



THE REPUBLIC OF UGANDA

MINISTRY OF GENDER, LABOUR AND SOCIAL DEVELOPMENT

COMPRESSED GAS CYLINDER SAFETY GUIDELINES AT WORK PLACES



2021

FOREWORD

As Uganda drives towards Vision 2040 through mass industrialization, the wide range application of compressed gases in the economy is inevitable. These gases are used for many different purposes including chemical processes, welding, breathing (e.g. diving, emergency rescue), medical and laboratory uses, extinguishing fires, heating and cooking.

However, the recent gas cylinder explosions in the country raises a threat level on the handling and usage of gas cylinders. Gas cylinders and their contents are potentially dangerous if mishandled hence can have devastating consequences to life, property and the environment. It is therefore, important that robust safety guidelines for the handling, transportation, use, storage and disposal of compressed gases are developed.

The Ministry of Gender, Labour and Social Development is committed to promoting the safe handling of compressed gases wherever possible and hopes that this document will serve as a guiding tool outlining the potential hazards of working with gases as well as promoting safer practices around their use, handling, storage and transport.



Frank K. Tumwebaze (MP)

MINISTER

Table of Contents

FOREWORD.....	I
1.0 Introduction.....	2
1.1 Types of compressed gases	3
1.2 Primary hazards of compressed gases.....	3
2.0 Identification of gases.....	4
2.1 Labelling requirements	4
3.0 Safe handling and use of gas cylinders	4
3.1 General precautions	5
3.2 Gases requiring special handling.....	8
3.2.1 Flammable gases	8
3.2.2 Asphyxiant and inert gases.....	9
3.2.3 Corrosive and toxic gases	10
3.2.4 Oxidizing gases.....	10
3.3 Supply points.....	11
3.3.1 Key principles.....	11
3.3.2 Location of gas supply points.....	11
3.3.3 Gas cabinets	12
3.3.4 Internal gas supply rooms	13
3.3.5 External gas supply points	14
4.0 Cylinder storage.....	15
4.1 General storage precautions	15
4.2 Store design and construction	18
4.3 Internal storage.....	19
4.4 External storage location.....	19
5.0 Transportation of gas cylinders	19
6.0 Cylinder leaks	22
7.0 Gas cylinder disposal	23
8.0 Inspection and maintenance of gas cylinders.....	23
9.0 Roles and responsibilities of key stakeholders	24
10.0 Review of the guidelines	25

1.0 Introduction

Gases are compressed in portable cylinders for use in a variety of tasks in industries, hospitals, schools, research laboratories, hotels, fabrication workshops and homes. As Uganda transforms from a peasant to a modern and prosperous country, use of compressed gases in cylinders is expected to rise. However, compressed gas cylinders can be extremely hazardous when mishandled during storage, transportation and use. Compressed gas cylinders can present a variety of hazards due to their pressurized contents. Depending on the particular gas, there is a potential for simultaneous exposure to both mechanical and chemical hazards.

The rise in gas cylinder explosions have been noted recently in the country. These include a sauna explosion in Ntinda, 2011, which left eight people in critical conditions and several fatal cylinder explosions reported in 2019 around Kyaliwajala, Wakiso and Banda that left five people dead, many injured and property damaged.

If no further efforts are put in place to manage the gas cylinder safety requirements at production, refilling, transportation, selling and use, more accidents will occur with catastrophic safety consequences.

Consequently, the Ministry of Gender, Labour and Social Development (MGLSD) through the Department of Occupational Safety and Health (DOSHS) in execution of its mandate, together with other stakeholders (MWE-DESS, NEMA, DLGs, Private sector) in ensuring safety at work places has developed this guide to arrest the rising compressed gas cylinder incidents at workplaces, and in preparation for the gas industry as the country drives towards production phase of the discovered oil and gas resources in the Albertine Graben.

1.1 Types of compressed gases

There are three major categories of compressed gases, namely: liquefied, non-liquefied and dissolved gases.

- i. Liquefied gases are gases which can become liquids when under pressure in the cylinder e.g. propane and carbon dioxide;
- ii. Non-liquefied gases, also known as, pressurized or permanent gases e.g. oxygen, nitrogen, helium and argon; and
- iii. Dissolved gases e.g. acetylene that is normally dissolved in a solvent, typically acetone at pressures up to 19 bars (275 psig) at 20°C (68°F).

1.2 Primary hazards of compressed gases

Compressed gases can be toxic, flammable, oxidizing, corrosive, and inert or they may possess combinations of these hazards.

- i. Fire and Explosions: flammable gases such as acetylene, hydrogen, and Liquefied Petroleum Gas (LPG) can burn or explode under certain conditions.
- ii. De-oxygenated atmosphere (Asphyxiation): inert gases, such as argon, helium, and nitrogen can displace enough air to reduce oxygen levels when released. If oxygen levels are too low, people entering the area can lose consciousness or die.
- iii. Poison (Health effects): some gases such as carbon monoxide, chlorine, arsine and hydrogen sulfide are toxic. They could cause various health problems depending on the specific gas and exposure.
- iv. High Pressure: extremely high pressures inside the cylinders can turn damaged cylinders into uncontrolled rockets with the potential to cause severe injuries.

These guidelines have been developed to guide and advice the manufacturers and users on the safe transportation, storage, handling, usage and disposal of compressed gases.

2.0 Identification of gases

Gases in cylinders can be identified by referring to the cylinder labels, which provide other vital safety information such as hazards associated with the gases contained in cylinders.

2.1 Labelling requirements

- i. Prior to use, ensure all cylinders are clearly labeled to identify their contents or lack thereof (e.g. empty).
- ii. Do not rely on the color of the cylinder for identification. Color-coding is not reliable because cylinder colors may vary with the manufacturer or supplier.
- iii. Never rely on labels on caps because they are inter-changeable.
- iv. All gas lines leading from a compressed gas supply should be clearly labeled to identify the gas and the area served.
- v. The labels should be coded to distinguish hazardous gases such as flammable, toxic, or corrosive substances.
- vi. No compressed gas cylinder should be accepted for use if its contents are not legibly identifiable by name.
- vii. If the labeling on a cylinder becomes unclear the cylinder should be marked “contents unknown” and returned to the supplier
- viii. Signs should be posted in areas where flammable compressed gases are stored or used, identifying the substance and appropriate precautions (e.g., DO NOT SMOKE, NO OPEN FLAMES).

(Refer to Annex A, for particular identification of common industrial gases)

3.0 Safe handling and use of gas cylinders

Without proper use and care compressed gas cylinders can explode killing workers and destroying equipment. Cylinders can also become flying projectiles when cylinder valves are damaged or broken off. Regulators can become bullets that tear through workers if safety precautions are not taken. Therefore, careful procedures are necessary for handling the various compressed gases.

3.1 General precautions :

Before and during cylinder use, the following precautions should be taken:

- a) Make sure the cylinder is equipped with the correct regulator.
- b) Only properly trained personnel should handle compressed gas cylinders.
- c) Never heat a cylinder to raise the pressure of the gas. This can defeat the safety mechanisms built in by the supplier.
- d) Never intentionally, drop or strike compressed gas cylinders against one another.
- e) Do not use a compressed gas in a confined space.
- f) Never use a leaking, corroded or damaged cylinder. Remove the cylinder from service and contact the supplier for return.
- g) Keep cylinder valves closed except when the cylinder is being used. When opening a cylinder valve, stand so that the valve outlet is pointed away from yourself and all other employees. Open valves slowly.
- h) Use only regulators, pressure relief devices, valves, hoses and other auxiliary equipment that is designed for the specific container and compressed gas to be used.
- i) A minimum of 6 metres (20 feet) must be maintained between oxidizers and flammable gases and other combustible materials, such as oil or grease. A firewall (partition) 5 feet high with a '30-minute'¹ rating can be substituted
- j) Keep the cylinder clear of all electrical circuits, flame, and sparks.
- k) Never leave the valve open when equipment is not in use, even when empty, air and moisture may diffuse through an open valve, causing contamination and corrosion within the cylinder
- l) Do not refill a cylinder if not authorized. Mixing of residual gases may cause a dangerous reaction.
- m) Clear the valve to prevent dust or dirt from entering the regulator before connecting a regulator.

¹ This is sometimes referred to as '30-minute fire resistance', meaning if a fire breaks out, a surface that has been treated correctly such as an interior wall, will be protected from the effects of a fire by a protective layer that is guaranteed to last for 30 minutes.

- i. Personnel shall stand to the side of the cylinder away from the valve outlet, and “crack” the valve by shortly opening the valve, then closing it immediately.
 - ii. Personnel shall not “crack” the valve of a cylinder that contains toxic gases.
- n) Inspect the regulator and cylinder valves for grease, oil, dirt, and solvent. Never use grease or oil to lubricate regulators or cylinder valves because they can cause an explosion.
- o) The cylinder should be placed so that the valve handle at the top is easily accessible.
- p) When using toxic or irritating gas, the valve should only be opened while the cylinder is in a working fume hood.
- q) Only use wrenches or tools that are provided by the cylinder supplier to open or close a valve. Pliers should never be used to open a cylinder valve. Some regulators require washers; this should be checked before the regulator is fitted.
- r) Refer to Safety Data Sheet (SDS) for the gas being used for information regarding use and toxicity.
- s) Fire extinguishing equipment should be readily available when combustible materials can be exposed to welding or cutting operations using compressed cylinder gases.
- t) Only use compressed gas cylinders in well-ventilated areas to avoid gas accumulation.
- u) Always inspect all parts of a compressed gas cylinder before use. A soapy water solution may be used to check for leaks.
- v) If a cylinder is designed to accept a cap, it must be securely in place, unless the cylinder is in use or connected for use.
- w) Follow “permit to work” system while carrying out non-routine activity such as hot works or involving toxic gases.
- x) Never attempt to repaint cylinders.
- y) Beware of trapping fingers between cylinders whilst they are being moved;

- z) Open cylinder valves slowly and pointing the outlet away from the personnel.
 - i. OPEN by turning the handwheel or cylinder valve key anti-clockwise, only use reasonable force.
 - ii. CLOSE by turning the handwheel or cylinder valve key clockwise, only use reasonable force.
 - iii. In order to quickly close safety valve in the event of an emergency, personnel shall keep wrenches and other recommended tools on the valve while the container is in use.
- a) Maintain a safe position when opening a regulator by:
 - i. Standing on the valve side of the cylinder at arms' length so you do not have to reach in front of the regulator face.
 - ii. Not reaching in front of or standing in front of the regulator face when opening the valve.
 - iii. Ensuring that the regulator is angled slightly upward, but not directed towards other personnel, so if there is an explosion, the adjusting screw and debris will fly away from your face.
- b) Properly install check valves and/or traps to prevent backflow and regularly inspect these devices to ensure proper operation.
- c) Ensure that a suitable pressure-regulating device is installed when the following conditions exist:
 - i. Gas is admitted to a system of lower pressure rating than the supply pressure, or
 - ii. The system rating can be exceeded due to the gas capacity of the supply source.

NOTE: Provided one of the conditions is met above, a pressure-regulating device shall be required, regardless of the existence of a pressure relief device (PRD) protecting the lower pressure system.

- d) When connecting a compressed gas container to a manifold, or its related equipment (regulators, safety devices, etc.), Personnel should ensure that:
 - iii. The threads on the container valve outlet match the threads on the regulator connection or other auxiliary equipment.

- iv. One never forces valve connections that do not fit properly.
 - v. The pressure gauges on the regulators are correct for the specific gas cylinder being used.
 - vi. The inlet connections, including piping, regulators and manifolds, are gas tight before use.
 - vii. The integrity of the connection can be confirmed using a mild soap solution, a compatible commercial leak test solution, or a leak detection instrument.
- e) Before removing a regulator, personnel should ensure that:
- viii. Cylinder valve is closed;
 - ix. Regulator of gas pressure is relieved by turning (i.e. opening) the adjusting screw and reclosing the adjusting screw.
- f) When using a cylinder containing a non-liquefied compressed gas:
- x. Personnel shall not reduce the pressure below the operating pressure of the system and;
 - xi. Not reduce the pressure less than 20 psig to prevent the backflow of contaminants into the container.
- g) Personal Protective Equipment (PPE)
- i. Eye protection must always be worn when handling and working with compressed gases. In some cases, additional protection may be needed in the form of a face shield.
 - ii. Use gloves and protective clothing to protect against frostbite (for cryogenic liquids), corrosives, and pinch points.
 - iii. If respirators are required for use with compressed gases (i.e. atmosphere-supplying respirator for asphyxiant gases), follow appropriate instructions for a good fit.

3.2 Gases requiring special handling

3.2.1 Flammable gases

Acetylene, ammonia, hydrogen, propane, propylene and methane are all flammable gases, also known as fuel gases. They burn when mixed with an

oxidant and provided with a source of ignition. The following guidelines shall be followed:

- a) Always store acetylene cylinders with the safety valve end up.
- b) Never use acetylene in its free state at pressures exceeding 15 psig, since it may undergo spontaneous combustion upon contact with air at pressure levels higher than 15 psig.
- c) Acetylene or other flammable gas cylinder valves should not be opened more than $\frac{1}{2}$ turns of the spindle, and in any case (preferably) no more than $\frac{3}{4}$ of a turn. This reduces the risk of explosion and allows the cylinder valve to be closed quickly cutting off the gas flow.
- d) Never take cylinders containing oxygen, acetylene, or other fuel gas into confined spaces.
- e) One shall always use non-sparking tools.
- f) Proper storage outdoors or in unoccupied buildings:
 - i. Shall not exceed 10.2 tonnes of liquefied petroleum gas (LPG) in one storage area.
 - ii. For determination of quantity, shall consider full or partially full cylinders as full cylinders.
 - iii. Shall always separate LPG and acetylene by at least 20 feet.
- g) Shall always ensure proper storage inside occupied buildings by:
 - i. Not storing near arcing electrical equipment, open flames, or other sources of ignition.
 - ii. Separating flammable gas containers at least 6 metres (20 feet) from flammable liquids, highly combustible materials, and oxidizers.
 - iii. If separation is not possible, shall isolate flammable gas cylinders by a non-combustible barrier that has a fire resistance rating of at least 30 minutes.

3.2.2 Asphyxiant and inert gases

Gases such as argon, helium, neon and nitrogen can cause injury or death if they are present in sufficiently high concentrations. They can displace oxygen levels in air to cause asphyxiation. Handling and use of these gases shall follow a number of guidelines:

- a) Shall not store asphyxiant gases in areas without proper ventilation.
- b) There shall be oxygen monitoring using appropriate oxygen sensors and meters in areas of storage and application of inert gases.
- c) Shall wear appropriate PPE during use and handling inert gases.

3.2.3 Corrosive and toxic gases

Corrosive gases such as ammonia, hydrogen chloride, chlorine and methylamine can burn or destroy body tissues on contact and corrode metals whereas toxic gases like carbon monoxide, chlorine, arsine and hydrogen sulfide can create a toxic environment for life. Therefore, the following guidelines shall be applied:

- a) Shall avoid contact with the skin or eyes or inhaling any corrosive gases.
- b) Shall wear appropriate personal protective equipment (PPE).
- c) Shall store corrosive and toxic gases in accordance with local and/or building fire protection procedures.
- d) Shall ensure emergency showers and eyewash facilities are available in areas where corrosive gases are used and stored.

3.2.4 Oxidizing gases

Oxidizing gases, including oxygen, are non-flammable but can support and accelerate combustion in the presence of an ignition source and a fuel. The following guidelines shall be applied:

- a) Shall ensure that cylinders are free from grease, oils and other contaminants;
- b) Shall not handle cylinders with oily hands or gloves;
- c) Shall use an oxygen-compatible material to clean all equipment that has been used with oxidizing gases;
- d) Shall store oxidizers separately from flammable or combustible materials whilst maintaining a minimum distance of 20 feet;
- e) Shall establish a non-combustible barrier at least 5 feet high, having a fire rating of at least 30 minutes.

3.3 Supply points

Gas supply points are defined as the points where the connected gas containers and associated valves and fittings are housed.

3.3.1 Key principles

Gas supply points should be:

- a) Secure (but with clear access);
- b) Well ventilated
- c) Free from naked flames and unprotected electrical equipment which could act as sources of ignition;
- d) Well separated from fire hazards and populated areas;
- e) Used exclusively for containers;
- f) Clearly labelled with the name of the gas and principal hazard(s);
- g) Well maintained;
- h) Provided with arrangements to stop containers from falling over;
- i) May be provided with a means of remote isolation of the supply, as close as is practicable to the supply container where a hazard could arise from an uncontrolled gas release in the downstream equipment.

3.3.2 Location of gas supply points

Gas containers of toxic, corrosive, pyrophoric² or flammable gases, which are connected for use, shall each have a separate supply point and be located as follows:

- a) Inside purpose-built gas cabinets;
- b) Within purpose-built internal gas supply rooms;
- c) External gas supply points in a safe place outside buildings. This is the preferred location for all gases;
- d) It is recommended that containers of other gases are kept as above.
However, they may be connected for use at points in the workroom

² Substance that ignites spontaneously in air at or below 54 °C or within 5 minutes after coming into contact with air.

provided attention is paid to the key principles above and the number of containers is kept to a minimum.

3.3.3 Gas cabinets

A gas cabinet is a purpose-built enclosure for the containment of gas supply containers. Its function is to provide security, separation and localized ventilation.

- a) Gas cabinets used for the containment of toxic or flammable gases should:
 - i. Be provided with forced air extraction ventilation which is safely discharged;
 - ii. Contain any purge gas supply container(s) associated with the toxic or flammable gas container(s) within the cabinet;
 - iii. As far as is practicable, contain the pressure / flow control / purging equipment associated with the toxic or flammable gas supply container(s) within the gas cabinet.
- b) Where practicable, gas cabinets should be separated from any other working areas by a wall of fire-resisting construction.
- c) Used containers should be removed from the gas cabinet to an external storage area as soon as is practicable.
- d) Gas cabinets should be dedicated to a specific gas and should be shared only with their appropriate inert purge gas container. If this is not practicable, for gases other than pyrophorics, the gases shall be chemically compatible.
- e) Gas cabinets shall be constructed of non-combustible materials.
- f) The strength of the cabinet should be such that it offers sufficient support for the gas containers and associated equipment during normal use and container changing.
- g) A suitable material to meet these requirements for cabinets containing more than one large (50 litres) container would be sheet steel of 2 mm nominal thickness. For cabinets housing flammable gases, the ventilation ducting shall be made of non-combustible material.
- h) The cabinet door(s) shall be designed to give full opening to change containers and a smaller opening for valve manipulation.

- i) Within the cabinet there shall be facilities to locate and secure the gas container to the cabinet.
- j) There shall be a label and a hazard warning sign, displayed on each cabinet identifying the gas and its potential hazard. A further sign shall be displayed in the area in a clear and visible location, giving emergency information (including emergency telephone numbers, action to be taken in an emergency and a list of the gases present in the area).
- k) Consideration shall be given to the monitoring of the air inside cabinets containing toxic gases and /or flammable gases.
- l) The cabinet shall be provided with sufficient extraction ventilation to achieve the following:
 - a) Prevent any escape of any hazardous gases to the workplace, with or without the valve manipulation window open;
 - b) Maintain the potential concentration of flammable gases in the extracted air to below 25 % of the lower flammable limit, except in the event of a catastrophic leak.
- m) The cabinet and all the equipment within the cabinet shall be electrically bonded to earth.
- n) Gas cabinets may share the same extraction ducting provided the mixing of incompatible gases is not possible within the ducting.

3.3.4 Internal gas supply rooms

Internal Gas supply rooms are separate rooms at workplace used solely to contain the supply gas containers and associated equipment. No other plant or machines shall be kept in these rooms and access shall be kept to a minimum and for authorized personnel only.

- a) The numbers of containers in gas supply rooms shall be restricted to the minimum required for operational and standby / reserve purposes.
- b) Gases and gas mixtures classified as pyrophoric and very toxic gases may be kept in internal gas supply rooms, provided they are enclosed in ventilated gas cabinets, which meet the requirements of sub-section 3.3.3.

- c) Where toxic gases are not housed in gas cabinets it shall be demonstrated that there is adequate ventilation and atmospheric monitoring to ensure that a safe working environment is maintained.
- d) Containers of inert purge gases serving gas supplies may be located in the same room as their appropriate process gas.
- e) For toxic, pyrophoric and flammable gases a clearly marked emergency isolation valve shall be provided on the gas supply system as close as possible to the container. The emergency isolation valve shall be operable remotely from both outside and inside the gas supply room. This may take the form of a remotely operable cylinder valve.
- f) For flammable gases, ignition sources shall be separated from potential sources of leaks, i.e., minimum separation distance of 3 metres (10 feet).

3.3.5 External gas supply points

This is the preferred location as there is usually good natural ventilation.

- a) Even outside, it is recommended that containers of very toxic gases should be enclosed inside a suitably ventilated enclosure or a gas cabinet as described in sub-section (3.3.3)
- b) A suitable enclosure for containers of hazardous gases (except where a cabinet is provided) should be a secure wire mesh cage located in a safe, well-ventilated place, with no ignition sources and away from occupied areas.
- c) It is particularly recommended that pyrophoric gas containers are installed outside whenever this can be reasonably achieved. In the event of a leak of pyrophoric gas, a delayed spontaneous ignition may result. In a confined space this could lead to an explosion. If located in the open air where there is plenty of natural ventilation, pyrophoric gas containers need not be housed inside a cabinet.
- d) Where necessary a limited number of gas containers, not containing very toxic gases, may be secured against building walls, provided that:
 - i. The wall is fire-resisting, to a minimum of 30 minutes;

- ii. The containers are away from windows, drains, air intakes, etc., to prevent the escape of gases into buildings and to protect the containers against fires within the building;
- iii. The containers are well ventilated.

4.0 Cylinder storage

4.1 General storage precautions

The precautions for the safe practice for the storage of gas cylinders are as follows: -

- a) The store has to be appropriately marked and labelled to indicate the special nature of its contents.
 - i. A list of personnel who are authorized to access the store is to be displayed.
 - ii. Rooms or cabinets should be labelled as “Compressed Gas”.
 - iii. Identify storage areas with the hazard class or the name of the gases stored.
 - iv. Empty cylinders should be labelled with the word “Empty” and separated from filled cylinders.
 - v. “No Smoking”/ No ignition source signage should be posted around the storage area of buildings, or at entrances, where flammable gases are stored.
- b) The cylinders should not be near exit routes, elevators, walkways, unprotected platform edges, or in locations where heavy moving objects can strike or fall on them.
- c) Acetylene cylinders should always be used or stored in an upright position and not on their sides to avoid the possibility of the liquid acetone used to stabilize the acetylene gas within the cylinder leaking out.
- d) Always place valve protectors on gas cylinders when the cylinders are not connected for use.
- e) Cylinders must be stored where they are protected from the ground to prevent rusting.

- f) When gases of different types are to be stored in the same location, cylinders shall be grouped by the type of gas and arranged taking into account the type of gas contained. Flammable gases shall never be stored near to corrosive/oxidizing gases.
- g) The store shall be used exclusively for the storage of gas containers.
- h) Accumulation of combustible materials shall not be permitted within or close to the storage area.
- i) Where flammable or oxidising gas containers are stored a risk assessment shall be carried out to assess the suitability of portable electrical, electronic devices and other equipment that may be required for use. As required, appropriate controls are to be applied e.g. flammable gas monitoring.
- j) Pyrophoric gas containers/cylinders shall be separated from other categories of gas containers/cylinders at a distance of 2 metres. It is preferable to use a separate store or a firewall with fire rating of 30 minutes.
- k) Within the storage area, oxidising gases such as oxygen must be stored at least 3 metres away from fuel gas cylinders (e.g. Acetylene, LPG, Hydrogen). The use of an appropriately fire rated wall may provide the required separation.
- l) The store shall be kept secure and access shall be restricted to authorised personnel.
- m) An inventory shall be kept listing all high hazard special gas containers e.g. very toxic or pyrophoric gases, held on site, whether full, in use or nominally empty. The container inventory should be managed to ensure that the oldest stock is used first.
- n) Store out of direct sunlight and away from sources of heat and ignition, temperatures must not exceed 125 °F (51.6 °C).
- o) Storage areas must be well ventilated, cool, dry, and free from corrosive materials with adequate space to accommodate the various cylinders of gases.
- p) All personnel handling special gases are to be provided with appropriate Personal Protective Equipment (PPE). The presence of special gases may require additional PPE to be provided.
- q) Always separate full and empty cylinders. If the cylinder is empty, replace the cap and move it to the empty cylinder storage area.

- r) Handle empty cylinders as carefully as full ones, residual pressure can be dangerous.
- s) All the electrical fixtures should be of explosion proof material in flammable gas storage area
- t) Always ensure that outdoor storage locations of cylinders are:
 - i. At least 5 feet from any doorway or opening in a building that has two means of egress
 - ii. At least 10 feet from any doorway or opening for any building that has only one means of egress.
 - iii. At least 20 feet from any automotive service station fuel dispenser.
- u) Use appropriate material, such as chain, plastic coated wire cable, commercial straps, etc., to secure cylinders.
 - i. When cylinders are secured by a chain or strap, the preferable method is to secure them in two locations – one strap or chain 1/3 from the top of the shoulder of the cylinder and one strap or chain 1/3 up from the bottom of the cylinder.
 - ii. At a minimum, cylinders shall be secured at approximately 2/3 the height of the cylinder – secured above the midpoint, but below the shoulder.
- v) Storage, use and handling areas should be secured against unauthorized entry or access of unauthorized personnel. Access to keys is to be controlled. A key log is to be maintained. Keys are to be made available to the emergency services in the event of an incident.
- w) Toxic gases must be stored separately from all other gases and the detailed instructions on the individual Safety Data Sheet (SDS) must be followed.
- x) The location of special gases is to be clearly designated and shown on the site plan. This site plan is to be available to the emergency services in the event of an incident. The emergency services are to be made aware of the additional hazards which may be encountered with special gases.
- y) Storage of fuel gases: Within the storage area, oxygen should be stored at least 3 metres from fuel gas cylinders. The use of a fire wall may provide the

required separation. If volume is greater than 200 m³ a separation distance of 5 metres needs to be executed.

- z) Plan for emergencies:
 - i. Ensure free and clear access to cylinder storage areas.
 - ii. All persons with a responsibility for storage or use of gas cylinders must be familiar with the hazards and emergency procedures. Store layouts and emergency procedures need to be structured accordingly and to cater for possible incidents.

4.2 Store design and construction

The following information applies to the design and construction of gas cylinder storage;

- a) Gas containers/cylinders should be stored at ground level.
- b) The store should be covered by a roof to protect containers from the weather and to provide some protection against corrosion. The roof should be designed with vents so that gas cannot accumulate in the roof-space.
- c) The design of the store is to take into consideration the density of the gases to be stored. Low-level ventilation is particularly important since many gases are heavier than air, but high-level ventilation may also be required.
- d) Where reasonably practicable all parts of the storage area shall be constructed of non-combustible materials.
- e) The floor shall be flat and constructed of concrete or other non-combustible, non-porous material. It should be laid on a slight slope, to prevent the accumulation of water. The slope of the floor shall be such that any product spill is directed to a low risk area.
- f) The store will be required to be secure. The design of the store is to take account of the level of security necessary to protect the type of gases being stored.
- g) Storage areas shall be located away from areas of fire risk. Fire extinguishing equipment should be readily available in all working areas. A water spray system that will operate either automatically or can be operated manually should be considered.

4.3 Internal storage

- a) Internal storage within a building is not recommended. The exception is where it is necessary to maintain specific gas properties that can only be carried out in a controlled environment.
- b) For home and hotel application, cylinders shall be used in kitchens strictly separated from occupied houses.

4.4 External storage location

- a) The first principle for the location of any store is for it to be in the open air where there is good natural ventilation.
- b) The storage areas should be well defined. Stores containing special gases are to be located in an area where they are secure.
- c) The store shall be located in an area away from sources of fire and/or ignition.
- d) The store shall be located away from residential houses
- e) There shall be good access and egress for delivery vehicles.

5.0 Transportation of gas cylinders

The appropriate method of transporting gas cylinders is to let a professional gas transport company handle it, however if that is impossible, you will need to know how to do it yourself properly.

5.1 In-house transportation:

- a) Never drag, slide or roll a cylinder, use a cylinder cart or basket.
- b) Always close the safety valve and have the protective cap covering the valve when moving the cylinder.
- c) Use foot, body and head protection when moving cylinders
- d) Do not use the valve cover to lift cylinders, they could be damaged and become unattached. If the cylinder is dropped on a hard surface, it can cause an explosion.
- e) Use valve protection caps before moving.
- f) The name of the distribution/transporting company shall be written clearly on the truck/vehicle.

- g) Do check that cylinders are properly labelled and have not been tampered with.
- h) Secure cylinders in a cylinder cart with a chain and move to new location.
- i) Transport cylinders in a properly restrained and in an upright position.
- j) Personnel moving cylinders between multilevel buildings should use freight elevators when possible. However, if there is no freight elevator, one should use common or staff elevator, and never allow other people to enter the elevator when transporting cylinders.

5.2 Vehicle transportation

Some gases are not permitted to be transported in personal vehicles (i.e. vehicles not designed and authorized to transport compressed gas cylinders). There are also maximum quantities of gases that can be transported in certain types of vehicles. Transporting compressed gas cylinders in vehicles that are unsuitable for such purposes, and by personnel who are unauthorized and untrained, can result in serious injury or death.

The preferred method of transporting cylinders is in the supplier's truck.

5.2.1 Requirements for vehicle transportation

- a) A suitable vehicle, such as a truck, must be used to transport the cylinder.
- b) Oxygen cylinders shall not be transported together with acetylene and other flammable gases.
- c) Driver/personnel carrying gases cylinders should be trained in safe handling & transportation, and shall ensure that they are familiar with the properties of contents, the hazards involved and emergency procedures to be followed.
- d) Trucks/vehicle shall be provided with dry chemical powder extinguishers of 6 kg and shall be maintained in good condition and updated.
- e) Use an open vehicle as this provides the best ventilation and avoids the risks of gas accumulation.
- f) Shipping papers. Also called hazard manifests, pick-tickets, way bills, or daily trip sheets. These are documents used to identify a hazardous

material being offered for transport. They contain information on the type, size, and quantity of hazardous materials. They must be within reach of the driver at all times.

- g) If you are transporting the gas cylinder inside a trade vehicle:
 - i. Keep the gas cylinder in a purpose-built sealed compartment or cabinet that provides adequate ventilation of any leaking gas to the outside of the vehicle;
 - ii. A side-mounted sealed compartment with its own door, ventilated externally is best practice.
- h) Do close the gas cylinder valve and disconnect the regulator, hoses and torch prior to transport.
- i) The valve cap must be on the cylinder to protect the valve stem.
- j) Any employee that drives a vehicle transporting hazardous materials must have Hazmat training. This training must occur within 90 days of employment and be reviewed regularly.
- k) The cylinder must be secured in an upright position in the back of the truck to prevent cylinder damage, especially the valve stem, during transport. Inspect the cylinder for existing damage prior to attempting transport.
- l) Do regularly check for leaks from valves.
- m) The cylinder must be located in the back of the truck to provide adequate ventilation in event of a leak. Direct sunlight or excessive temperatures can result in a release of the cylinder contents.
- n) Do not smoke during transport.
- o) Do unload the cylinder from inside the vehicle immediately on reaching your destination, unless the vehicle has a purpose-built sealed compartment vented externally.
- p) Do not transport gas cylinders in the passenger compartment of any vehicle due to the difficulty of providing appropriate load restraint. Transporting gas cylinders inside the driver or passenger compartment of passenger cars

is extremely dangerous and could cause an explosion fire, exposure to toxic gas, or asphyxiation.

5.2.2 Enclosed vehicles used to continuously transport gas cylinders:

When cylinders are continuously transported in enclosed vehicles (such as ambulances, service vans with welding equipment, etc.) the following is recommended:

- a) A permanent system should be in place to secure the gas cylinders (and cryogenic liquid receptacles); and
- b) Gas cylinders should be carried in a side mounted sealed compartment with its own door, ventilated externally.

6.0 Cylinder leaks

Cylinder leakages are the common incidences and causes of consequent accidents in gas sub-sector. In case of a leakage, the following shall be considered appropriate:

- a) If the cylinder contains a flammable, inert, or oxidizing gas, remove it to an isolated area, away from possible ignition sources. Allow it to remain isolated until the gas has discharged, making certain that appropriate warnings have been posted.
- b) If the gas is a corrosive, remove cylinder to an isolated, well-ventilated area. The stream of leaking gas should be directed into an appropriate neutralizing material.
- c) For toxic material, the cylinder should be removed to an isolated, well-ventilated area, but only if this is possible while maintaining personal safety. It may be necessary to evacuate the facility.
- d) If the leak is at the junction of the cylinder valve and cylinder, do not try to repair it. Contact the supplier and ask for response instructions. Shut a leaking valve and tighten the valve gland or nut. If it still leaks, close it, remove the cylinder to a well-ventilated area, and post a warning of the hazard rendering it unserviceable.
- e) Never use a flame to detect a gas leak. Use soapy water.

7.0 Gas cylinder disposal

In most cases, when you purchase a compressed gas, you are only purchasing the contents of the cylinder; not the cylinder itself. Cylinders are considered hazardous waste and are not easily disposed of, and one should therefore never dispose off compressed gas cylinders as conventional waste. The following shall be done:

- i. Users should return empty, damaged or leaking gas cylinders to the gas supplier or distributor, as soon as possible.
- ii. Properly label cylinders as “Empty” or “Damaged”. If the cylinder is empty, replace the cap and move it to the empty cylinder storage area.
- iii. Treat empty cylinder as a full cylinder because they poses similar hazards.
- iv. Follow procedures of storing gas cylinders in section 4 when storing empty or damaged cylinders awaiting disposal.
- v. Users or employers shall contact National Environmental Management Authority (NEMA) to coordinate the disposal of non-returnable compressed gas cylinders. Remember, the rules that govern the disposal of chemicals also apply to the container (cylinder) and to any residue remaining in the container.

8.0 Inspection and maintenance of gas cylinders

- a) This shall only be done performed by qualified personnel to repair manifolds, valves and other related equipment.
- b) The employer shall always consult gas supplier for recommended maintenance schedules.
- c) Inspections of safety valves and regulators, and maintenance shall be conducted periodically.
- d) Visually inspect/examine compressed gas cylinders before each use for the following:
 - i. Corrosion and pitting
 - ii. Dents
 - iii. Cuts, digs and gouges
 - iv. Bulges

- v. Leaks
- vi. Thread or neck defects
- e) All damaged or questionable cylinders or equipment should be returned to the supplier for correction or replacement
- f) Hydrostatic Testing³
 - i. All cylinders require periodic hydrostatic testing. During hydrostatic testing, the cylinder is examined to ensure it can safely hold its rated pressure.
 - ii. Cylinder owners must set up this testing prior to refilling the cylinder, whereas rented cylinders will be tested by their owner prior to refill.
 - iii. The frequency of the testing depends upon the cylinder material:
 - Aluminum –every 5 years
 - Steel –every 5 years

9.0 Roles and responsibilities of key stakeholders

a) MGLSD- Department of OSH

- Overall responsibility for ensuring implementation of these guidelines.
- Supply technical information and advice to employers and workers on the most effective means of complying with the legal requirements related to compressed gas cylinders handling.
- Review and update these guidelines.
- Investigate related incidents together with other relevant MDAs.

b) NEMA and MWE-DESS

- Promote use of these guidelines and ensure compliance to other relevant laws and regulations at workplace to prevent environmental disasters.
- Shall assist and guide end-users in the appropriate disposal of damaged cylinders
- Carryout investigations on related environmental impacts together with relevant agencies.

³ A hydrostatic test is a way in which pressure vessels are tested for strength and leaks

c) Uganda Police Force

- Promote the implementation of these guidelines and other related laws and regulations.
- Isolate the affected area in accordance with the emergency response guidelines in the event of an accident.
- Respond and investigate related incidents together with other relevant MDAs.

d) Manufacturers, suppliers and /or users

- Ensure strict adherence to these guidelines and other related laws and regulations on compressed gas safety.
- Report any compressed gas incident at workplace to Commissioner OSH immediately.
- Prepare and submit quarterly reports to DOSH on compressed gas incidents.

10.0 Review of the guidelines

These guidelines shall be reviewed periodically to evaluate their effectiveness. Users may identify gaps and propose amendments to the Commissioner OSH, Ministry of Gender, Labour and Social Development for consideration.