Safe Use, Handling and Storage of Compressed Gas Cylinders

Document Number: **LMS0005A**	**Standard – Administrative**	Applies To: **Oil Sands**
Revision Date: **2015/03/30** Revision: **1** Review Cycle: **3 years**	Document Owner (Title): **Director, Environment, Health & Safety**	

Summary of Changes

Rev No.	Section Changed	Revision Made
1		New revision number as no previous number assigned

Scope

This procedure applies to all personnel working at Suncor Oil Sands including vendors and contractors.

Purpose

To ensure those activities relating to the handling, storage, onsite transportation and safe use of compressed gas cylinders (CGCs), regardless of volume, are performed in such a manner to prevent personal injury, equipment damage, environmental excursion and/or production loss.

This standard does not address special requirements for:

- medical oxygen
- fire extinguishers and their components
- Scott Air-Pak / SKA-Pak other than minimum bottle pressure.

Compliance

Oil Sands Business Unit.

Roles and Responsibilities

The following individuals and groups have the following roles and responsibilities:

Document Owner	• Ensures this document is reviewed according to the required revision cycle. • Ensures the document is updated to accommodate changes to Suncor, provincial, and federal regulation. • Ensures the document is updated to mitigate risks found as the result of an incident.
Document Approver	• Ensures this standard is necessary and that it aligns with management and company direction.
Oil Sands Line Management	• Ensures the implementation and adherence to this standard.

References

- Alberta Fire Code, Part 3 *(Compressed Gases), (Indoor Storage of CGC)* and *(Outdoor Storage CGC)*
- Alberta Fire Code, Part 5.2 - Hot Works
- Alberta Occupational Health and Safety Act
- Alberta Occupational Health & Safety Code – Part 10, Section 171-174
- ANSI B 31.2, "Fuel Gas Piping Code"
- ANSI B 31.3, "American National Standard Code for Chemical Plant and Refinery Piping"
- CAN1-B149.2, "Installation Code for Propane Burning Appliances and Equipment"
- CAN/CSA W-1172-94 - Welding Cutting and Allied Processes
- CAN/CGA - B149.2-M95 - Propane Storage standards for additional information
- Department of Transportation - Specifications on Hydrostatic Testing & numbering of Compressed Gas Cylinders
- NFPA 43C, "Gaseous Oxidizing Materials, Storage and Handling"
- FPA 45, "Laboratories Using Chemicals"
- NFPA 51, "Oxygen-Fuel Gas Systems for Welding, Cutting and Allied Processes"
- NFPA 54, "National Fuel Gas Code"

Continued on next page

References *Continued*

- NFPA 58, "Liquefied Petroleum Gases, Storage and Handling"
- NFPA 59A, "Liquefied Natural Gas, Storage and Handling"
- NFPA 77, "Recommended Practice on Static Electricity"
- CGA Pamphlet C-6, "Standards of Visual Inspection of Compressed Gas Cylinders"
- CGA Pamphlet P-1, "Safe Handling of Compressed Gases in Containers"
- CGA Pamphlet P-12, "Safe Handling of Cryogenic Liquids"
- CGA Pamphlet S-1.1, "Pressure Relief Device Standards Part I - Cylinders for Compressed Gases"
- CGA Pamphlet S-1.2, "Pressure Relief Device Standards Part II - Cargo and Portable Tanks for Compressed Gases"
- CGA Pamphlet S-1.3, "Pressure Relief Device Standards Part III - Compressed Gas Storage Containers"
- CGA Pamphlet V-1, "American National Standard, Canadian Standards Association and Compressed Gas Association Standard Compressed Gas Cylinder Valve Outlet and Inlet Connections: ANSI B57.1, CSA B96
- CGA Pamphlet V-6, "Standard Cryogenic Liquid Transfer Connections"
- CGA Safety Bulletin SB-8, "Use of Oxy-Fuel Gas Welding and Cutting Apparatus"
- CGA Technical Bulletin TB-3, "Hose Line Flash back Arrestors"
- Transport of Dangerous Goods Act and Regulations
- Compressed Gas Association, Inc. *Handbook of Compressed Gases*, 3rd edition. Van Nostrand Reinhold; New York: 1990
- Compressed Gas Association, Inc. *Handbook of Compressed Gases*, 4th edition. Kluwer Academic Publishers; Massachusetts: 1999
- Compressed Gas Association, Inc. *Safe Handling of Compressed Gases in Containers*, 9th edition (Pamphlet CGA P-1). Compressed Gas Association, Inc.; Arlington, Virginia: 2000
- CSA International Standard W117.2-94 *Safety in Welding, Cutting, and Allied Processes*. CSA International; Rexdale, Ontario: 1994
- LCS0011A Personal Protective Equipment

Terms, Definitions and Acronyms

The following terms, definitions and acronyms are used in this standard:

CGC Compressed Gas Cylinder

Standard

1. The current Alberta Occupational Health and Safety Code, Part 10 Sections 171-174 for Compressed & Liquefied Gas shall form the basis for this standard. The following activity guidelines apply to all types of compressed gases in various locations. More specific guidelines are provided in other sections of this standard.

Item	Description
1.1	Line managers / supervisors shall ensure: • WHMIS labelling is visible on all Compressed Gas Cylinders (CGCs) for clear identification of their content. • Provisions are made to have mislabelled, illegibly labelled or out of date cylinders returned immediately to the appropriate Materials Department or supplier. • Cylinders in use must have valid hydrostatic test stamps (within the last 5 years or, as noted by H, 10 years) as per the Alberta Fire Code Part 5 - Hot Works (reference CSA W117.2-94) • As a general rule, containers of compressed gases being transported shall be kept in an **upright position**, be protected against mechanical damage and be held securely in place with the use of chains, strapping or other approved methods. Acetylene cylinders shall not be placed on their side at any time. • When manufactured, cylinders are equipped with a valve protection cap with a means of attachment. The caps are to remain in place until the cylinder is secured and placed in service. • Cylinders in storage racks, cabinets or as part of a gas system shall be protected against valve damage. In general, this means the cylinders are to be equipped with valve caps, steel rings or protective handles as appropriate. • All compressed gas piping systems shall be provided with manual shut-off valves at all points of supply and at all points of use. (A cylinder valve can be considered the shut-off valve at point of supply. If the point of use is within immediate reach of the point of supply, a separate shut-off valve is not required.) • A wrench that does not protrude into the cap to interfere with the bottle valve is to be used to remove caps that cannot be removed by hand. • A compressed or liquefied gas system must not be exposed to heat sources as that may result in failure or explosion of the contents or system or will exceed the maximum exposure temperatures specified by the manufacturer. • A compressed or liquefied gas system must be kept clean and free from oil, grease and other contaminants that may cause the system to fail, burn or explode if they come in contact with the contents of the system. • Generally, 500 psi on the pressure gauge is considered the level at which the cylinder is to be exchanged and returned for a refill. • Use work specific personal protective equipment as listed on the MSDS when handling or working with compressed gas cylinders. (Reference LCS0011A - Personal Protective Equipment) • Nozzle guards must be supplied when using airless spray machinery. **Note:** Workers are to exercise caution in accordance with the manufacturer's specifications when working with compressed gas cylinders.

2. Handling

Note: The following activity guidelines apply to handling of all types of compressed gases in various locations.

Item	Description
2.1	Line managers / supervisors shall provide equipment and resources to ensure: • Cylinders taken through doorways and over uneven surfaces are to be secured to the appropriate carts, cradles, trolleys, back-frames or other mobile rack systems before moving them. • Cylinders are never dropped, slid, or dragged. Cylinders may be rolled on their bottom edge for short distances (within a room or from adjacent storage racks). • Compressed gas cylinders are only to be lifted to aboveground work platforms in specifically designed and approved carriers by hoisting equipment. Compressed gas cylinders are NEVER lifted by their cap or using a rope, sling, chain or magnet. • Compressed gas cylinders are not transported in an elevator at the same time as personnel or flammable liquid containers.

2.2	Workers shall:
	• Ensure oxygen cylinders, valves, regulators, hoses and fittings or oxygen apparatus are NOT handled with hands or gloves contaminated by oil and/or grease.
	• Ensure compressed gas cylinders are always handled in a controlled manner and only approved devices are used when transporting cylinders.
	• Ensure compressed gas cylinders are not inserted or removed from a storage compartment by holding the valve or valve protection cap.
	• Ensure the nozzle guard of airless spray machinery is in place at all times of operation.
	• Ensure that if a pressurized cylinder is dropped or damaged:
	  • The cylinder is left in place.
	  • Potential sources of ignition are eliminated.
	  • The immediate area is evacuated.
	  • Emergency Services are contacted.
	  • Supervision is informed of the mishap.
	  • All information (e.g. information tag) regarding the cylinder being dropped or damaged is attached to the cylinder to aid the manufacturer's representative in the assessment of the integrity of the cylinder.

3. Safe Use

Note: For specific laboratory use refer to LSP1701A – Gas Cylinder Handling and Replacing

Item	Description

3.1 Workers shall:

- Check the cylinder stencil and label to ensure that only the correct type of gas for which the compressed gas equipment is designed is used and NOT rely on the colour of the cylinder.
- Inspect oxygen regulators and cylinder valves to ensure they are free of oil and gas contamination before connecting them.
- **Ensure that when using an oxygen-fuel system, a** flashback **device is installed at either the torch end or the regulator end and a back-flow prevention device is installed at the torch end.**
- Back off the pressure adjusting screw of the regulator to release spring force before opening the cylinder valve.
- Stand with the cylinder between themselves and the regulator (cylinder valve outlet facing away) and, only then, slowly open the discharge valve of compressed gas cylinder.
- Except in situations where continuous gas flow is required from compressed gas cylinders to maintain operational integrity of equipment, cylinder valves should be shut off and line pressure bled when leaving a cylinder unattended. (CGCs as part of welding or cutting equipment is only to be left open while work is in progress.)
- If regulator must remain attached between uses, close the bottle and relieve the internal regulator pressure by backing off the pressure adjusting screw (gauge to zero).
- Ensure sparks, flames or other sources of ignition do not come in contact with cylinders, regulators, hoses or other apparatus of a compressed gas system.
- Never use oxygen in place of compressed air supply to pneumatic equipment, (tools, hoses, air guns), to start an engine, blow lines clear or equalize pressure on any equipment.
- Do not use oxygen or compressed air to blow dirt off of clothing.
- Never transfer gas from one cylinder to another.
- Compressed air bottle systems with defective regulators, gauges or connected apparatus must be removed from service immediately. Only qualified personnel shall make repairs using parts and procedures specified by the equipment manufacturer.
- Tag and replace defective regulators, gauges or connected CGC apparatus. Do not replace regulators or gauges from one gas service to another. Supervisors shall be notified of all CGC equipment replacements.
- Never use compressed gas cylinders as rollers or a workbench.
- Keep the number of compressed gas cylinders in use on a job at one time to a minimum.
- Never place a cylinder where it could become part of an electrical current.
- Remove all oxygen, acetylene and propane cylinders from an operating area at the end of each day, and/or immediately after the completion of the job.

4. Storage

Note: The following guidelines apply to specific storage of activities of all types of compressed gases in various locations.

Item	Description
4.1	Line management / supervisors shall ensure:

- Compressed gas cylinders are stored in dry, well-ventilated areas protected from excessive heat or cold. Unless fabricated of special metal for low temperature use, cylinders subjected to temperatures below -29°C (-22°F) shall be moved to a protected area before use. Excessive heat above 52°C (125°F) could increase the gas pressure within a cylinder to activate a pressure relief device or rupture the cylinder.
- Indoor ventilation is adequate at both floor and ceiling levels and conforms to fire regulations.
- Containers of compressed gases are not to be located in any exit or corridor providing access to an exit, under any fire escape or exit stairway. Alberta Fire Code Part 3 requirements for exterior cylinder storage will be adhered to.
- Compressed gas cylinders stored in the open are protected from direct sunlight and accumulations of ice and snow.
- Oxygen cylinders are NEVER stored near flammable or combustible materials such as oil, grease, gasoline, alcohol or ether.
- Compressed gas cylinders are to be stored away from elevators, stairs or gangways in assigned locations where the cylinders cannot be knocked over or damaged by passing or falling objects.
- Cylinders in storage are separated from flammable and combustible liquids, fuel gases and from easily ignited materials by at least 6m (20 ft.) or by a noncombustible barrier at least 1.5m (5ft.) high with a fire resistance of at least 1/2 hour.
- The same distance shall separate fuel gas cylinders (e.g. propane, natural gas) or reserve stocks of calcium carbide cylinders from oxygen cylinders in storage or barrier as described above.
- Containers of compressed gases are separated from other dangerous goods, including other compressed gases, in conformance with Table 3.2.7.6 of the Alberta Fire Code.

Note: This table applies to warehouse storage areas.

5. Confined Space

Note: The following guidelines apply to specific use of flammable compressed gas/gas mixtures in a confined space.

Item	Description
5.1	Line management / supervisors shall ensure: • Before starting "hot" work using flammable compressed gas/gas mixtures, the confined area is free of all flammable vapors/residue and oxygen concentration is at a safe level. • All flammable compressed gas cylinders remain outside of the confined space. • All hoses/connections used in conjunction with flammable compressed gas cylinders must be approved for use in that application and must be leak checked before use. • An alternate egress/escape route must be available other than the egress where hoses and cylinders are located. • As general rule, fire watch provided for the confined space is in addition to the confined space monitor. • The assigned fire watch personnel has ready access to the shutoff valves of the flammable compressed gas cylinders. • Fire extinguishers are readily available inside and outside of the confined space. • There is proper ventilation in the confined space to prevent build up of undesirable gases and/or the displacement of oxygen. • Flammable gas torches shall not be left unattended while in operation.

6. Transportation

Note: The following guidelines apply to transportation activities for all types of compressed gases either as cargo or on welding / service vehicles.

Step	Action

6.1	Line management / supervisors shall provide procedures and resources to ensure:
	• Confirmation that all valves are closed on cylinders in transit, regardless of the volume.
	• **No compressed gas cylinders, regardless of contents or volume shall be transported inside the driver or passenger compartment of a vehicle.**
	• For compressed gas cylinders transported **as cargo** on plant site, the following requirements shall apply:
	  • All cylinders manufactured with valve protection caps will be transported with caps in place.
	  • Containers of compressed gases shall kept in an upright position, be protected against mechanical damage and be held securely in place to engineered racks or mounts by chains, strapping or other approved methods. Acetylene cylinders shall not be placed on their side at any time
	  • Portable propane cylinder valves are closed and capped before transportation (CAN/CGA - B149.2-M95).
	  • Oxygen and propane cylinders are transported as separate loads.

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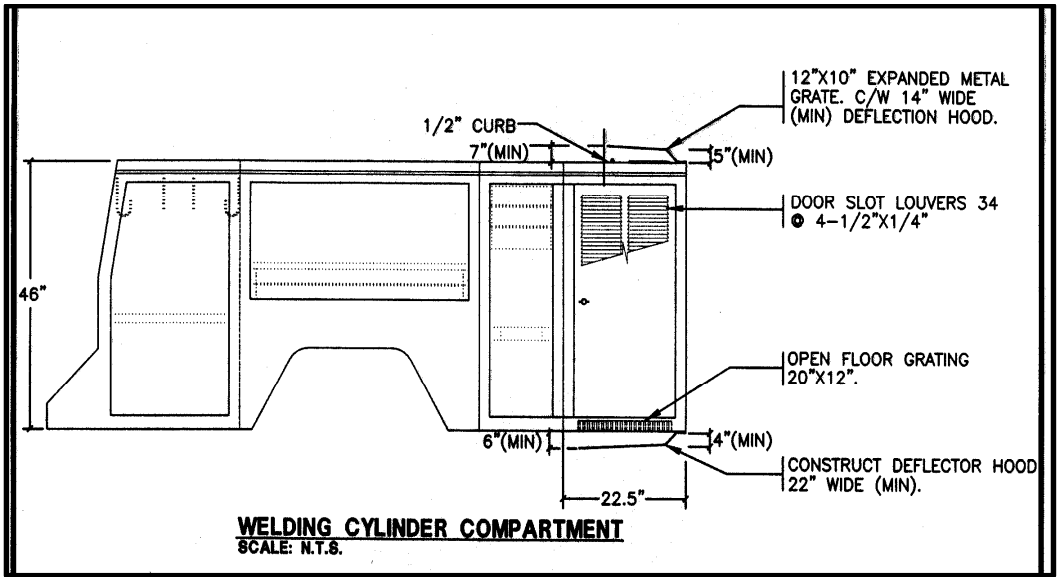
Step	Action
6.2	Welding and service vehicles shall: • Only carry compressed gas cylinders inside of engineered cabinets / compartments meeting the minimum of 0.18 square metres (2 ft^2) of free area for every 0.42 cubic metres (15 ft^3) of compartment volume. Refer to example in Appendix I - Sample Service & Welding Truck Oxy/Acetylene CSA compliant Cabinet Design. • Display identification as to the contents of the cabinet by affixing the required WHMIS or TDG labels on the outside door. If the labeling is too large for the cabinet door, labels will be overlapped on the adjacent cabinet / compartment doors. • Ensure in service, compressed gas cylinders enclosed in cabinets are maintained in a fixed condition, held securely in place against accidental movement and protected against mechanical damage to conform with the criteria listed in CAN/CSA W-1172-94 - Welding Cutting and Allied Processes. Refer to Appendix II - Welding and Service Vehicle Compressed Gas Cylinder Storage In Enclosed Cabinet requirements. • Ensure propane and other fuel gases/liquids are stored in separate compartments. Under no circumstances shall oxygen be stored in the same compartment as propane. • Minimum acceptable sitewide safe operating and inspection procedures are followed as listed in Appendix III. • Welding and service vehicle operators shall ensure valve is turned off and pressure in the hose is released, except when cutting and welding is in progress. Regulators shall be removed and placed in a protective box when the truck is taken out of service. • Welding and service vehicles shall have the regulator removed, valves closed, and cylinders capped before leaving the plant site or when service vehicle is not in service for any reason.

End of Standard

Appendix I – Sample Service & Welding Truck Oxy/Acetylene CSA Compliant Cabinet Designs

- If oxygen and acetylene gas cylinders are stored in a solid-walled storage compartment, the compartment must have adequate ventilation to prevent the build-up of gases beyond their explosive limits. At a minimum, vents must provide 0.18m^2 (2 ft^2) of free area for every 0.42m^3 (15 ft^3) of compartment volume.
- The vents must be located on the top and bottom of the storage compartment to permit gases, depending on their density, to rise or fall and leave the compartment. Additional vents exceeding these design criteria may be added to the storage compartment.
- Vents must have the free area split evenly between the top surface and the bottom surface of the storage compartment and the storage compartment must be built so gases and vapours cannot flow into adjoining compartments.
- To be effective, vents must remain unobstructed under all conditions of use. For example, vents must be free of ice and snow build-up during winter operating conditions and free of mud and other debris at all times. Figure 1 shows one approach to meeting these requirements.

Figure 1 Example of welding cylinder compartment



Appendix II – Welding And Service Vehicle Compressed Gas Cylinders Storage In Enclosed Cabinet Requirements

Compartment Door Hardware

Latching and locking hardware used on compartment doors should be made of non-sparking materials to minimize the possibility of creating a spark.

Explosion-Proof Components Inside The Cylinder Storage Compartment

Electrical components such as wiring harnesses, cables, lights and switches should not be located within gas cylinder storage compartments. However, if present, they must be designed for use in an explosive atmosphere. Products certified as “explosion-proof” by CSA-International, or an equivalent organization, meet this condition.

Preventing The Spread Of Gases And Vapours

The gas cylinder storage compartment must be fabricated and assembled in such a way that gases or vapours arising in the compartment cannot flow to, and accumulate in, adjoining compartments.

Closing Valves

To minimize the possibility of gas accumulating in a storage compartment due to a leak or an improperly closed valve, both torch and cylinder valves must be closed after each use.

Gas-Specific Regulators

Regulators are designed to be gas-specific and must not be interchanged. The regulator being used must be the correct one for the type of gas being delivered.

Storing And Securing Cylinders

Compressed gas cylinders must be secured to prevent falling or rolling. Properly secured gas cylinders may be stored in a horizontal position although Workplace Health and Safety prefers that cylinders be secured in the vertical position whenever possible.

Open Flames and Sparks

Sources of open flame such as torches, lighters, and smoking materials, and sparks created by various devices and materials, should never be allowed near gas cylinder storage compartments, whether or not they have vents.

Flashback Devices

Flashback devices must be installed at the regulator end of all gas lines.

Transportation of Dangerous Goods (TDG) Labeling

The welding gases oxygen, acetylene, propane and mixtures of methyl acetylene and propadiene have a special exemption under the TDG Regulations. The operator is exempt from documentation, placarding, and needing a Certificate of Training if all of the following conditions are met:

- the total weight of the gas cylinders being transported is no more than 500 kg;
- the cylinders are transported in an open vehicle so that the TDG label displayed on each cylinder is visible from outside the vehicle; and the cylinders are secured in or on the vehicle during transport.

If any one of these conditions is not met, as in the case of the cylinders being stored within a storage cabinet on a mechanic’s, welders, or service truck, then the TDG rules apply. In this situation, the operator must follow one of the following options:

Option 1

- Complete a shipping document that includes gas shipping names, classifications, compatibility groups, product identification numbers, etc.;

- Have training in the handling, offering for transport, or transportation of welding gases unless the operator is working under the direct supervision of a trained person. When a worker is trained, their employer must issue them a Certificate of Training. It is the employer's responsibility to determine what level of training a worker needs, and;
- Make sure the appropriate TDG label appears on each cylinder.

Option 2

- Have a Precedent C permit. This Equivalent Level of Safety permit allows for the handling, offering for transport, or transporting of dangerous goods in a manner that does not necessarily comply with the TDG Regulations but provides a level of safety equal to that required by the Regulations. These permits are available through Alberta Infrastructure. For information about:
  - these permits, contact Alberta Infrastructure's Coordination and Information Centre at 1-800-272-9600, and;
  - make sure that a TDG label appears on each cylinder and TDG labels must be displayed on the outside of the gas cylinder storage cabinet according to the labeling requirements summarized below.

    Acetylene alone:

    The red Class 2.1 flammable gas label shown in Figure 2 is required.

    Oxygen alone:

    (1) Both the green Class 2.2 non-flammable gas label (Figure 3) and the yellow Class 5.1 oxidizer label (Figure 4) with no number in the bottom corner, are required; or

    (2) the yellow Class oxidizer label (Figure 5) with a number 2 in the bottom corner.

    Both Acetylene and Oxygen:

    (1) Both a red Class 2.1 flammable gas label (Figure 2) & the yellow Class 5.1 oxidizer label with a number 2 in the bottom corner (Figure 5); or red Class 2.1 flammable gas label (Figure 2) & a green Class 2.2 non-flammable gas label (Figure 3) & a yellow Class oxidizer label (Figure 4) with no number in the bottom corner.

Figure 2

Figure 3

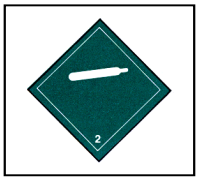


Figure 4

Figure 5

Appendix III – Sitewide Safe Operating Procedures

Step	Action
1	At the end of each shift and before moving welding or service equipment • Each cylinder valve must be closed, the hoses bled and regulators backed off to prevent gas creep. • Any disconnected regulators are stored in such a manner to prevent damage to the "bullnose" (the end of the stem from the regulator to the bottle valve under the connecting nut).

2	Cylinders, gauges, regulators and cabinets shall be visually inspected before the start of work and include the following:
	• Cylinders
	  • Ensure each stored cylinder is equipped with a valve protection cap
	  • Ensure cylinders are properly secured to prevent dislodgment
	  • Ensure cylinders are identified as to their contents
	• Gauges and Regulators
	  • Ensure a leak check is performed on regulator/hose connections.
	  • Regulators are properly treaded on to valve assembly and tightened with proper tools to manufacturer specifications.
	  • Regulators are inspected for pitting or damage to the bullnose, regulator body/stem assembly and gauge connections.
	• Cabinets
	  • Ensure oxy/acetylene/propane bottles are not exposed to sources of heat that could generate excessive temperatures in the cabinet.
	  • Ensure cabinets are identified as to their contents.
	  • Ensure the cabinet is maintained in a clean state, free of oil and grease.
	  • Ensure all cabinet vents are clean and clear.

The following individuals have approved and signed this document.

UserName: Perry Canning (pacanning)
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Date: Thursday, 16 April 2015, 03:26 PM Mountain Time
Meaning: Approver 1 Signed
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