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CODE OF SAFETY FOR WELDING AND CUTTING

PART 1 – OXYGEN – FUEL GAS SYSTEMS

SRI LANKA STANDARDS INSTITUTION

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SLS 727 : Part 1 : 1987

Gr. 13

SRI LANKA STANDARDS INSTITUTION
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SRI LANKA STANDARD
CODE OF SAFETY FOR WELDING AND CUTTING
PART 1 OXYGEN-FUEL GAS SYSTEMS

FOREWORD

This Sri Lanka Standard was authorized for adoption and publication by the Council of the Sri Lanka Standards Institution on 87-05-19, after the draft, finalized by the Drafting Committee on Code of Safety for Welding and Cutting, had been approved by the Mechanical Engineering Divisional Committee.

The existence of proper safety regulations and their use are the most important steps in any programme of safety and accident prevention.

This standard is presented in the hope that adherence to the safety requirements contained herein will result in the elimination of possible hazards due to welding and cutting; hence elimination of avoidable accidents and property damage.

This standard includes safety provisions for the use of oxy-fuel gas systems. This standard is in two sections. Section 1 General requirements, deals with precautionary measures applicable in general and welding and cutting under special circumstances. Section 2 Specific requirements deals with precautions pertaining to gases, their containers and associated equipment.

The following parts of this standard have been already published as Sri Lanka Standards:

Part 3 Fire prevention and protection.
Part 4 Safety of personnel.

It is intended to publish Part 2 of this standard covering, arc welding, cutting and resistance welding equipment.

The assistance derived from the publications of the American National Standards Institution in the preparation of this standard is gratefully acknwoledged.

1 SCOPE

This code covers provisions for the safe use of oxy-fuel gas systems, when used only for cutting and welding, to ensure that loss of property or damage to them are minimized and the personnel are provided with adequate protection against accidents and health hazards.

2 REFERENCES

SLS 727 Code of safety for welding and cutting
Part 3 Fire prevention and protection
Part 4 Safety of personnel

3 TERMINOLOGY

3.1 Approved equipment/apparatus

Wherever the word 'approved' is appearing in this standard the reference is made to equipment approved by the Sri Lanka Standards Institution or any other agency authorized by the Sri Lanka Standards Institution.

4 GENERAL REQUIREMENTS

4.1 Set up and installation

4.1.1 *Equipment and condition maintenance*

All welding and cutting equipment shall be kept in good working condition, inspected periodically to be sure it is in good working condition and when found to be defective (incapable of reliable, safe operation) shall be promptly repaired by qualified personnel or withdrawn from service.

4.1.2 *Operation*

All equipment shall be operated in accordance with manufacturers recommendations and instructions, provided these are consistent with this standard.

4.2 Responsibilities

Operators and management shall recognize their joint responsibilities for safety in welding and cutting.

4.2.1 *Management*

4.2.1.1 Training

Management shall assure that welders and their supervisors are trained in the safe operation of their equipment, the safe use of the process, and emergency procedures.

4.2.1.2 Designated areas and procedures

Management shall designate approved areas, and establish procedures for safe welding and cutting.

Management shall designate an individual responsible for authorizing welding and cutting operations in areas not specifically designed or approved for such processes. The individual shall be aware of the hazards involved and familiar with the provisions of this standard.

4.2.1.3 Approved equipment

Management shall assure that only approved apparatus, such as torches, manifolds, regulators, pressure reducing valves, acetylene generators, personal protective devices etc., are used.

4.2.1.4 Contractors

Management shall select contractors to perform welding who have suitably trained personnel, and who have an awareness of the risks involved.

Management shall advise contractors about flammable materials or hazardous conditions of which they may not be aware.

4.2.2 *Supervisors*

4.2.2.1 Safe use of equipment

Supervisors shall be responsible for the safe handling of the welding equipment and for the safe use of the welding process.

4.2.2.2 Combustibles

Supervisors shall determine what combustible materials and hazardous areas are present or likely to be present in the work location. They shall ensure that combustibles are not exposed to ignition by taking one of the following actions :

a) Have the work moved to a location free from combustibles;
b) Have the combustibles moved to a safe distance from the work or properly shielded against ignition if the work can not readily be moved; or
c) Schedule welding and cutting so that combustibles are not exposed during those operations.

4.2.2.3 Authorization

Supervisors shall secure authorization for the welding or cutting operations from the designated management representative.

Supervisors shall oversee that the welder has approval that conditions are safe, prior to commencing work.

4.2.2.4 Protective equipment and fire protection

Supervisors shall assure that proper personal protective equipment is used. They shall assure that fire protection and fire extinguishing equipment are properly located at the site, and that fire watchers are assigned and hot work authorization procedures are followed where required (see 4.5).

Where a fire watcher is not required, a final inspection shall be made by the supervisor one-half hour after the completion of welding operation, to detect and extinguish possible smouldering fires.

4.2.3 *Welders*

4.2.3.1 Safe handling of equipment

Welders shall take all precautions to avoid injury by proper control and safe handling of equipment.

4.2.3.2 Safe condition

Welders shall cut or weld only where all safety precautions have been met.

4.2.3.3 Permission

Welders shall have obtained permission of the supervisor before starting to weld or cut. Welders shall continue to weld or cut only so long as conditions are unchanged from those under which permission was granted.

4.3 Protection of personnel and the general area

Relevant provisions under 3 of SLS 727 : Part 4 shall apply.

4.4 Ventilation

Relevant provisions under 4 of SLS 727 : Part 4 shall apply.

4.5 Fire protection and prevention

Provision of SLS 727 : Part 3 shall apply.

4.6 Confined spaces

Work in confined spaces requires special precautions.

4.6.1 *Ventilation in confined spaces*

In addition to the requirements for adequate ventilation to keep air borne contaminants in breathing atmospheres below allowable levels, as described in 4.4, ventilation in confined spaces must also be sufficient to assure adequate oxygen for life support, to prevent accumulation of flammable mixtures, and to prevent oxygen enriched atmospheres.

Asphyxiation causes unconsciousness and death without warning. Confined spaces shall not be entered unless they are well ventilated, or unless the welder is wearing an approved air-supplied breathing apparatus with a similarly equipped second person present (see 4.6.5). Confined spaces should be tested for toxic or flammable gases and vapours, and for adequate or excess oxygen before entering. Approved instruments must be used. Gases heavier-than air such as argon and carbon dioxide may accumulate in pits, tank bottoms, low areas, and near floors; gases lighter-than air such as helium may accumulate in tank tops, high areas; and near ceilings. The same precautions shall apply to these areas, as to confined spaces. If possible, a continuous monitoring system with audible alarms should be used for confined space work.

Adequate ventilation in confined spaces must be assured not only to protect welders or cutters themselves, but to protect all personnel who may be present in the area.

4.6.1.1 Air quality

Only clean, respirable air shall be used for ventilation. The quality of air for ventilation shall be such that personnel exposures to hazardous contaminants are maintained below the limits specified in 4.4.

4.6.1.2 Prohibited ventilation gases

Only air shall be used for ventilation.

Oxygen, or any other gas or mixtures of gases, shall not be used for ventilation in order to prevent the danger of explosion.

4.6.1.3 Ventilation in areas immediately dangerous to life and health.

When welding, cutting or related processes are performed in areas immediately dangerous to life and health, positive pressure, self-contained breathing apparatus or airline respirators shall be used.

4.6.2 *Service equipment*

4.6.2.1 Compressed gas cylinders

When welding or cutting in confined spaces, gas cylinders shall be located outside the confined space.

4.6.2.2 Heavy portable equipment on wheels

Heavy portable equipment mounted on wheels shall be securely blocked to prevent accidental movement before operations are started in a confined space.

4.6.3 *Adjacent areas*

When welding or cutting is to be done over or adjacent to any confined space, personnel must be made aware of the respiratory hazards in the confined space and must not enter such spaces without necessary precautions.

4.6.4 *Emergency signal*

When a person must enter a confined space through a manhole or other small opening, means shall be provided for signalling out side personnel for help.

4.6.5 *Attendant in areas immediately hazardous to life*

When operations are carried on in confined spaces where atmospheres immediately hazardous to life may be present or may develop, an attendant shall be stationed on the outside of the confined space to ensure the safety of those working within.

4.6.5.1 Attendant's responsibilities

The attendant shall have a pre-planned rescue procedure for quickly removing or protecting those working inside in case of emergency, shall observe the workers inside or be in constant communication with them, and shall be capable of putting rescue operations into effect. A positive pressure, self-contained breathing apparatus or airline respirators with emergency escape provision shall be available for rescue operations.

4.6.5.2 Safety belts and life lines

When safety belts and life lines are used for emergency rescue purpose, they shall be attached to the person's body so that they do not become obstructed in passing through a small or tortuous exit path in following the pre-planned rescue procedure.

4.7 Public exhibitions and demonstrations

The following additional requirements shall apply to the public exhibitions and demonstrations:

4.7.1 *Supervision*

Installation and operation of welding cutting and related equipment shall be done by or under the supervision of a competent operator.

4.7.2 *Site*

4.7.2.1 Site design

The site shall be constructed, equipped, and operated so as to minimize the possibility of injury to viewers at the site.

4.7.2.2 Site location

Materials and equipment on the site shall be located so as not to interfere with evacuation of people during an emergency.

4.7.3 *Fire protection*

4.7.3.1 Extinguishers

Sites shall be provided with sufficient portable fire extinguishers of appropriate size and type.

4.7.3.2 Combustibles

Combustible materials at the site shall be shielded from flames, sparks and molten metal.

4.7.3.3 Fire department of the local authority

The fire department of the local authority shall be notified in advance of such use of the site.

4.7.4 *Protection of the public*

This section contains safe precautions specific to welding and cutting performed at public demonstrations and exhibitions to ensure the protection of viewers, demonstrators and the public.

4.7.4.1 Radiation

The public shall be shielded from harmful ultra-violet, infra-red, and other electromagnetic radiation. Shielding shall protect direct viewers and adjacent passers-by.

4.7.4.2 Fumes and gases

The public shall be protected from hazardous concentrations of fumes and gases.

4.7.5 *Cylinders*

4.7.5.1 Capacity

Cylinders of non-liquefied gases such as acytelene shall be charged to gauge pressure not exceeding half of their maximum permissible capacity. Cylinders of liquefied gases shall be charged to not more than one-half the maximum permissible capacity in kilogrammes.

4.7.5.2 Storage

Unconnected cylinders, stored at the site, shall be limited to approximately one day's consumption of each gas used. Other cylinders shall be stored in an approved storage area, preferably out doors but not near an exit of a building.

4.7.5.3 Trucks

When transported, cylinders weighing more than 18 kg shall be carried on a hand or motorized truck.

4.7.5.4 Cylinder valves

Cylinder valves shall be closed when equipment is unattended.

4.7.5.5 Valve caps

Where cylinders are designed to be equipped with valve protection caps, the cap shall be in place except when the cylinders are in service or connected ready for service.

4.7.5.6 Protection

Cylinder shall be located or secured so that they cannot be knocked over.

4.7.6 *Process hoses*

4.7.6.1 Physical damage

Hoses shall be located and protected so that they will not be physically damaged.

4.7.6.2 Tripping

Hoses shall be located and protected so as to minimize tripping hazard to the public.

4.8 Warning signs and posters

Welding and cutting operations pose potential hazards from fumes, gases, heat, radiation, sparks, flying particles and sometimes noise. Personnel shall be warned against these hazards, where applicable, by use of adequate precautionary labelling signboards, posters, etc., (see SLS 727 : Part 3 and SLS 727 : Part 4 for details).

5 SPECIFIC REQUIREMENTS

5.1 Oxygen and combustibles

5.1.1 *Keep oxygen from combustibles*

Oxygen cylinders, cylinder valves, couplings, regulators, hoses and apparatus shall be kept free from oily or greasy substances. Oxygen cylinders or apparatus shall not be handled with oily hands or oily gloves.

NOTE

Oxygen will not burn, but vigorously supports and accelerates combustion causing flammable materials to burn with great intensity. Oil or grease in the presence of oxygen may ignite spontaneously and burn violently and may lead to an explosion.

5.1.2 *Prohibited uses for oxygen*

Oxygen shall not be used as a substitute for compressed air. Oxygen shall not be used in pneumatic tools, in oil preheating burners, to start internal combustion engines, to blow out pipelines, to dust clothing or work, or to create pressure for ventilation or similar applications. Jets of oxygen shall not be permitted to strike an oily surface, greasy clothing or enter fuel oil or other storage tanks.

5.1.3 *Oxygen equipment*

Oxygen cylinders, equipment, pipelines, or apparatus shall not be used interchangeably with any other gas.

5.2 Torches

5.2.1 *Approval*

Only approved torches shall be used.

5.2.2 *Operation*

5.2.2.1 Leak testing connections

Connections shall be checked for gas tightness after assembly and before lighting the torch. Use soapy water or the equivalent, not a flame.

5.2.2.2 Purging hoses

Before lighting the torch for the first time each day, hoses shall be purged individually. This consists of allowing each gas to flow through its respective hose separately, long enough to purge out any flammable gas mixture in the hose. Hoses shall not be purged into confined spaces or near ignition sources.

5.2.2.3 Lighting torch

Use a friction lighter, stationary pilot flame or other suitable source of ignition. Do not use matches or cigarette lighters for lighting torches; do not attempt to light or relight torch from hot metal in a small cavity, hole, furnace, etc.; where gas might accumulate. Point the torch away from persons or combustible materials. Manufacturers procedures shall be followed with respect to the sequence of operations in lighting adjusting and extinguishing torch flames.

5.2.2.4 Confined spaces

To minimize the possibility of gas accumulation in confined space due to leaks or improperly closed valves when gas welding or cutting is completed, the torch valves shall be closed and in addition, the fuel gas and oxygen supply to the torch shall be positively shut off at a point outside the confined area whenever the torch is not to be used for a substantial period of time, such as during lunch or overnight. Where practicable, the torch and hose shall be removed from the confined space.

See also 4.6 of this standard for other precautions to be observed in working in confined space.

5.3 Hose and hose connections

5.3.1 *Specifications*

Hose for oxy-fuel gas service shall comply with any national standard acceptable to Sri Lanka Standards Institution.

NOTES

1 No component containing more than 60 per cent copper shall be used in contact with acetylene. In the presence of acetylene copper forms an extremely unstable compound and dissociates explosively at the slightest provocation.

2 Metal clad or armoured hose is not recommended. However, as part of a machine or an appliance when conditions of use make reinforcing advantageous, hose may be used in which such metal reinforcing is exposed to neither the inside gases nor the outdoor atmosphere.

5.3.2 *Colours*

The colours of welding hoses used for different gases shall be as follows:

Name of gas	Colour
Oxygen	Blue
Combustible gases (except LPG)	Red
Liquefied Petroleum gas (LPG)	Orange
Other non-combustible gases	Black

5.3.3 *Taping*

When parallel lengths of oxygen and fuel gas hose are taped together for convenience and to prevent tangling, not more than 100 mm in each 300 mm shall be covered by tape.

5.3.4 *Maintenance*

Hose showing leaks, burns, worn places or other defects rendering it unfit for service shall be repaired or replaced.

NOTE

Repairs shall be carried out in such a manner that no components or materials containing more than 60 per cent copper shall be used in contact with acetylene. In the presence of acetylene copper forms and extremly unstable compound and dissociates explosively at the slightest provocation.

5.3.5 *Hose connection specifications*

Only approved hose connections shall be used.

Hose connections for welding gas lines should not be compatible with connections for breathing air.

5.3.6 *Hose connection quality*

Hose connections shall be fabricated and maintained in a manner that will withstand without leakage, twice the pressure to which they are normally subjected in service, but in no case less than 2.1 Mpa. Oil free air or an oil-free inert gas shall be used for testing.

5.3.7 *Devices*

When an approved device such as a hose check valve or flash back arrestor is used in an oxy-fuel gas welding and cutting torch system, the device shall be used and maintained in accordance with the manufacturers instructions.

5.4 Pressure-reducing regulators

5.4.1 *Approval*

Only approved pressure reducing regulators with inlet connections shall be used.

5.4.2 *Inspection before use*

Union nuts and connections on regulators shall be inspected before use to detect faulty seats which may cause leakage when the regulators are attached to cylinder valves or hoses. Damaged nuts or connections shall be replaced.

5.4.3 *Oxygen gauges*

Gauges used for oxygen service shall be marked 'USE NO OIL'.

5.4.4. *Oxygen regulators*

Regulators shall be drained of oxygen before they are attached to a cylinder or manifold, or before the cylinder valve is opened (see 5.5.4.5 and 5.5.5.12). The regulator attached to a cylinder can be drained of oxygen by momentarily opening and then closing the down stream line to the atmosphere with the regulator adjusting screw engaged and the cylinder valve closed. The cylinder valve is then open at slowly. The oxygen cylinder or manifold outlet connection should be wiped clean with a clean cloth, free of oil and lint and the cylinder valve 'cracked' before connecting the regulator (see 5.5.4.4). Oxygen cylinder or manifold valves shall always be opened slowly (see 5.5.4.4 and 5.5.4.5).

5.4.5 *Maintenance*

When regulators or parts of regulators, including gauges, need repair the work shall be performed by skilled mechanics who have been properly instructed.

5.5 Cylinders (containers)

5.5.1 *General cylinder provisions*

5.5.1.1 Approval

All portable cylinders used for storage and shipment of compressed gases shall be constructed and maintained in accordance with the gas manufacturers, gas suppliers instructions.

5.5.1.2 Filling authorization

No one except the gas suppliers authorized by the gas manufacturers shall fill a cylinder.

5.5.1.3 Mixing gases

No person other than gas suppliers authorized by the gas manufacturers shall mix gases in a cylinder or transfill gases from one cylinder to another.

5.5.1.4 Content identification

5.5.1.4 (a) Compressed gas cylinders shall be legibly marked with either the chemical or the trade name of the gas for the purpose of identifying the gas content. Such markings shall be by means of stencilling, stamping, or labelling and shall not be readily removable. Do not use cylinders on which the labelling is missing or illegible. Return such cylinders to the supplier.

5.5.1.4 (b) The cylinder shall also be painted with the colours indicated below:

Name of gas		Colour
Oxygen	-	Black
Acetylene	-	Maroon
Liquefied petroleum gas	-	Signal Red

5.5.1.5 Changing markings

No person other than the authorized gas suppliers shall change the identification marking on the cylinder.

5.5.1.6 Connection threads

Compressed gas cylinders shall be equipped with approved connections.

5.5.1.7 Valve protection

All cylinders with a water weight capacity over 14 kg shall be equipped with a means of connecting a valve protection cap or with a collar or recess to protect the valve.

5.5.1.8 Cylinder temperature

The temperature of the cylinder contents shall not be allowed to exceed 54 °C.

5.5.2 *Cylinder storage*

5.5.2.1 Protection

Cylinders shall be stored where they will not be exposed to physical damage, tampering by unauthorized persons or subject to temperatures which would raise the contents above the limits specified in 5.5.1.8.

Cylinders shall be stored away from elevators, stairs or gangways in assigned places where cylinders will not be knocked over or damaged by passing or falling objects. Cylinders shall be secured in storage to prevent falling.

5.5.2.2 Cylinders separated from combustibles

Cylinders in storage shall be separated from flammable and combustible liquids and from easily ignited materials such as wood, paper packaging materials, oil and grease by at least 6 m, or by a barrier of noncombustible materials, at least 1.5 m high having a fire resistance of at least 30 minutes.

5.5.2.3 Oxygen separated from fuel gas

Oxygen cylinders in storage shall additionally be separated from fuel gas cylinder or from reserve stocks of calcium carbide, by a similar distance or barrier as described in 5.5.2.2.

5.5.2.4 Oxygen in acetylene generator buildings

Oxygen cylinders stored outside acetylene generator houses shall be separated from the generator or calcium carbide storage rooms by a noncombustible partition having a fire resistance of at least one hour. This partition shall be without openings and shall be gastight. Oxygen shall not be stored inside acetylene generator rooms.

5.5.2.5 Fuel gas cylinders upright

Acetylene and liquefied gas cylinders shall be stored valve end up.

5.5.2.6 Fuel gas storage limits

Fuel gas storage limits shall be in accordance with **5.5.2.6 (a)**, **5.5.2.6 (b)**, **5.5.2.6 (c)** and **5.5.2.6 (d)**.

5.5.2.6 (a) Less than 70 m in indoor areas

In non-sprinkled indoor areas, the maximum nonliquefied fuel gas storage shall be 70 m^3. More than one such storage area is permitted in a building if separated by a minimum distance of 30 m.

NOTE

The maximum liquefied fuel gas storage shall be 330 kg water capacity; 330 kg water capacity is equivalent to 140 kg propane or 170 kg butane.

5.5.2.6 (b) Less than 140 m^3 in indoor areas

The total gas capacity of acetylene or nonliquefied flammable gas in one storage area may be increased to 140 m^3 in cylinder storage areas protected by automatic sprinkler systems and water supply and which will furnish a sprinkler discharge density of at least 10 $l/min/m^2$ when sprinklers are operating over an area of at least 90 m^2 with sprinklers located not more than 6 m above the floor where the cylinders are stored; or protected by an automatic water spray fixed system of equal capacity.

5.5.2.6 (c) More than 140 m^3 in indoor areas

Fuel gas cylinders may be stored in unlimited quantities in excess of those permitted in **5.5.2.6 (a)** and **5.5.2.6 (b)** shall be in a separate room as provided in **5.6.3.2 (a)** and **5.6.3.2 (b)**.

5.5.2.6 (d) Fuel gas storage in outdoor areas

Fuel gas cylinders may be stored in unlimited quantities outside or in a separate building having no other occupancy.

5.5.2.7 Oxygen storage limits

Oxygen storage limits shall be as specified for oxygen manifolds under **5.6.4.2.**

5.5.3 *Cylinder handling*

5.5.3.1 Rough handling

Cylinders shall not be dropped, struck or permitted to strike objects violently in a manner which may damage the cylinder, valve or safety device.

5.5.3.2 Rolling or dragging

Cylinders shall not be rolled or dragged. They shall be carried on a cart.

5.5.3.3 Rollers or supports

Cylinders shall never be used as rollers or supports, whether full or empty.

5.5.3.4 Safety devices

Safety devices shall not be tampered with.

5.5.3.5 Closed valves

Cylinder valves shall be closed before moving cylinders.

5.5.3.6 Valve protection caps

Valve protection caps, where the cylinder is designed to accept a cap, shall always be in place and handtight (except when cylinders are in use or connected for use).

5.5.3.7 Manual lifting

Valve protection caps shall not be used for lifting cylinders.

5.5.3.8 Lifting equipment

When transporting cylinders by a crane or derrick, a cradle or suitable platform shall be used. Slings or electromagnets shall not be used for this purpose.

5.5.3.9 Transporting cylinders

When cylinders are transported by motor vehicle, they shall be secured in position.

5.5.3.10 Cylinders with regulators attached

When cylinders are to be moved with regulators attached, the cylinders shall be secured in position when moved, and cylinder valve closed.

5.5.4 *Cylinder usage*

5.5.4.1 Pressure regulator

Compressed gas shall never be used from cylinders without reducing the pressure through a suitable regulator attached to the cylinder valve or manifold, unless the equipment used is designed to withstand full cylinder pressure.

5.5.4.2 Maximum acetylene pressure

Acetylene shall not be utilized at a pressure in excess of 104 kPa gauge pressure or 206 kPa absolute.

NOTE

The 206 kPa absolute limit is intended to prevent unsafe use of acetylene in pressurized chambers usch as caissons, underground excavations, tunnel construction.

5.5.4.3 Draw off rate

The maximum draw off rate of acetylene cylinder shall not exceed 1/7 of the charging capacity of the cylinder per hour.

NOTE

This is to prevent acetone from entering the cylinder line.

5.5.4.4 'Cracking' cylinder valve

Before connecting a regulator to a cylinder valve, the valve outlet shall be wiped clean with a clean cloth free of oil and lint, and the valve shall be opened momentarily and closed immediately.

This action, generally termed 'cracking' is intended to clear the valve of dust or dirt that otherwise might enter the regulator.

5.5.4.5 Special procedure for oxygen cylinders

The following shall be done after the regulator is attached to oxygen cylinders:

a) engage the adjusting screw and open the downstream line to drain the regulator of gas; and

b) disengage the adjusting screw and open the cylinder valve slightly so that the regulator cylinder pressure gauge pointer moves up slowly before opening the valve all the way.

Stand to one side of the regulator and not in front of the gauge faces when opening the cylinder valve. If oxygen high pressure is suddenly applied, it is possible to cause ignition in the regulator and injure the operator.

5.5.4.6 Hammer or wrench

A hammer or wrench shall not be used to open cylinder valves that are fitted with hand wheels.

5.5.4.7 Special wrench

Cylinders not having fixed hand wheels shall have keys, handles or nonadjustable wrenches on valve stems while these cylinders are in service so that the gas flow can be turned off quickly in case of emergency. In multiple cylinder installations at least one such wrench shall always be available for immediate use.

5.5.4.8 Valve wide open

When a high pressure (nonliquefied) gas cylinder is in use, the valve shall be opened fully in order to prevent leakage around the valve stem.

5.5.4.9 Valve partially open

An acetylene cylinder valve shall not be opened more than approximately one and one-half turns and preferably no more than three-fourth of a turn. This is so that it may be closed quickly in case of emergency.

5.5.4.10 Interference

Nothing shall be placed on top of a cylinder when in use which may damage the safety device or interfere with the quick closing of the valve.

5.5.4.11 Stopping work

Cylinder valves shall be closed when work is finished.

5.5.4.12 Draining regulator

Before a regulator is removed from a cylinder, the cylinder valve shall be closed and the gas released from the regulator.

5.5.4.13 Secure cylinders during use

A suitable cylinder cart, chain or steadying device shall be used to keep cylinders from being knocked over while in use.

5.5.4.14 Fire protection

Cylinders shall be kept far enough away from actual welding or cutting operations so that sparks, hot slag or flame will not reach them. Alternatively fire resistant shields shall be provided.

5.5.4.15 Electric circuits

Cylinders shall not be placed where they might become part of an electrical circuit. Contacts with third rails, trolly wires, etc., shall be avoided. Cylinders shall be kept away from radiators, piping systems, layout tables, etc., that may be used for grounding electric circuits such as for arc welding machines. The tapping of electrodes against a cylinder shall be prohibited. Do not strike an arc on cylinders.

5.5.4.16 Fuel gas cylinders upright

Acetylene and liquefied gas cylinders shall be used valve end up.

5.5.5 *Cylinder emergencies*

5.5.5.1 Fuel valve packing leak

If a leak is found around the valve stem of a fuel gas cylinder, the gland nut should be tightened or the cylinder valve closed.

5.5.5.2 Fuel gas leaks which cannot be stopped

If tightening the gland nut does not stop a valve stem leak or if a fuel gas valve is leaking at the seal and cannot be stopped by closing the valve firmly, or if a leak should develop at a cylinder fuse plug or other safety device, then the fuel gas cylinder should be moved to a safe location outdoors, away from any source of ignition, marked properly and the supplier informed immediately.

A warning sign should be posted not to approach the cylinder with a lighted cigarette or source of ignition. The cylinder valve may be opened slightly to gradually discharge the contents.

5.5.5.3 Fuel cylinder fires

Small fires at fuel gas cylinders, usually resulting from ignition of leaks described in 5.5.5.1 and 5.5.5.2 should be extinguished, if possible, by closing the cylinder valve or by the use of water, wet cloths, or fire extinguisher. The leaks should then be treated as described in those sections.

In the case of a large fire at a fuel gas cylinder, such as from the functioning of a fuse plug or safety device, personnel should be evacuated from the area. It would be usually better to allow the fire to continue to burn and consume the escaping gas, otherwise it may re-ignite with explosive violence.

If circumstances permit, it is often better to allow the cylinder fire to burn out in place rather than attempt to move the cylinder. If the cylinder is located where the fire should not be allowed to burn out in place, attempts may be made to move it to a safer location, preferably outdoors. Personnel should remain as distant as possible, and the cylinder should be kept cool with a water stream.

5.6 Cylinder manifolding

5.6.1 *Approval*

Fuel gas manifolds and high pressure oxygen manifolds (for use with oxygen cylinders having a service pressure above 1.7 MPa gauge) shall be approved either separately for each component part or as an assembled unit.

5.6.2 *Gas service*

All manifolds and parts shall be used only for the gases which they are approved.

5.6.3 *Fuel gas manifold capacity limits and locations*

Fuel gas manifold capacity limits and locations shall be in accordance with 5.6.3.1 and 5.6.3.2

5.6.3.1 Fuel gas manifolds, indoors, less than 70 m^3 capacity

Except as provided in 5.6.3.2, fuel gas cylinders connected to one manifold inside a building shall be limited to a total gas capacity of 70 m^3 of acetylene or nonliquefied gas or a total water capacity of 330 kg for LP gas.

More than one such manifold with connected cylinders may be located in the same room provided the manifolds are at least 15 m apart or are separated by a barrier of noncombustible material at least 1.5 m high having a fire resistance rating of at least one half hour.

5.6.3.2 Fuel gas manifolds, exceeding 70 m^3 capacity

Fuel gas cylinders connected to one manifold having a total gas capacity exceeding 70 m^3 of acetylene or nonliquefied gas or a water capacity of 330 kg for LP gas, shall be located outdoors or in a separate building or room constructed in accordance with 5.6.3.2 (a) and 5.6.3.2 (b).

NOTE

A water capacity of 330 kg is equivalent to about 140 kg of propane, or 170 kg of butane.

5.6.3.2 (a) Construction of rooms

The walls, partitions, floors and ceilings of the rooms shall be constructed of noncombustible materials having a fire resistance rating of at least one hour. The walls or partitions shall be continuous from floor to ceiling and shall be securely anchored. At least one wall of the room shall be an exterior wall.

5.6.3.2 (b) Fire doors and windows

Openings from the room to the parts of the building shall be protected by a swinging type, self-closing fire door for a Class B opening and having a rating of at least one hour. Windows in partitions shall be wired glass in approved metal frames with fixed sash. Installation shall be in accordance with a national standard acceptable to Sri Lanka Standards Institution covering requirement for the Installation of Fire Doors and Windows.

5.6.4 *Oxygen manifold capacity limits and locations*

Oxygen manifold capacity limits and locations shall be in accordance with **5.6.4.1** and **5.6.4.2**.

5.6.4.1 Separation from combustibles

Oxygen manifolds shall not be located in an acetylene generator room. Oxygen manifolds shall be separated from fuel gas cylinders or combustible materials (specially oil or grease) in the same room by a minimum distance of 6 m, or by a barrier of noncombustible material at least 1.5 m high having a fire resistance rating of at least 30 minutes.

5.6.4.2 High pressure oxygen manifolds

High pressure oxygen manifolds are manifolds for use with cylinders having a service pressure above 1.7 MPa.

5.6.4.2 (a) High pressure oxygen manifolds, less than 160 m^3 capacity

Except as provided in 5.6.4.2 (b) high pressure oxygen cylinders connected to one manifold shall be limited to a total gas capacity of 160 m^3. More than one such manifold with connected cylinders may be located in the same room provided that manifolds are at least 6 m apart.

5.6.4.2 (b) High pressure oxygen manifolds, exceeding 160 m^3 capacity

A high pressure oxygen manifold to which cylinders having an aggregate capacity of more than 160 m^3 of oxygen are connected shall be located:

i) Outdoors;
ii) In a separate building constructed of noncombustible or limited combustible materials; or
iii) If located inside a building having occupancy other than that directly associated with the production of acetylene, the storage of calcium carbide or the storage and manifolding of fuel gases used in welding and cutting, shall be in either a separate room constructed of noncombustible material, or materials having a fire resistance rating of at least 30 minutes, or in an area having no combustible materials within 6 m of the manifold.

5.6.4.2 (c) High pressure oxygen manifolds or bulk systems, exceeding 560 m^3 capacity

A high pressure oxygen manifold or oxygen bulk system which has a storage capacity of more than 560 m^3 of oxygen (measured at 100 kPa and 21 °C) including unconnected reserves on hand at the site, shall comply with any national standard which covers requirements for high pressure oxygen manifolds or bulk systems.

5.6.4.3 Low pressure oxygen manifolds

Low pressure oxygen manifolds are manifolds for use with cylinders having a service pressure not exceeding 1.7 MPa.

5.6.4.3 (a) Low pressure oxygen manifolds, less than 330 m^3 capacity

Low pressure oxygen cylinders connected to one manifold shall be limited to a total gas capacity of 330 m^3. More than one such manifold with connected cylinders may be located in the same room provided the manifolds are at least 15 m apart.

5.6.4.3 (b) Low pressure oxygen manifolds, exceeding 330m^3 capacity

An oxygen manifold to which low pressure cylinders having an aggregate capacity of more than 330 m^3 of oxygen are connected shall be located:

i) Outdoors;
ii) In a separate building constructed of noncombustible or limited combustible materials; or
iii) If located inside a building having occupancy other than that directly associated with the production of acetylene, the storage and manifolding of gases used in welding and cutting shall be either a separate room constructed of combustible material or materials having a fire resistance rating of at least 30 minutes, or in an area having no combustible materials within 6 m of the manifold.

5.6.5 *Manifold requirements*

5.6.5.1 High pressure manifolds

These manifolds are for use with cylinders having a service pressure exceeding 1.7 MPa gauge, approximately.

5.6.5.1 (a) Pressure regulators

High pressure manifolds shall be provided with approved pressure regulating devices.

5.6.5.2 Low pressure manifolds

These manifolds are for use with cylinders having a service pressure not exceeding 1.7 MPa gauge, approximately.

5.6.5.2 (a) Construction

Low pressure manifolds shall be of substantial construction suitable for use at a pressure of 1.7 MPa. They shall have a minimum bursting pressure of 6.8 MPa gauge and shall be protected by a safety relief device which will relieve at a maximum pressure of 3.4 MPa gauge.

5.6.5.2 (b) Hose

Hose and hose connections subject to cylinder pressure shall comply with 5.3. Hose shall have a minimum bursting pressure of 6.8 MPa gauge.

5.6.5.2 (c) Pressure test

The assembled low pressure manifold, including loads, shall be tested and proved gas-tight at a pressure of 2.5 MPa gauge or at the relief valve set pressure whichever is higher. The gas used for testing oxygen manifolds shall be oil-free and not combustible.

5.6.5.2 (d) Caution sign

The following sign shall be conspicuously posted at each low pressure manifold.

LOW PRESSURE MANIFOLD
DO NOT CONNECT HIGH-PRESSURE CYLINDERS
MAXIMUM PRESSURE - 1.7 MPa gauge

5.6.5.3 Fuel gas manifolds, check valves

Each fuel gas cylinder lead should be provided with a non return valve.

5.6.5.4 Acetylene manifold flash back arresters

When acetylene cylinders are coupled, approved flash back arresters shall be installed between cache cylinder and the coupler block. Where the number of cylinders coupled does not exceed three, one flash back arrester installed between the coupler block and regulator is acceptable, only for outdoor use.

5.6.5.5 Portable outlet headers

The term portable outlet header is used to mean any assembly of valves and connections used for service outlet purposes, which is connected to the permanent service system by means of a hose or other non-rigid conductor. Devices of this nature are commonly used at piers and drydocks in shipyards where the service piping cannot be located close enough to the work to provide a direct supply.

5.6.5.5 (a) Indoors prohibited

Portable outlet headers shall not be used indoors except for temporary service where the conditions preclude a direct supply from outlets located on the service piping system.

5.6.5.5 (b) Service piping outlet (valves)

Each outlet on the service piping from which oxygen or fuel gas is withdrawn to supply a portable outlet header shall be equipped with a readily accessible shut-off valve.

5.6.5.5 (c) Service piping outlet (valve caps)

Each service outlet on portable outlet headers shall be provided with a valve assembly that includes a detachable outlet seal cap, chained or otherwise attached to the body of the valve.

5.6.5.5 (d) Master shut-off valves

Master shut-off valves for both oxygen and fuel gas shall be provided at the inlet of the portable outlet header.

5.6.5.5 (e) Backflow protection

Portable outlet headers for fuel gas service shall be provided with an approved hydraulic back-pressure valve installed at the inlet and preceding the service outlets, unless an approved pressure-reducing regulator, an approved back-flow check valve, or an approved hydraulic back-pressure valve is installed at each outlet. Outlets provided on headers for oxygen service may be fitted for use with pressure-reducing regulators or for direct hose connection.

5.6.5.5 (f) Hose and hose connections

Hose and hose connections used for connecting the portable outlet header to the service piping shall comply with 5.3.

5.6.5.5 (g) Portable outlet headers shall be provided with frames which support the equipment securely in the correct operating position and protect them from damage during handling and operation.

5.6.6 *Manifold installation and operation*

5.6.6.1 Supervision

Cylinder manifolds shall be installed under the supervision of someone familiar with the proper practices with reference to their construction and use.

5.6.6.2 Cylinders vertically

Acetylene and liquefied fuel-gas cylinder shall be manifolded in a vertical position.

5.6.6.3 Cylinder pressures

The pressure in the gas cylinder connected to an discharged simultaneously through a common manifold shall be approximately equal.

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The Sri Lanka Standards Institution is the owner of the registered certification mark shown below. Beneath the mark, the number of the Sri Lanka Standard relevant to the product is indicated. This mark may be used only by those who have obtained permits under the SLS certification marks scheme. The presence of this mark on or in relation to a product conveys the assurance that they have been produced to comply with the requirements of the relevant Sri Lanka Standard under a well designed system of quality control inspection and testing operated by the manufacturer and supervised by the SLSI *which includes surveillance inspection of the factory, testing of both factory and market samples.*

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The principal objects of the Institution as set out in the Act are to prepare standards and promote their adoption, to provide facilities for examination and testing of products, to operate a Certification Marks Scheme, to certify the quality of products meant for local consumption or exports and to promote standardization and quality control by educational, consultancy and research activity.

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