no Australian Standard for mixers. Some overseas National Standards may provide useful guidance.

Mixers shall be stamped with a mark identifying either or both the model type and manufacturer or supplier.

Attachments including mixers may perform other functions such as cutting.

The manufacturer's operating instructions shall include all information necessary for the safe use of the mixer, such as maximum flows and minimum supply pressures, recommended supply blowpipes and downstream equipment.

Where the form of attachment of the mixer to the blowpipe is not standardized, i.e. it is proprietary, intended blowpipes to supply the mixer shall be nominated in the manufacturer's operating instructions.

6.8 Tips, nozzles and their attachment fittings

Each heat output device such as tips and nozzles shall be permanently marked with a model identification and manufacturer or supplier identification. Where practicable, they should also carry information relating to their use, such as operating pressures, design flow capacity and recommended output. They shall be supplied with all the manufacturer's information for their safe and efficient use.

NOTES:

1 Tips and nozzles operate safely and efficiently over a limited range of flows. Below a minimum flow the flame will move backwards into the tip or mixer with potential hazard of flashback. Above its maximum figure the flame may lift off and separate from the tip. Manufacturers should specify the minimum and maximum recommended flows for each tip and nozzle.

2 Operating pressure should be quoted at a specific point in the assembled system due to the pressure drops necessarily incurred in a flowing system between regulator outlet and tip or nozzle. Commonly pressures are referred to either the blowpipe inlet or the regulator outlet pressure gauge. In the latter case, the user has to allow for the pressure drop in the safety devices and the hose, which for large output may be significant.

3 Common practice in Australia is to call the end heat output device 'tip' if it is used for welding or heating and 'nozzle' if it is used for cutting, e.g. 'welding tip' and 'cutting nozzle'.

6.9 Safety devices

Safety devices for oxy-fuel equipment shall comply with AS 4603.

Safety devices shall be used in all oxy-fuel systems. As a minimum, one non-return valve and flashback arrestor per gas line shall be used with due consideration to the pressure drops experienced in all components of the assembled system at the rated flow capacity of the tip or nozzle in use. See Clauses 7.3 and 7.4.

6.10 Cylinder trolleys

Cylinder trolleys should be designed and built with due regard to stability in operation. The cylinders, maximum of one each oxygen and fuel, should rest fully and securely on the base of the trolley. Acetylene cylinders shall remain upright at all times. Means of restraint of the cylinders, e.g. a chain or strap, should be provided. Consideration should be given to possible release of the cylinder safety devices, and unimpeded gas release from them should be provided. The maximum size of cylinder allowed by the design should be stated on a permanent label on the trolley.

6.11 Personal safety wear

Eye protection in accordance with AS/NZS 1336 and AS/NZS 1337 shall be worn by operators of oxy-fuel equipment at all times.

Additionally, protective clothing and gear including breathing apparatus shall be used as required.

NOTE: See AS/NZS 1715 and AS/NZS 1716.

7 SYSTEM ASSEMBLY, FLOW CAPACITY AND SAFETY DEVICES

7.1 General

As shown in Figure 1, a portable or mobile oxy-fuel gas system comprises many components from gas cylinder to tip or nozzle. In the general case, these components may be provided separately by many manufacturers and suppliers. Even where all the system components are supplied by one vendor, the possible combinations are many. The user shall decide the complete combination selected for any particular application. Hence, it is vital that, in addition to complying with the manufacturer's operating instructions, the user shall ensure the assembled system is safe to use and complies with this Standard.

7.2 Fuel gas

The choice of fuel gas determines uniquely several of the system operating parameters, especially equipment and operating pressures. Only equipment recommended by the manufacturer for use with that particular fuel, e.g. acetylene, shall be used.

Only regulators clearly marked for acetylene service shall be used with acetylene gas.

Acetylene systems shall not be used at flowing pressures exceeding 150 kPa downstream of the outlet of the pressure regulator (see AS 4267). LP Gas equipment including especially regulators and hose, shall not be used in acetylene systems, except for multi-fuel safety devices, gas blowpipes and mixers where the manufacturer specifically nominates acetylene amongst the recommended fuels. It should be noted that gas suppliers recommend that the acetylene gas draw-off rate should not exceed one-seventh of the cylinder contents per hour. For draw off rates exceeding this, manifolded acetylene cylinders shall be used.

LP Gas systems shall use only equipment especially designated for LP Gas except for multi-fuel gas components where the manufacturer specifically nominates LP Gas amongst the recommended fuels. The LP Gas system is not subject to maximum outlet pressure limitations except that at low temperatures the vapour pressure in the cylinders for some mixtures may prevent high system pressures. 400 kPa is a commonly used upper limit.

Hydrogen systems may operate at higher pressures than acetylene and LP Gas. Only equipment specifically designated for hydrogen shall be used. Extreme care shall be taken in not exceeding the maximum rating of hydrogen safety devices. This may be in the range 400 to 600 kPa.

Compressed natural gas generally may be handled by LP Gas systems. Reticulated natural gas is outside the scope of this Standard, and has a very low supply pressure which may be

unsuitable for some equipment. Compressed natural gas may be used in much the same way as LP Gas, with caution, due to its higher contents pressure.

7.3 Safety devices

7.3.1 *General*

The safe operation of oxy-fuel gas systems may be achieved solely through the strict supervision of operators who have received extensive training and the use of properly selected, adjusted and maintained welding, cutting and heating equipment. However, it should be recognized that in practice mishaps cannot be entirely avoided and the highest reasonably achieved degree of protection in the way of additional safety devices should be specified. Therefore this Standard calls for the general use of safety devices. Equally, the flow capacity of currently available safety devices may not be sufficient for the required minimum flow at the end heat output device in the case of large gas flows if all the safety devices specified below are installed, therefore, hose sizes may have to be reconsidered.

7.3.2 *Fitment of safety devices*

There shall be at least one safety device, e.g. a flashback arrestor, to protect each line of oxygen and fuel gas. Flashback arrestors shall comply with AS 4603. Additional devices shall be fitted whenever practicable. The minimum recommended configurations are listed in Clauses 7.3.3 to 7.3.5 in order of preference.

NOTE: Fitment of safety devices resulting in reduced flow capacity below the minimum required by the end heat output device, and or, the mixer will result in flame instability with increased probability of flashback. Once this point is reached, additional safety devices may reduce, rather than increase, the safety level due to the reduced flow capacity. Flashback arrestors with different flow capacities are available. For high flow applications (such as heating) the operator is to ensure higher flow flashback arrestors are used.

7.3.3 *Flashback arrestors at both hose ends (optimum protection)*

Optimum protection is provided when at the blowpipe end a flame arrestor and a non-return valve for each gas line is fitted, and at the regulator end a flame arrestor, a non-return valve and a temperature activated cut-off valve for each line is fitted. Pressure activated cut-off valves at the regulator end are optional. The options in Clauses 7.3.4 and 7.3.5 below provide lower levels of protection and should be used only when it is not otherwise possible to achieve the rated flows of the end heat output device through the lack of outlet pressure from the pressure regulator.

7.3.4 *Flashback arrestors at the blowpipe hose ends only*

A flame arrestor and a non-return valve shall be fitted to each blowpipe inlet connection.

7.3.5 *Flashback arrestors at the regulator hose ends and check valves at the blowpipe ends*

At the blowpipe end, non-return valves shall be fitted on each gas line. At the regulator end, a flame arrestor, non-return valve and a temperature activated cut-off valve shall be fitted to each gas line. A pressure activated cut-off valve may also be fitted at the regulator end of each gas line.

7.4 Flow capacity and operating pressure

The operating pressure and flow of each gas recommended by the manufacturer for the tip or nozzle in use shall be ensured by the user after the final assembly has been chosen. The user shall ensure that pressure drops through the whole of down stream equipment have been taken into account.

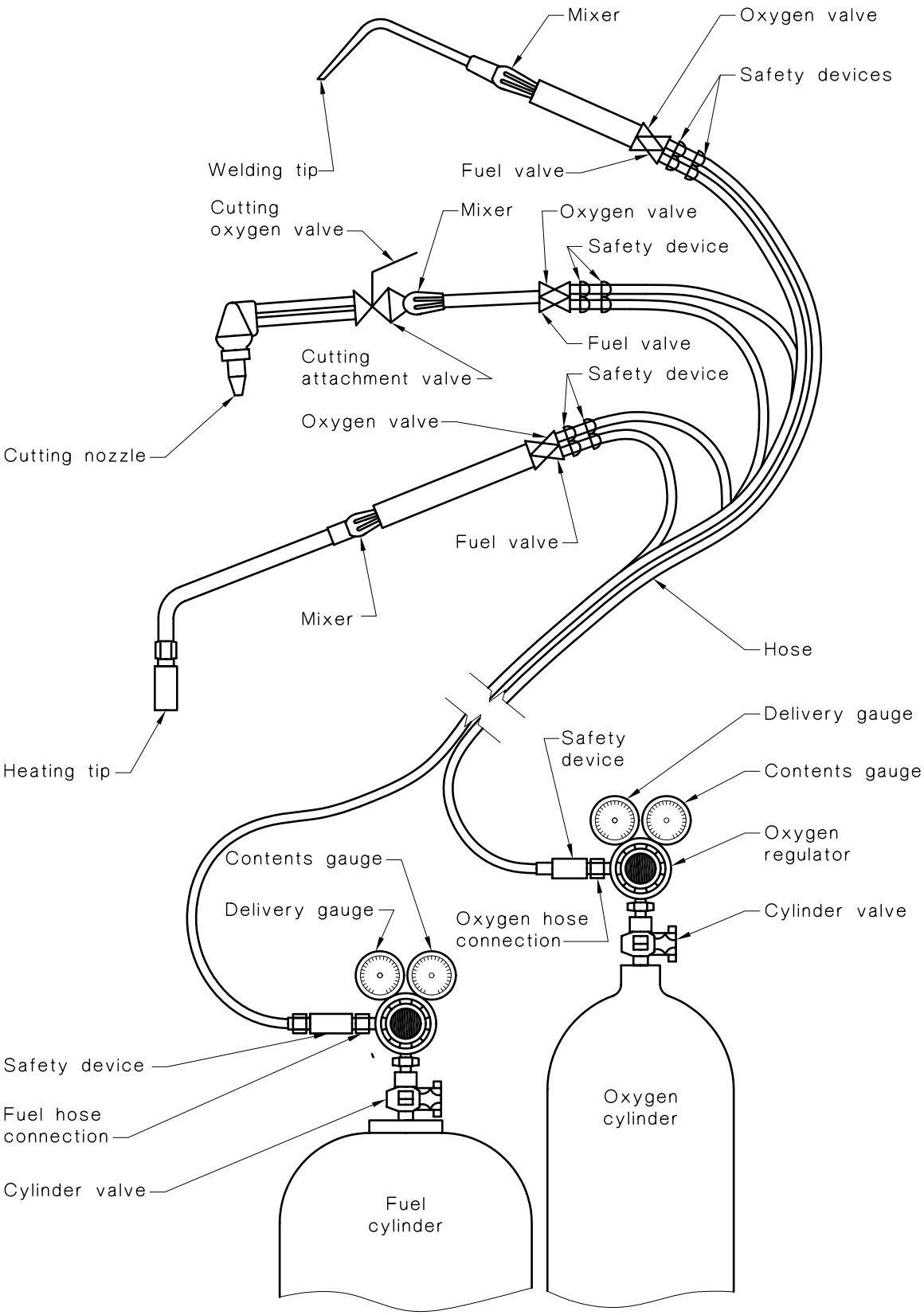

FIGURE 1 DIAGRAM OF TYPICAL OXY-FUEL WELDING, CUTTING AND HEATING SYSTEMS

Where manufacturer provides this information in the form of a table indicating suitable combinations of regulator outlet pressure, appropriate lengths and diameters of hose and type and position of safety devices, only those combinations shall be used. An example of such a table is shown for guidance in Figure 2.

Tip model and size	Regulator models and outlet pressure	Regulator mounted safety device model	Hose min. diameter	Hose max. length	Blowpipe mounted safety device models

FIGURE 2 SUGGESTED ASSEMBLED SYSTEM COMPONENT LISTING

Where such a table is not available the user shall ensure that the safety devices specified in Clause 7.3 are selected such that, together with the diameter and length of welding hose chosen, the complete system has sufficient flow capacity to operate the mixer and tip within their safe range of output flows at the outlet pressures provided by the pressure regulators in use.

Significant factors to be considered and avoided include insufficient outlet pressure at the regulator outlet, especially in the case of acetylene, welding hose of too small a diameter or too long, and insufficient flow capacity due to the number of safety devices downstream.

8 LEAK TESTING AND MAINTENANCE

8.1 Leak testing

8.1.1 *General*

Leaks may develop in any part of a gas system. All equipment shall be regularly checked and any corrective action taken before use.

Hose assemblies shall be tested after repair. Worn ends shall be cut back and refitted with the appropriate hose connections. Any hose that shows signs of deterioration shall be discarded.

Leakage of gas around the spindle of the cylinder valve may be revealed by hissing and in the case of fuel gases by smell.

If a leak on a cylinder cannot be shut off, the cylinder shall be marked and removed to a well ventilated safe area at a safe distance from the employees and the general public, and the gas supplier informed. Repairs shall not be attempted on a leaking cylinder.

Any leak detecting fluids used shall be compatible with the gases in use. The tested area shall be wiped dry with a clean lint-free cloth after the leak checks have been completed.

If leaks occur whilst the system is presssurized, the system, shall be depressurized and removed from service for repair.

8.1.2 *Equipment connection*

The procedure shall be as follows:

(a) Check that all equipment, equipment connections and especially both cylinder valve outlets and regulator inlets are clean and free from oil and grease.

(b) ‘Crack’ (briefly open and close) the cylinder valves.

WARNING: FUEL VALVES SHOULD BE CRACKED IN A WELL VENTILATED AREA CLEAR OF SOURCE OF IGNITION.

(c) Screw the regulators into the cylinder valve outlets using an appropriate spanner where applicable. Make sure the regulators knobs are fully released.

(d) Fit hoses to the regulator outlets using an appropriate spanner, including flashback arrestors, if used.

(e) Slowly open the oxygen cylinder valve, then the acetylene valve.

(f) Adjust the oxygen regulator to allow a small flow through the hose and then release the control knob. Repeat for the fuel gas regulator. (This blows off dust and chalk from the hoses.)

(g) Connect the blowpipe to the other hose ends, including flashback arrestors.

(h) Connect any required attachments, tips and nozzles to the blowpipe, ensuring all equipment is compatible.

8.1.3 *Leak testing procedure*

8.1.3.1 *Initial system pressurization*

The procedure shall be as follows:

(a) Both cylinder gas supply valves shall be fully closed.

(b) Both regulator pressures adjusting knobs shall be turned anti-clockwise until fully open to the extent of their screwed spindle.

(c) The blowpipe valves shall be fully closed.

(d) Each cylinder gas supply valves shall be opened slowly one at a time. The low pressure gauge on each regulator shall be observed. If pressure is registered on either or both low pressure gauges, this indicates a faulty regulator. Replace the faulty regulator and restart the pressurization procedure. If the system indicates a leak-free state, screw in the fuel gas regulator pressure adjusting knob until a pressure of 100 kPa is achieved. Do the same for the oxygen regulator.

(e) Turn both gas cylinder supply valves off fully.

(f) Observe the pressure gauges on each regulator for a nominal (1) minute. If a drop in pressure is indicated, then there is a leak in the system. Comply with Clause 8.1.3.2 to find the leak.

8.1.3.2 *Specific test locations*

Test for leaks at the following points (using a suitable leak detecting solution):

(a) Between both the gas cylinder supply valves and the regulator connections.

(b) Between the regulator outlet connections and the welding hose connection.

(c) Between the welding hoses and the hose connections on both ends.

(d) Between the blowpipe inlet connections and the welding hose connections.

(e) Around the spindles of all blowpipe and cutting attachment valves.

(f) At the connection joint between the blowpipe and the welding cutting or heating attachment.

(g) At the tip or nozzle.

If leaks are detected at any of these points then necessary adjustments, repairs or replacements shall be made before proceeding.

8.1.3.3 *Other possible sources of gas leaks*

It is possible that after the tests in Clause 8.1.3.2 have been successfully carried out, the system may still lose pressure. In such a case, the following procedures shall be undertaken. The following procedures shall be carried out by personnel suitably trained by the equipment manufacturer:

(a) *Pressure regulators* Regulators can be isolated from the system by disconnecting the hose and sealing off the outlet connection. After pressurizing, each regulator shall be checked for external leaks with a suitable leak detecting liquid.

NOTE: If such a leak source is not found, then the regulator should be removed from the system and sent for repair to authorized repairers accredited by the regulator manufacturer.

(b) *Welding hoses* If the regulators are found to be leak-free, then the hose shall be disconnected from the blowpipe blanked off and pressurized via the regulators. Once pressurized both gas cylinder supply valves shall be turned off. If there are any hose leaks present then they can be detected with a suitable leak detection liquid at the hose connections or by observing the pressure gauges on the regulators.

(c) *Blowpipe, cutting attachment or mixer* If the regulators and hoses are found to be leak-free then the blowpipe, cutting attachment or mixer, can be connected to the welding hoses. The nozzle or tip shall be blanked off. Leak detection shall be undertaken using a suitable leak detection fluid or immersion of the whole assembly in clean water.

8.2 Maintenance

Periodicity and details of maintenance actions shall be in compliance with Table 1.

Maintenance shall be carried out by a technically competent person. That person shall possess the following:

(a) Sound knowledge of, and sufficient practical experience of, oxy-fuel gas equipment to carry out the duties required.

(b) Sound theoretical knowledge of oxy-fuel gases used and their potential hazards when used in the workplace.

(c) An understanding of the importance of integrity and safety in the use of oxy-fuel equipment.

Examine the blowpipe nozzle regularly and if it is becoming clogged, clean it in a manner described by the manufacturer.

All oxy-fuel equipment shall be kept clean and free of oil and grease at all times inclusive of the cylinders.

NOTE: A high standard of cleanliness to be applied when the equipment is not in use.

TABLE 1

GUIDANCE ON MAINTENANCE

Equipment	Maintenance		
	Weekly (if in constant use) or before every use (to be performed by the operator)	**As nominated (to be carried out by a technically competent person)**	**Refurbishment or replacement intervals (Equipment condition determines whether refurbishment or replacement is required.)**
1. Regulators (including their integral protective devices)	According to the manufacturer's instructions including— visual examination to determine suitability for service (e.g. gas, pressure rating, damage); condition of threads and sealing surfaces; and oil or grease contamination. Leak test all joints at working pressure.	Six monthly: Functional tests to ensure the correct operation of internal components.	Manufacturer or supplier recommendation, but not exceeding five years.*
2. Flashback arrestors and other external devices (including non-return valves)	Visual examination to determine suitability for service (e.g. gas, pressure rating, damage); condition of threads and sealing surfaces; and oil or grease contamination. Leak test all joints at working pressure.	Yearly as detailed in AS 4603 or following a flashback: Proper functioning of the non-return valves and flashback arrestors. For pressure-activated valves, check there is no flow in the normal direction with the valve tripped.	Manufacturer or supplier recommendation, but not exceeding five years.*
3. Hose assemblies	Visual examination to determine suitability for service (e.g. gas, pressure rating, damage); condition of cover; and threads and sealing surfaces of the end fittings. Leak test all joints at working pressure.	Six monthly: Check for absence of cuts and excessive wear by bending the hose in a tight radius, to ensure reinforcement is not visible.	Determined by the hose assembly condition.
4. Blowpipes, mixers and attachments	Visual examination for damage of the threads and sealing surfaces of the hose connections and the attachment connections. Leak test all joints at working pressure.	Six monthly: Test control valve function. Blank the attachment connection and leak test for internal malfunction.	Manufacturer or supplier recommendation, but not exceeding five years.*

* Regulator elastomers and seals will wear and deteriorate in service and deteriorate out of service. Items stored for one year or over without use should receive inspection as per the annual maintenance inspection.

9 SYSTEM OPERATION

9.1 General

Before operating system the actions required by Sections 7 and 8 shall have been successfully completed.

9.2 Pressurizing the system

Close all regulators and downstream valves.

Slowly open each cylinder valve in turn until it is within half a turn of the fully open position. If a cylinder key is used, leave the key fitted to the valve.

Adjust the regulators to give the required gas pressures and check the equipment for leaks.

Re-adjust pressures with gas flowing.

9.3 System purging

Prior to lighting up the blowpipe, each hose shall be purged separately. After purging close each blowpipe valve. This whole operation shall take place in a well ventilated space away from any source of ignition or naked flame.

The procedure of purging gas systems shall take place following each period of non-use.

9.4 Lighting up

The blowpipe manufacturer's instruction shall be followed to light up the blowpipe. If there are any signs of leakage, fluctuations of gas supply, gas starvation or misshaped flames, the equipment shall be shutdown, and the fault corrected.

Care shall be taken to avoid the fire hazard caused by an excess quantity of unburned fuel gas being discharged to the atmosphere, if the lighting up procedure fails.

9.5 Shutdown procedure

Shutdowns for short periods, e.g. tea breaks, shall comply with Items (a) to (e). Longer period shutdowns, e.g. days or weekends, shall comply with Items (a) to (h). The procedure is as follows:

(a) Extinguish the blowpipe flame in compliance with the manufacturer's operating instructions.

(b) Extinguish any pilot lights.

(c) Close both cylinder valves.

(d) Open blowpipe valves to vent hoses separately. Reclose blowpipe valves.

(e) Return the regulator pressure-adjusting screw to zero delivery position.

(f) Check equipment for damage. Any damage shall be reported and the equipment tagged as defected.

(g) Return equipment and cylinders to a place of safe storage.

(h) Finally check to ensure that the cylinder valves are properly closed and that there is no leakage of gas.

Confined space working shutdowns should be carried out carefully to ensure the minimum escape of oxy-fuel gases. Blowpipes should be removed from the confined space, after ensuring that the cylinder valves are closed tight, when work has ceased for a substantial time, such as meal breaks or overnight, for guidance, see AS/NZS 2865.

10 SAFETY INSTRUCTIONS

10.1 General

10.1.1 *Safety considerations*

When performing gas welding, cutting, heating and allied processes, the following particular safety considerations apply:

(a) Burns from flames, hot objects, molten particles, etc.

(b) Explosion from mixed gas concentrations created from the fuel gas leakage from cylinders, hoses and equipment connections.

(c) Fire caused by ignition of flammable materials, leakage of fuel gases, contact with hot slag, etc.

(d) Ignition of materials not normally considered flammable due to oxygen enrichment.

(e) Asphyxiation due to displacement of atmospheric, breathable air by inert or toxic gases, e.g. leakages in confined spaces or lack of oxygen resulting from excessive rusting in confined spaces.

(f) Radiation damage, to eyes principally.

(g) Fumes originating from the particular materials being welded, cut or heated.

(h) Electric shock which could result from gas welding or cutting on cables or other conductors at high voltage.

(i) Influence on the workplace from the above hazards (containers, vessels, heights, etc.)

10.1.2 *Operator safety*

The operator should comply with the following:

(a) Wear suitable clothing and footwear. Synthetics, shorts, non-leather or open-toed footwear should not be worn.

NOTE: Heavy cotton or woollen clothing with suitable leatherwork boots are suitable.

(b) An approved face shield or a pair of approved welding goggles to protect the eyes should be worn.

(c) Leather gloves to protect the hands should be worn. If required, other leather apparel should be worn on other parts of the body if further protection is desired.

(d) Fumes produced by any of the processes may be harmful, in such cases, respiratory protection should be worn. Work should always be undertaken in well-ventilated areas, and where necessary, fume extraction should be used.

(e) Lighting up of the blowpipe should only be by a flint lighter or a pilot light, never with matches or cigarette lighters.

(f) The use of compressed oxy-fuel gases to dust off clothes or work should not be undertaken to avoid oxygen enrichment with possible subsequent self-ignition.

(g) Hands and gloves should be free from hydrocarbons such as grease, oil, coal dust, etc. Also, the cleaning out of cylinder valves by running either a gloved or ungloved finger around the thread should not be practiced, as, when assembling the equipment, high pressure oxygen can react violently with hydrocarbons.

10.1.3 *Operator workplace safety*

The operator shall ensure the following:

(a) The surrounding area is free from flammable materials before lighting-up.

(b) The work area is well ventilated to minimize the potential hazards of any gas leaks and to reduce the concentration of fumes.

(c) Fire and accident prevention procedures are implemented.

(d) Blowpipes that are lit are not left unattended.

(e) Utmost care be undertaken when using a lit up blowpipe to avoid burns to other personnel or a resulting fire.

10.1.4 *Safe use of equipment*

The operator should ensure the following:

(a) An adequate gas supply is available to safely complete the work. Cylinders are safety secured.

(b) Equipment is matched to the fuel gas to be used.

(c) Flashback arrestors are fitted for added protection.

(d) All parts of the system are in good working order. If in any doubt, replace or repair before proceeding.

(e) Minimize the length of the welding hoses and use a larger bore size if required. Keep the hose free from kinks and tangles.

(f) Test the system for leaks before lighting up.

(g) Ensure that the correct lighting-up and shutdown procedures are followed.

(h) All equipment items should be kept free from hydrocarbons, such as grease, oil, coal dust, silicon sealant, and the like.

10.1.5 *Tanks and containers operator safety*

No work should be carried out, e.g. welding or cutting, on any tank or container until the contents or previous contents are known.

Upon establishing what was in the container, flush or clean out with water or a suitable cleansing agent.

Work should proceed when the danger of fire or explosion is declared by a competent person to be negligible.

10.1.6 *Confined spaces operator safety*

For confined space working, the cylinders should be kept outside the confined space, clear of the entry, and in a well ventilated area.

Extra care should be taken to ensure that there are no leaks in the system and that the equipment is working properly.

Provision should be made to extract fumes. The operator shall, where necessary, be provided with a suitable supplied air respirator and a supply of breathing air.

An assistant should be stationed outside the confined space at all times to light-up the blowpipe, adjust the gas supply, if required, and to render any other assistance required by the operator.

An assistant should observe the operator, the work and work area and, in the case of emergency, close down the gas supply and take the necessary emergency action.

If the equipment is not to be used for a substantial time, such as lunch breaks or overnight, then the relevant shutdown procedure should be followed. For guidance see AS/NZS 2865. When not in use, the blowpipe should be extinguished and removed from the confined space.

10.2 Emergency procedures

10.2.1 *General emergency procedures*

Since it is not possible in a Standard of this type to offer detailed advice on every possible incident, this Clause (10.2) covers only two common difficulties that may arise and of suitable related action. Users are urged to seek fuller advice from equipment manufacturers or regulatory authorities in respect of local conditions or operations.

10.2.2 *Sustained backfire*

In a sustained backfire, the operator shall undertake the following:

(a) Close both blowpipe valves, oxygen valve first.

(b) Check the correctness of the regulator pressure settings and that the cylinders are not empty.

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

(d) Purge both hoses individually and ensure that correct gas flows have been restabilized.

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

(f) If there is any recurrence, the equipment shall be withdrawn from service for full examination by a competent person or by a repairer accredited by the equipment manufacturer.

10.2.3 *Flashback/self-extinguishing backfire*

In a flashback or self-extinguishing backfire, the operator shall undertake the following:

(a) Close both blowpipe valves immediately.

(b) Close both cylinder valves.

(c) Ascertain the cause of the incident and examine all equipment thoroughly for damage. In particular, check if either 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.

(d) Replace any damaged equipment.

(e) Before attempting any steps towards re-ignition, ensure that the safety devices cut-off valves, if fitted, are reset or replaced as necessary.

(f) Carry out all preparation procedures laid down in Clause 8 and this Clause (10.2.3). Extreme care shall be undertaken during the first few minutes after lighting-up.

11 EMERGENCIES INVOLVING COMPRESSED GAS CYLINDERS

11.1 General

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 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 may involve injury to the operator, the fire should be extinguished by prompt use of 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 and the area evacuated.

As soon as fire occurs, and is not readily extinguished, either the works fire brigade or the local fire service should be alerted, even if attempts are being made to extinguish the fire with hand-held dry powder or CO_2 extinguishers.

11.2 Actions common to all cylinders

Key actions for dealing with gas cylinders in the event of fire are as follows:

(a) The alarm shall be sounded, the danger area evacuated and the fire brigade called.

(b) If gas cylinders are directly involved in a fire, personnel shall be kept well clear.

(c) The fire brigade shall be informed immediately of the location and type of any gas cylinders involved in the fire. They shall also be made aware of the location and type of other gas cylinders on the premises.

(d) Cylinders which are not directly involved in the fire and which have not become heated shall be moved as quickly as possible to a safe place, provided this can be done without undue risk. Cylinder valves shall be closed.

(e) Cylinders in the fire shall be cooled by spraying with copious quantities of water over the entire exposed surface. Personnel engaged in this shall take up positions, that will give protection from exploding cylinders.

(f) Great caution should be taken after the fire has been extinguished as there is still the possibility of cylinders exploding, particularly acetylene cylinders.

11.3 Special actions for acetylene cylinders

Key actions for dealing with acetylene gas cylinders in the event of fire or heating of cylinders shall be as follows:

(a) Take action as detailed in Clause 11.2.

(b) Do not approach or move cylinders.

(c) Apply cooling water copiously for one hour after the fire has been extinguished.

(d) Interrupt cooling.

(e) If the cylinder surface is steaming while its surface remains wetted, reapply cooling water for 30 minutes and check again.

(f) If the cylinder is not steaming while its surface remains wetted, reapply cooling water for a further 30 minutes and check again.

(g) If the surface remains wetted check if it remains cold for 30 minutes. If it does not, reapply cooling water for 30 minutes and check again.

(h) If the surface remains cold, wait for half an hour and check if the entire cylinder is cold. If it is not, reapply cooling water for half an hour and repeat the entire procedure, first checking if the surface remains wetted.

(i) If the entire cylinder remains cold, remove it carefully and submerge it in water for 12 hours. The gas manufacturer shall be contacted for advice on how to proceed after this 12 hours.

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