1. PURPOSE

This document provides requirements for the use, transportation, and storage of compressed gas, to ensure that hazards are controlled to minimize the risk to employees. This document implements requirements from codes and standards along with *contractor* (see def.) requirements. Any applicable regulatory or contractor requirements must be followed, with the most stringent requirement being met.

2. APPLICABILITY

This document applies to all subcontractors who use, transport, or store compressed gases or who use high-pressure compressed gas systems at the Idaho Cleanup Project (ICP), as specified in their contract with contractor. This procedure does not cover the handling of fission-product gases, such as xenon or krypton, which are covered in rare gas recovery procedures.

Stricter requirements may be imposed by subcontractors upon their employees or subtier contractors. The requirements of this document must be followed by subcontractors; however, the means of implementation may vary as determined by the subcontractor.

3. REQUIREMENTS

3.1 General Requirements

3.1.1 Personnel who operate, maintain, or modify compressed gas equipment, systems, and associated equipment shall be trained to operate those systems safely before assignment. Training shall be repeated as needed to maintain proficiency.

3.1.2 Breathing air couplings shall be incompatible with outlets for nonrespirable plant air or other gas systems to prevent inadvertent servicing of air-line respirators with nonrespirable gases.

3.1.3 Suitable pressure regulating devices shall be used where gas is admitted to systems having pressure rating limitations lower than maximum cylinder supply pressure.

3.1.4 Valve outlet connections shall comply with Compressed Gas Association (CGA) V-1, American National, Canadian, and Compressed Gas Association Standard Compressed Gas Cylinder Valve Outlet and Inlet Connections.

3.1.5 Operating parameters and training requirements for specific compressed gas systems shall be developed and implemented.

3.1.6 There shall be no attempt to repair, alter, or otherwise tamper with cylinders, isolation valves, safety relief devices, or other components of a compressed gas system.

3.1.7 Supervision shall conduct frequent surveillance to ensure compliance with this document.

3.1.8 Valves, regulator connections, and other related piping connections shall not be forced or cross-threaded.

3.1.9 Established control measures and precautions shall be followed.

3.1.10 Compressed gas cylinders shall contain pressure relief devices.

3.1.11 Ventilation requirements for the discharged gas shall be evaluated and prudently controlled.

3.1.12 Compressed gas cylinders shall be inspected before handling or using them to ensure that the cylinders are not visibly damaged and the cylinder contents are clearly labeled on the external surface with either the chemical or trade name of the gas.

3.1.13 Compressed gas cylinders shall be inspected before handling or using them to ensure that markings, labels, decals, tags, and stencil marks attached by the supplier for identification of contents have not been removed or defaced.

3.1.14 The subcontractor shall contact a contractor POC if there is doubt as to the proper label for a compressed gas cylinder.

3.1.15 Compressed gas lines shall be marked as to their contents, or the contents shall be readily apparent by the proximity to their source.

3.1.16 At least 8 out of 12 inches of parallel sections of oxygen and fuel gas hoses shall be visible for line identification and inspection.

3.2 Receiving Areas

3.2.1 When compressed gas cylinders are received, they shall be inspected to ensure that the cylinders are properly marked and labeled and are not visibly damaged (cylinders delivered directly to the site of use will be inspected by the user before they are connected for service).

3.3 Connecting and Using Compressed Gases

3.3.1 Suitable pressure regulating devices shall be used in all cases where gas is admitted to systems having pressure rating limitations lower than the cylinder pressure.

3.3.2 Before a regulator is removed from a cylinder, the cylinder isolation valve shall be closed and regulator shall be relieved of gas pressure.

NOTE: *Regulators do not need to be removed at the end of work shifts when it is impractical, provided that the cylinder is properly maintained in the upright position and is protected from falling objects.*

3.3.3 With the exception of ongoing processes or operations (for example, analytical instrumentation), regulators shall be removed from cylinders at the end of each work shift.

3.3.4 Only regulators that are approved and designed for the gas and cylinder in question shall be used.

3.3.5 White lead, oil, grease, or any other non-approved joint compound shall not be used for sealing oxygen system fittings.

3.3.6 Only solder or litharge and glycerin or other approved joint compounds shall be used for sealing oxygen system fittings.

3.3.7 Two-stage regulators for inert gases shall be equipped with two relief valves that protect the regulator diaphragms and gauges from excessive over-pressure.

3.3.8 Single-stage cylinder regulators (except acetylene regulators) shall be equipped with a single relief device that shall be set to relieve at not over the highest graduation on the low-side gauge.

3.3.9 Gas regulators used for corrosive gases, such as chlorine, fluorine, and HCI, shall only be disassembled and inspected in accordance with vendor recommendations by a factory-trained person qualified to perform this type of work.

3.3.10 Compressed gas systems shall be protected by reverse flow or check valves if they could be contaminated by feedback or process materials; check valves and/or traps shall be checked and maintained on a regular schedule to ensure proper ventilation.

3.3.11 Flash-back arresters shall be placed at regulators and used with oxygen-fuel gas systems.

3.3.12 Any equipment (cylinder, regulator, hose or other associated hardware that defines a pressure boundary) that shows excessive corrosion, pitting, denting, burns, or other irregularities shall be tagged out-of-service, removed from service, and if contractor owned they must be removed from the INL Site.

3.3.13 Any foreign material shall be cleared from the valve port before a regulator is installed on a compressed gas system. Before a regulator is installed, the valve shall be slowly opened to blow any foreign material out of the port. A person shall not be facing the port during this operation.

3.3.14 Relief valves shall be safely vented on regulators for use with flammable, toxic, or radioactive gases.

WARNING

Explosions or spontaneous fire may occur if flammable gases or organic materials come into contact with oxygen. Gas/material incompatibilities can result in catastrophic failures. Oxygen will dramatically increase the flammability of ordinary combustibles.

3.3.15 Regulators, manifolds, and their related components shall not be interchanged from one type of gas to another without a qualified person evaluating the change in application.

3.3.16 Connections shall be kept tight to prevent leakage.

3.3.17 Leak detection methods shall not generate additional hazards.

3.3.18 If a cylinder leak cannot be remedied by simply tightening a valve gland or packing nut, then the valve shall be closed, and the equipment shall be tagged stating that the cylinder is unserviceable.

3.3.19 Leaking compressed gas systems shall be reported to supervision and safety personnel for corrective action as soon as they are discovered.

WARNING

Gases may present numerous hazards, including asphyxiation, flammability, corrosivity, etc.

3.3.20 If a situation appears serious because of escaping gases, the immediate area shall be evacuated, and local emergency procedures shall be initiated.

3.3.21 Cylinder valves on empty cylinders shall be kept closed to prevent internal contamination of the cylinder; valve protection caps shall be installed.

3.3.22 Pressure shall never be left on a hose that has been placed in storage.

3.3.23 Removable keys or handles shall be kept on valve spindles or stems while cylinders are in service.

3.3.24 Cylinder pressure shall not be drawn below 25 psig, to prevent siphoning impurities into the cylinder.

3.3.25 Empty cylinders shall be identified using a tag, label, or other marking and shall be removed from the work area.

3.3.26 Cylinder isolation valves shall be opened slowly, with the valve opening away from the body and other persons.

3.3.27 Wrenches or tools that are not provided or approved by the gas manufacturer shall not be used for opening cylinders.

3.3.28 Oxygen shall not be used to purge lines, in pneumatic tools, for dusting clothing, or as a substitute for compressed air.

3.3.29 Oxygen cylinders shall not be handled with greasy or oily hands or gloves.

3.3.30 Cylinders of oxygen, acetylene, or other fuel gases shall not be placed within a confined space.

3.3.31 Gas cylinders shall not be taken into confined spaces without proper evaluation and controls being in place.

3.4 Transportation and Handling

NOTE: *An exception to requirement 3.4.1 is permitted in the case of breathing air cylinders or lecture bottles, which may be in a position other than vertical.*

3.4.1 Compressed gas cylinders shall be transported in an upright position and shall be securely restrained at about two-thirds their height (or as necessary to prevent cylinder from falling), with the protective caps in place.

3.4.2 Valves shall be closed, regulators shall be removed, and valve-protection caps shall be installed (when provided) before cylinders are moved, unless the cylinders are firmly secured on a special carrier intended for this purpose and the valves are protected.

3.4.3 When cylinders are moved mechanically by crane or hoist, they shall be secured with chain or rope tiedowns to a cradle, boat, platform, or specifically designed lifting device.

3.4.4 Magnets or choker slings shall not be used to hoist or transport individual cylinders.

3.4.5 Bars shall not be used under valves or valve-protection caps to pry cylinders loose when frozen to the ground or otherwise fixed.

3.4.6 Bars shall not be used to pry valve protection caps loose.

3.4.7 Cylinders shall be handled carefully.

3.4.8 Cylinders shall not be lifted vertically by the cap, dropped, or permitted to strike violently against each other or against other surfaces.

3.4.9 Cylinders shall not be used as rollers for moving materials or for supporting other items.

3.4.10 A two-wheel or specially designed cylinder cart with a chain tiedown shall be used to move a cylinder within a building, where practical.

3.4.11 Oxygen cylinders shall never be stored near flammable or combustible materials such as oil, grease, reserve acetylene supplies, or other fuel gases.

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

3.5 Storage Locations

3.5.1 Compressed gas cylinders shall be stored in assigned places that meet the following criteria:

3.5.1.1 Cylinders will not be knocked over or damaged.

3.5.1.2 The area is dry and well ventilated (for inside storage only).

3.5.1.3 Cylinders will not be exposed to continuous dampness.

3.5.1.4 Cylinders are not near sources of intense heat such as furnaces, steam lines, or radiators.

3.5.1.5 Cylinders will be shaded from direct sunlight and not stored at temperatures above 125 F.

3.5.1.6 Cylinders must be stored in an area free from grass, weeds or any combustible materials.

3.5.2 Cylinders containing flammable or combustible materials shall be separated from oxidizing agents by at least 20 feet or a noncombustible barrier at least 5 feet high with a fire resistance rating of at least 30 minutes.

3.5.3 Fuel gas and oxidizer gas shall be stored in appropriate locations.

3.5.4 For storage in subsurface locations, a documented safety review shall be obtained before cylinders are stored.

3.5.5 Compressed gas storage areas shall be prominently posted with the names of the gases to be stored and a “No Smoking or Open Flames” sign.

3.5.6 The following precautions shall be followed when storing cylinders:

3.5.6.1 Nested cylinders shall be held together using a chain or other device to prevent falling or tipping.

3.5.6.2 All nested cylinders shall be wall supported.

3.5.6.3 Cylinders shall be placed so they cannot become part of an electric circuit.

3.5.6.4 Cylinders shall not be stored in exit pathways.

NOTE: *An exception to step 3.5.6.5 is permitted in the case of breathing air cylinders or lecture bottles, which may be in a position other than vertical.*

3.5.6.5 Cylinders shall be stored in the upright position.

3.5.6.6 Cylinders shall be securely restrained to a firm structure, at about two-thirds their height. A properly sized cylinder stand shall be used to support a cylinder where a tiedown bracket cannot be attached.

3.5.6.7 Cylinders shall be kept far enough away from hot work so that sparks, hot slag, or flames will not reach them (if this is not possible, fire-resistant shields shall be provided for the cylinders).

3.5.6.8 When cylinders are used in conjunction with electric welding, precautions shall be taken against accidentally grounding the cylinders or allowing them to be burned by electric welding arc.

3.5.6.9 Boxes used to store gas hose shall be ventilated, with the exception of hoses that have never been used.

3.6 Refilling Cylinders

3.6.1 Vendor-supplies compressed gas cylinders shall be refilled by the vendor only.

3.7 Fuel Gas and Oxygen Manifolds

3.7.1 Fuel gas and oxygen manifolds shall bear the name of the substance they contain in letters at least 1-inch high, either painted on the manifold or on a sign permanently attached to it.

3.7.2 Rooms or enclosures that house manifolds serving compressed gas systems shall be kept locked, restricted for entry of unauthorized personnel, and posted with signs alerting employees of the danger.

3.7.3 Fuel gas and oxygen manifolds shall be placed in safe, well ventilated, and accessible locations.

3.7.4 Manifold and header connections shall be capped when equipment is not attached.

3.7.5 Manifold hose connections between fuel gas and oxygen manifolds and supply header connections shall not be interchangeable.

NOTE 1: *All manifold design and use needs to go through a safety review to ensure compliance with applicable standards.*

NOTE 2: *Some gases may carry solvents with them (for example, acetone in acetylene) or corrosive contaminants (for example, water vapor in chlorine or hydrogen chloride).*

3.7.6 Manifold systems shall be designed and manufactured of materials suitable for the particular gas, potential contaminants, and service for which they are intended and in compliance with OSHA, ANSI and CGA standards, and National Fire Protection Association (NFPA) Standards 50, 51, 51B, and 55.

3.7.7 All flammable gas manifolds shall be electrically grounded.

3.7.8 Smoking shall be prohibited, and there shall be no source of potential ignition in areas where flammable compressed gas cylinders are connected to manifolds.

4. DEFINITIONS

See LST-27

5. REFERENCES

5.1 Source Documents

29 CFR 1910.101, "Compressed Gases (General Requirements)"

29 CFR 1910.102, "Acetylene"

29 CFR 1910.103, "Hydrogen"

29 CFR 1910.104, "Oxygen"

29 CFR 1910.105, "Nitrous Oxide"

29 CFR 1910.176, "Handling Materials – General"

29 CFR 1910.252, "Welding, Cutting, and Brazing General Requirements"

29 CFR 1910.253, "Oxygen-Fuel Gas Welding and Cutting"

29 CFR 1910.250, "Subpart H, Material Handling, Storage, Use, and Disposal"

29 CFR 1910.350, "Gas Welding and Cutting"

29 CFR 1910.352, "Fire Prevention"

29 CFR 1910.353, "Ventilation and Protection in Welding, Cutting, and Heating"

49 CFR 171, "General Information, Regulations, and Definitions"

49 CFR 172, Subpart E, Labeling

49 CFR 173, Subpart G, "Gases – Definition and Preparation"

49 CFR 177, "Carriage by Public Highway"

49 CFR 178, "Shipping Container Specifications"

CGA V-1, "American National, Canadian, and Compressed Gas Association Standard Compressed Gas Cylinder Valve Outlet and Inlet Connections"

NFPA 50, "Bulk Oxygen Systems at Consumer Sites"

NFPA 51, "Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes"

NFPA 51B, "Fire Prevention in Use of Cutting and Welding Processes"

NFPA 55, "Storage, Use, and Handling of Compressed and Liquefied Gases in Portable Cylinders"

5.2 Related Requirements

The following documents may also contain requirements that apply to this activity:

PRD-2010, "Welding, Cutting, and Other Hot Work"

PRD-2201, "Flammable and Combustible Liquid Storage and Handling"

6. APPENDIXES

None