Purpose
To define the minimum required control measures for reducing the risk of injury, illness, or environmental impact related to handling, storing, or using compressed gases.

Scope
These requirements are applicable to the Coca-Cola system locations (manufacturing, distribution, offices, laboratories and all other locations) with pressure vessels or compressed gas cylinders, or where steam, compressed air or other compressed gases (stored or used) with pressure exceeding 2.76 bar (40 psi).

Definitions
See Appendix.

Requirements

1. Compliance
Implement management practices and controls in accordance with the stricter of Company requirements or regulations related to pressure vessels, boilers or compressed gases.

- Identify laws and regulations that apply to the Compressed Gas Management program and periodically verify compliance. These verifications may be specific to compressed gases or part of a more comprehensive compliance process.

**NOTE:** Applicable legal rules, existing human resource policies or bargaining unit agreements may affect the development of compressed gas management policies, rules, and accident investigation procedures. Partner with the local human resources and legal departments in implementing these requirements.

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1 “Applicable legal requirements” means any law, regulation, rule, requirement, standard, norm, decree or code applicable to the relevant facility and/or operation enacted, promulgated or issued by any governmental or regulatory agency or body at the National, Federal, State, Provincial, Municipal or other local level. It may also include relevant and applicable international or regional laws, regulations, rules and agreements, such as, but not limited to United Nations Guidelines and/or European Union (EU) Directives or Regulations, whether adopted into locally applicable law or directly applicable without the need for local adoption.
2. Hazard Assessment
Establish, Implement and maintain a procedure to:

1. Identify, assess and control environmental and occupational safety and health risks related to:
   a. Pressure vessels
   b. Boilers
   c. Compressed gases
2. Determine risks that have or can have a significant impact
3. Record the results of the assessment
4. Review the results of the hazard assessment annually
   a. The review may be specific to compressed gas or part of a more comprehensive risk assessment.
5. Update if any changes take place at the facility
6. Include a routine review of available process and instrumentation diagrams to ensure the diagrams reflect the current systems. The frequency of the routine review must be at least every three years. Record the review and its findings.
7. Include evaluation by a qualified industrial hygienist for exposures to gases where required by this document, or otherwise identified as a known or potentially significant risk

3. Hazard Communication
Identify and/or label the contents and associated hazards of compressed gas cylinders, storage vessels and piping in compliance with Managing Hazardous Materials Requirements (ES-RQ-190).

- Label storage, handling and manifold delivery areas to show potential hazards and any required controls (for example; “Flammable,” or “No Smoking”). Include labeling of the flow direction inside of the piping.
- Label low pressure manifolds to prevent the connection of high-pressure cylinders to the manifold.
- Labels, signs, placards, tags or markings must be easy to understand by all personnel in the facility.
4. Compressed Gas Cylinder Storage and Handling

Protect compressed-gas containers from physical damage during storage and use.

At a minimum:

- Store cylinders in a dry and well-ventilated place protected from extreme temperatures, direct sunlight or corrosive atmospheres.
- Do not allow contents of compressed gas cylinders to reach temperatures above 51°C (125°F).
- Protect cylinder storage and usage areas from damage due to moving vehicles, forklifts, moving machinery or other sources that could damage the cylinders.
- Maintain a 7.5-meter (25-feet) radius around cylinder storage and handling areas or provide a one-hour rated fire separation for areas containing compressed gas cylinders that are inside, attached to, or within 15 meters (50 feet) of occupied buildings. The 7.5-meter radius around the cylinder must be free of weeds, trash, flammable liquids and other combustible materials.
- Use physical controls to prevent containers from falling or tipping.
- Use a suitable hand truck, forklift truck or similar device to move cylinders. Ensure cylinders are firmly secured prior to moving.
- Do not roll or drag containers, lift them by the protective caps or valve stems, sling them with ropes or chains, or lift them with electromagnets.
- Do not use cylinders as rollers or for any purpose other than to contain the gas as supplied.
- Segregate incompatible gases from each other and from other incompatible materials.
  - Separate oxygen cylinders in storage or in manifold systems from combustible materials, including oil and grease, acetylene or other fuel-gas cylinders, by a minimum distance of 6 meters (20 feet) or by a noncombustible barrier at least 1.5 meters (5 feet) high having a fire-resistance rating of at least one hour.
  - Single cylinders of oxygen may be maintained without these separation requirements, provided that they are stored and used in accordance with the other requirements in this section.
  - Oxygen and acetylene cylinders can be stored together as part of an oxy-acetylene cutting torch system provided that they are secured.
  - Do not store oxygen cylinders near incompatible materials.
- Never tamper with pressure-relief devices.
• Store all flammable gas cylinders, except those needed for immediate use, attached to vehicles or on oxy-acetylene carts, outside of occupied areas and buildings.

• Store acetylene gas cylinders upright with their valves uppermost. If an acetylene tank has been left on its side, set it upright for at least one hour before they are used.

• Keep cylinders, cylinder valves, couplings, regulators, hoses and apparati free from oily or greasy substances, and do not handle them with oily hands or gloves.
  o When cylinders are not in use:
    ▪ Retain/replace the valve protection caps; and–
    ▪ Replace outlet caps or plugs and cylinder caps as soon as the cylinder is disconnected from equipment.

• When shutting off the gas flow:
  o Close the cylinder valve first, then
  o Close the regulator.

• Use only recommended keys or hand wheels to open valves if a tool is required. Do not use pipe wrenches or similar tools to over-leverage the valve.

5. Delivery Systems and Manifolding
Maintain the safety and integrity of gas delivery systems.

At a minimum:

• Use only supplier-recommended regulators, gauges, hoses and other designated appliances with a particular gas or group of gases, and made from materials compatible with the gas used.

• Piping and fittings must comply with the gas supplier’s specifications.

• Do not substitute materials having different chemical properties, unless permitted by the supplier.

• Do not lubricate cylinder valves, fittings, or regulator threads unless the gas supplier or manufacturer recommends the lubricant for that purpose.

• Only apply joint-sealing compounds or tape recommended by the gas supplier or equipment manufacturer.

• Inspect and maintain gas-delivery systems regularly to identify leaks, corrosion, wear or other factors that could cause a component to fail.

• Clean and inspect safety devices annually:
Compressed Gas Management

- Document inspections, tests, and maintenance activities related to safety devices.
- Retain the above records until the system or component is removed from service.
- Maintain pressure-relief valves as described in Section 5.2, Flow Control and Pressure Relief.

**WARNING:** Gases can react with certain metals and other materials to create hazardous conditions. (For example, acetylene forms explosive compounds when in contact with copper, silver, mercury, or their alloys, including bronze or brass containing more than 65 percent copper.)

**WARNING:** Do not use brass fittings or mercury pressure gauges in ammonia systems. Ammonia attacks brass and can react with mercury to form an explosive compound. All materials used to convey ammonia must be compatible with ammonia.

### 5.1 Piping Installation

Install and maintain distribution lines in a safe operating condition.

At a minimum:

- Route the piping as directly as practicable, and protect it against physical damage.
- Make proper allowance for expansion and contraction, jarring and vibration.
- Protect the pipe laid underground in earth against corrosion.
- Case or jacket pipes leading to the surface of the ground where necessary to prevent loosening or breaking.
- Weld or braze connections for hazardous gas pipes that meet the following conditions:
  - Pipes within occupied areas.
  - Pipes through tunnels or ducts near occupied areas.

Shutoff valves must be located outside such conduits, to isolate them in an emergency. Pipelines carrying incompatible materials may be run together in the same conduit if all of the pipe and distribution system requirements in this section are provided.
5.2 Flow Control and Pressure Relief

Design and install controls for compressed gas and other pressure systems to prevent the uncontrolled flow of gas or overpressure of equipment.

At a minimum:

1. Provide at least one of the following at each cylinder connection to prevent backflow from high pressure cylinders into empty or lower-pressure cylinders:
   - A manufacturer-approved, pressure-reducing regulator.
   - A back-flow check valve.
   - A hydraulic back-pressure valve.

2. Install gas shutoff valves on hazardous gas lines that enter occupied spaces.

3. Install gas shutoff valves at readily accessible points to shut off the gas supply to buildings in an emergency.

4. For hazardous gases (including ammonia, chlorine, ozone, flammable, etc.) install a remotely operated master shutoff valve in a safe location, this allows the manifold or supply line to be shut off.
   - Prominently display the location of the Master Shutoff Valve.
   - Pressurized lines and delivery systems must have safety relief devices (pressure safety valves), sufficiently sized to provide the required flow rate for the container on which they are installed.
     - Install and maintain these devices in accordance with local regulations and the manufacturer’s (or gas supplier’s) recommendations, and document maintenance activities. As a minimum, clean and visually inspect relief valves annually, and test or replace them at the following frequencies (shown in Table 5.2) or by the frequencies set by local regulations, if more stringent.

**NOTE:** Typically, the installation point will be at the discharge line from the generator, gas holding tank, distribution manifold, or other supply source.
Perform and record routine maintenance for all pressure relief valves in accordance with Table 5.2 below.

**Table 5.2 - Routine Maintenance Schedule**

<table>
<thead>
<tr>
<th>Maintenance Action</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean and visually inspect relief valves.</td>
<td>Annually</td>
</tr>
<tr>
<td>Test or replace relief valves used for compressed gas cylinders, cryogenic-jacketed (double-walled) tanks and ammonia systems.</td>
<td>Every 5 years</td>
</tr>
</tbody>
</table>
| Test or replace all other safety and pressure relief devices not mentioned above (e.g. air receivers, etc.). | • Initial frequency of once a year.  
• If devices pass two successive tests, extend to 2 years.  
• If devices pass two successive tests, extend to a maximum of 3 years. 
  ▪ In the event of any failed test, immediately repair or replace the defective pressure relief device and return to the previous inspection frequency. |
| Clean and test or replace boiler/steam generator relief valves | Annually |
| Calibrate pressure relief valves | As needed to maintain operation within specified tolerances |

- Do not install shutoff valves in safety relief lines (before or after the safety relief device), **unless required by local regulations**, in such a manner that the safety relief device could be rendered ineffective.
- Do not terminate discharges (with the exception of compressed air) from any bulk system pressure relief device to any of the locations that follow:
Compressed Gas Management

- In or beneath any building (with the exception of steam)
- Near the inlet of any ventilation air intake point.
- Onto a pedestrian walkway; or
- Other normally occupied area.

6. Bulk Tank Storage
Install and maintain bulk tank systems in accordance with local regulations and the manufacturer’s or gas supplier’s recommendations. This section applies to bulk tank storage with the exception of compressed air receivers.

At a minimum:

- Tanks of hazardous gases must be placed to minimize risks to personnel safety and public exposure.
  - Bulk tanks are not permitted inside occupied buildings unless they are maintained in an enclosed area designed to isolate gas from other areas of the operation; and
  - Bulk tanks are fitted with the safety controls specified for that gas (listed below).
  - Bulk tanks of flammable gas must be located at least 15 meters (50 feet), (or as otherwise specified by local regulations, from normally populated buildings.)
- Provide overfill protection for bulk tanks of corrosive and flammable gases and oxygen via administrative and/or physicals controls.
- Adequately vent tanks to prevent the development of vacuum or pressure that can distort the tank.
  - Extend venting outdoors for indoor tanks.
  - Vent outlets must be located away from ignition sources, air intakes, windows, building eaves or other obstructions that could cause a safety hazard.
- Fit delivery systems with excess flow valves or other appropriate controls to shut off supplies at the source should the flow exceed a prescribed limit due to a distribution line break downstream of the supply.
  - The system must also provide for an alarm or other indicator to alert operators when the system has been activated.
- Visually inspect pressurized components annually to identify leaks, corrosion, wear or other factors that could cause a component to fail.
Install and maintain safety devices in accordance with local regulations and the manufacturer’s or gas supplier’s recommendations, and document these activities.

- As a minimum, clean and visually inspect safety devices annually and test or replace pressure relief valves at the following frequencies. Refer to Table 5.2 - Routine Maintenance Schedule.

Perform physical tank integrity testing on compressed gas bulk storage tanks (e.g. gas bulk tank storage, ammonia receivers, air receivers, etc.), at a minimum frequency recommended by the manufacturer or the frequency required by the local regulations, whichever is more stringent. If no frequency is specified, conduct testing at least every five years and if a change occurs, whichever is more stringent.

Physical tank integrity testing should be performed with the following exception:

- Do not perform physical integrity testing on cryogenic jacketed tanks, unless required by law. Cryogenic jacketed tanks are typically used for carbon dioxide and nitrogen storage.

Perform annual visual inspections of cryogenic (e.g. carbon dioxide and nitrogen) jacketed bulk storage tanks and record the annual inspection.

Perform monthly non-recorded visual inspections of cryogenic (e.g. carbon dioxide and nitrogen) jacketed bulk storage tanks.

If the visual inspection indicates the need for additional inspections and/or testing, the work must be conducted by a competent expert. The visual inspection must at a minimum identify:

- Indication of damage to the tank or jacket
- Abnormal functional performance of the relief valves
- Abnormalities on the tank skin; excessive frosting or icing on piping or the tank; mold; punctures; gas venting from: tank surface, jacket, or connections; or any other abnormality which could affect performance

Document the construction material for carbon dioxide bulk storage tanks.

Remove carbon dioxide bulk storage tanks constructed of alloys SA-212 or SA-515 from service by the end of the year 2018, even if they met regulatory and industry standards at the time of manufacture and installation.

⚠️ CAUTION: Severe conditions (damp locations, corrosive environments or very high pressures or temperatures) may warrant more frequent physical integrity tests or visual inspections.
7. **Boilers and Steam Generators**
Construct, install and maintain boilers and steam generators to minimize the potential for fire and explosion, the hazards associated with pressure buildups in enclosed piping or containers, and other risks identified through the site’s risk assessment.

At a minimum:

- Install and maintain systems per the manufacturer’s specifications.
- Provide boiler and steam generators with combustion safeguards meeting the requirements for the Controls and Safety Devices for Automatically Fired Boilers (ANSI/ASME CSD-1) or other locally appropriate consensus standard.
- Test safety devices, including pressure-relief valves, per the manufacturer’s recommendations, and document these inspections. As a minimum, clean and test or replace pressure safety valves annually. Calibrate them as needed to maintain operation within listed tolerances. Perform periodic preventive maintenance of pressure-relief valves in accordance with Table 5.2 - Routine Maintenance Schedule.
- Boilers and steam generators must have physical integrity testing conducted at least at a frequency recommended by the manufacturer or the frequency required by the local regulations, whichever is more stringent. Where no frequency is recommended the testing should be conducted at least every 5 years.
- Visually inspect pressurized components each year to identify leaks, corrosion, wear or other factors that could cause a component to fail.

8. **Oxygen Storage and Handling**
Install and maintain oxygen storage and handling facilities to minimize the potentials for skin or eye damage due to:

- The low temperature of liquid oxygen
- Fire and explosion risks with organics and hydrocarbons,
- The creation of oxygen-enriched atmospheres
- The hazards associated with pressure buildups in enclosed piping or containers; and
- Other risks identified through the site’s risk assessment.

At a minimum:

- Comply with the Company’s Personal Protective Equipment Requirements (ES-RQ-205). Unless otherwise specified, wear a full-face shield, loose-fitting cryogenic handling gloves, apron and cuffless pants for transferring liquid oxygen.
- For new construction and if space allows, locate bulk oxygen systems at least 15 meters (50 feet) from normally populated buildings or as otherwise specified by
Compressed Gas Management

local regulations. If these systems are installed inside, attached to or within 15 meters (50 feet) of occupied buildings, provide them with the fire controls following the Company’s Fire Control Requirements (ES-RQ-140).

- Liquid oxygen storage and handling areas, including offloading areas for liquid oxygen, must be free of combustible and hydrocarbon-based substances (e.g. wood, asphalt).
- Oxygen piping and fittings at pressures in excess of 700 psi (4.8 MPa) must be stainless steel or copper alloys.

WARNING: At no time should oxygen be allowed to contact an oily surface, asphalt or greasy clothes, or to enter a vessel containing a hydrocarbon. Oxygen can permeate clothing and other materials making them highly combustible. Oxygen-saturated asphalt can be explosive and detonated by pressure, such as walking on it.

9. Flammable Gas Storage and Handling

Install and maintain flammable gas storage and handling facilities to minimize fire and explosion risks, the hazards associated with pressure buildups in enclosed piping or containers, and other risks identified through the site’s risk assessment.

At a minimum:

- Locate bulk storage tanks and fuel-gas cylinders with an aggregate capacity exceeding 135.0 kilograms (300 pounds) of liquefied petroleum gas or 84 cubic meters (3,000 cubic feet) of other fuel-gas at least 15 meters (50 feet) from occupied structures.
- Provide flammable gas storage areas with the fire controls following Fire Control Requirements (ES-RQ-140).
- For new construction and renovation of existing bulk flammable gas storage inside of buildings, provide explosion venting and/or explosion release hardware and panels on exterior wall panels.
- Protect flammable gas distribution systems (risers, meters, pressure reducers, piping, etc.), including natural gas supply systems, from accidental contact from vehicles or other contact hazards.
- Perform the filling of fuel containers for industrial trucks or motor vehicles from bulk storage at least 9 meters (30 feet) from occupied buildings or any building opening (window, vent). If the exterior wall of the building is masonry, the distance can be reduced to 3 meters (10 feet).
- Provide fire extinguishers following Fire Control Requirements (ES-RQ-140), and as indicated by the site’s risk assessment. Locate at least one Class B:C or
A:B:C fire extinguisher within 5 meters (15 feet) of flammable gas storage areas or as otherwise specified by local regulations.

- Do not store or use flammable gas near incompatible materials such as strong oxidizing agents like oxygen, permanganates, ozone or hypochlorites, which can increase risk of fire and explosion.

**WARNING:** Flammable gases form explosive mixtures with air. Most fuel gases are slightly heavier than air and can travel a considerable distance to a source of ignition and flash back to a leak. They can also accumulate in confined spaces, resulting in an explosion hazard.

- Ensure tanks and piping are grounded. Ensure bonding across flanged pipeline connections through the use of unpainted nuts and bolts, or additional bonding connections. Comply with Electrical Safety (ES-RQ-120).

- Do not use unalloyed copper for the piping of acetylene. Piping for acetylene must be steel or wrought iron.

**WARNING:** Acetylene forms explosive compounds when in contact with copper, silver and mercury or their alloys, including bronze or brass containing more than 65 percent copper. Control ignition sources in areas where flammable gases are stored, handled or dispensed through, as a minimum, the following practices:

- Store and use flammable gases only in designated areas constructed and equipped with the appropriately classified wiring and equipment, as described in the Company’s Flammable Liquid Requirements (ES-RQ-150);
- Do not handle flammable gases outside of closed systems in the presence of open flames or other ignition sources;
- Control gas leaks to prevent flashback from an ignition source;
- Prohibit or restrict hot work and other spark or heat-producing activities within 7.5 meters (25 feet) of flammable gases handling or storage areas, and manage these areas as “High Hazard” areas in compliance with the Company’s Hot Work Requirements(ES-RQ-170); and
- Maintain a 7.5-meter (25-foot) radius free of fire hazards (e.g. weeds, tall grass, trash) around storage areas.

### 10. Anhydrous Ammonia

Install and maintain ammonia storage and handling facilities to minimize the potential for skin or eye damage due to the corrosive nature of this gas, the creation of oxygen-depleted atmospheres, the hazards associated with pressure buildups in enclosed
piping or containers, the risk of explosion in atmospheres with high levels of anhydrous ammonia and other risks identified through the site’s risk assessment.

- Select Personal Protection Equipment (PPE) based on compliance and risk assessment sections specified in the Company’s Personal Protective Equipment Requirements (ES-RQ-205).

- Do not store or use ammonia gas near incompatible materials, such as oxidizing agents (e.g. nitrogen oxide, oxygen), halogens (e.g. chlorine, fluorine) or heavy metals (e.g. mercury, silver). Do not use brass fitting or mercury pressure gauges in ammonia systems.
  - Enclosed areas in which ammonia gas is used (e.g. refrigeration rooms, filling rooms, etc.) must have:
    - A continuous leak detection system with audible and visual alarm systems. Calibrate and test the system per the manufacturer’s recommendations, or at least annually, with the testing documented. If a monitor is used as a leak detection system for indoor installations, the minimum detection limit for the monitor must meet the local regulated minimum exposure limits (if no exposure limit indicated, comply with the minimum detection limit of 35 ppm); and
    - A plumbed emergency eyewash and safety deluge shower; and
    - Ventilation controls as required to reduce the potential hazardous exposures to below the local regulated minimum exposure limits (e.g. 50 ppm).

- Provide smoke or heat detection and one-hour rated fire separation in ammonia compressor rooms that are inside, attached to, or within 15 meters (50 feet) of occupied buildings.

- Class I, Division II electrical systems are required in all ammonia compressor rooms that do not have the ventilation specified above.

- All ammonia system equipment (e.g. ammonia compressors, condensers, exchangers, receivers and other gas hold-ups) must be protected from physical damage, if physical damage risks are identified in the risk assessment (e.g. forklifts, etc.).

- For new construction, place compressors, condensers, exchangers and other gas hold-ups in detached buildings or in a 1-hour rated cutoff room when feasible. Provide explosion venting and/or explosion release hardware and panels on exterior wall panels.

11. Chlorine
If compressed chlorine gas is stored and used on-site, the facility needs to assess if replacement is feasible.
Install and maintain chlorine gas storage and handling facilities to minimize the potential for respiratory, skin or eye damage due to the corrosive nature of this gas, the creation of oxygen-depleted atmospheres, the hazards associated with pressure buildups in enclosed piping or containers, and other risks identified through the site’s risk assessment.

- Select PPE based on compliance and risk assessment sections specified in the Company’s Personal Protective Equipment Requirements (ES-RQ-205). Wear full face respirators with chlorine gas cartridges when changing chlorine cylinders or when working around pressurized dosing equipment.

- Install and maintain chlorine systems in accordance with local regulations and the manufacturer’s or gas supplier’s recommendations. Any modifications must be approved in writing by the manufacturer.

- Provide a dedicated, vapor-tight room or cabinet for operating chlorine gas cylinders within 15 meters (50 feet) from occupied areas. Locate the structure outside, separated from other operating areas, preferably near the use point and away from entrances, windows, louvers, walkways, etc. Seal pipe openings into occupied areas. Do not store or use chlorine gas cylinders outside of sealed rooms or cabinets.
  
  - Fit the door to the structure with a shatter-resistant inspection window. Equip the door(s) with panic hardware that opens outward to the building exterior (providing an easy escape).
  
  - Equip the structure with a ventilating fan that provides a minimum of one complete air exchange per minute when the room is occupied (four exchanges is optimal). The fan should move air as far as practical from the door and air inlet, and discharge to the outside atmosphere. In addition, louvers should facilitate airtight closure for air intake near the ceiling and exhaust near the floor. Locate separate switches for the fan and lights outside the chlorine room.

- Floor drains are not permitted in chlorine gas storage or use areas.

- Provide chlorine use areas with a plumbed emergency eyewash and safety deluge shower near the containment structure.

- Areas in which chlorine gas is used must have a continuous leak detection system with audible and visual alarms. Calibrate and test the system per the manufacturer’s recommendations, or at least annually, with the testing documented. The maximum threshold setting for the alarm is 0.5 ppm.

- Piping used to convey chlorine gas must be ASTM A333 carbon steel and alloy steel pipe in continuous lengths, with butt-welded, flanged or brazed joints. Screwed and socket-welded joints can be used in piping up to 4 centimeters (1 1/2 inches). Do not use cast iron or malleable iron fittings and general-purpose valves.
• Provide secondary containment such as double-walled piping or exhausted enclosures for piping valves, fittings and related components external to the structure.

• Assure that dry chlorine systems are protected from the severe corrosion and component failure that result from intrusion of moisture, including wet compressed air or exposure to ambient air.
  o TCCC moisture content specification for chlorine gas is 20 ppm or less.

• Protect piping from overpressure due to chlorine's unusually high coefficient of thermal expansion through the use of expansion chambers, relief devices or other suitable means. Protect piping from over pressure where chlorine can be trapped between closed valves.

**WARNING:** Chlorine is an extremely reactive gas. Among other hazards it:
  o Reacts violently with hydrocarbons, such as oils, solvents and fuels, and can cause these materials to spontaneously combust;
  o Reacts violently with ammonia;
  o Can create phosgene gas, a deadly poison, when contacted with carbon monoxide, (combustion exhaust gas); and
  o Hydrolyzes in the presence of moisture, forming hydrochloric acid, which attacks the respiratory system, eyes and skin.
  o Is two and one half times as heavy as air and will seek the lowest level in the building or area in which the leak occurs.

### 12. Asphyxiant Gases

Install and maintain asphyxiant gas manufacturing, storage and handling facilities, including those for carbon dioxide (CO\(_2\)) and nitrogen (N\(_2\)), to minimize the risk of potential injuries due to the low temperature of the liquid/gas, the creation of oxygen-depleted atmospheres, the hazards associated with pressure buildups in enclosed piping or containers, and other risks identified through the site’s risk assessment.

• Unless otherwise specified, a full-face shield, loose fitting cryogenic handling gloves, apron and cuffless pants must be worn for transferring cryogenic fluids.

• Install and maintain asphyxiant gas systems in accordance with local regulations and the manufacturer's or gas supplier's recommendations.

• Where asphyxiant gases are used indoors, provide direct ventilation to the atmosphere or vent to an area where the gas will mix with air and will not accumulate. **In addition, based on the risk assessment findings, provide fixed gas detection systems (e.g. oxygen, nitrogen or carbon dioxide) as needed to ensure oxygen levels are at the appropriate level.**
Only store or use portable containers where there is sufficient ventilation. Do not place containers in a closet or other enclosed space where there is no ventilation supply to the area; this prevents the buildup of inert gas and creation of an oxygen-deficient atmosphere.

If the hazard assessment indicates that the flow of asphyxiant gas into a work area may be sufficient to depress oxygen content to less than 19.5% by volume or to elevate carbon dioxide content to 2% (20,000 ppm), then an analyzer that activates an audible and visual alarm is required. The alarm must notify people who are already in the room as well as those who are outside and want to enter the room. Installation of at least two lights or horns are required: one inside the room and one outside.

If a continuous mechanical ventilation system is used to prevent asphyxiant gas build-up, provide protection in one of two ways:

- Apply an interlock to prevent asphyxiant gas from flowing unless the fans are running.
- Apply a monitoring and interlock system that shuts off the flow of asphyxiant gas if the oxygen level is less than 19.5 percent.
  - Inspect interlocks on a routine basis. Record the inspection.

Do not accept cryogenic containers showing evidence of loss of vacuum in their outer jacket (ice buildup on the outside of the container) from the gas supplier. Contact with air (or gases with a higher boiling point) can cause an ice plug in a cryogenic container.

Use special vacuum jacket containers with loose-fitting lids or overpressure relief devices to handle small quantities of the liquid gas.

**13. Carbon Dioxide Filling**

Install and maintain carbon dioxide filling facilities to minimize the risk of potential injuries due to the low temperature of the liquid/gas, the creation of oxygen-depleted atmospheres, the hazards associated with catastrophic failures of the cylinders from over-pressuring or damaged cylinders and other risks identified through the site’s risk assessment.

- For enclosed filling areas, provide direct ventilation to the atmosphere or vent to an area where the gas will mix with air and will not accumulate.
- If the hazard assessment indicates that it is likely that the flow of asphyxiant gas into a work area is sufficient to depress oxygen content to less than 19.5 percent by volume or to elevate carbon dioxide content to 2 percent (20,000 ppm), then an analyzer that activates an audible or visual alarm is required to alert the operators of the elevated CO$_2$ levels. Record your inspection.
Comply with the Company’s personal Protective Equipment Requirements to select and use PPE for carbon dioxide filling. Unless otherwise specified, face shields, gloves and safety shoes with steel toes are required.

Pressure test cylinders in accordance with legal regulations or at least every five years, if more stringent. Stamp the date of testing on the cylinder or make it otherwise identifiable to operators.

Inspect cylinders before filling to identify damaged tanks and those past due for pressure testing. Visually inspect for obvious damage such as dented cylinders, broken or missing carry handles or valve-handles, leaking cylinders, defective pressure reliefs, etc. Implement controls to prevent damaged cylinders from being filled.

14. Ozone

Install and maintain ozone generation, storage and handling facilities to minimize the risk of respiratory exposure, the creation of oxygen-depleted atmospheres, and the hazards associated with pressure buildups in enclosed piping or containers, and other risks identified through the site’s risk assessment.

Install and maintain ozone generation and delivery systems in accordance with local regulations and the manufacturer’s or gas supplier’s recommendations.

Construct ozone generators and system components of ozone compatible materials in accordance with recognized industry standards.

Provide ventilation controls as necessary to maintain personnel exposure levels below the 0.1 ppm, 8-hour, time-weighted average.

As part of the Hazard Assessment specified in Section 2: Hazard Assessment, evaluate airborne or other exposures to ozone. If indicated by the risk assessment, quantify specific exposure(s) using accepted industrial hygiene monitoring procedures.

If a continuous mechanical ventilation system is used to prevent gas buildup:
  - Provide an interlock so that the generator is shut down and gas cannot flow unless the fans are running. Inspect interlocks on a regular basis to insure they will function when they are needed; and
  - Provide controls to ensure that the ozone concentration of the ventilation exhaust at the point of discharge to atmosphere is less than 2.5 ppm.

Provide a designated ozone-generator room or enclosure. If provided, the room must be normally unoccupied and kept free of combustible and hazardous material storage.

Equip areas where ozone is generated or used with a continuous gas detection system that will sound a local alarm and shut off the generator and/or gas flow.
when concentrations are **above 0.1 ppm**. Calibrate and test the system per the manufacturer’s recommendations, or at least annually and document the testing.

- Piping used to convey ozone gas must be continuous or have welded or brazed joints. All materials used to convey ozone must be compatible with ozone (e.g. stainless steel, Teflon) No other plastic piping is permitted unless the manufacturer supplies a certificate that the tubing is approved for contact with anhydrous ozone gas at the output concentration supplied by the generator.

- **Design ozone generators to have a visual notification when ventilation systems and detectors have failed and that cause the generator to automatically shut down under the following conditions:**
  - When the dissolved ozone concentration in the water being treated is above saturation and when measured at the point where the water is exposed to the atmosphere;
  - When the process using generated ozone is shut down;
  - Failure of the ventilation system, if continuous mechanical exhaust ventilation is the primary control to manage personnel exposures; and
  - Failure of the gas detection system.

- **Provide manual emergency shutdown controls at the generator and,**
  - If in a designated generator room, locate emergency shutdown outside the room and within 3 meters (10 feet) of the main exit or exit-access door.

- **Do not allow pooling of ozonated water from tank filler discharge or other equipment.**

- **Do not sanitize the equipment externally with ozonated water. External sanitation with ozonated water is not permitted.**

**WARNING:** An ozone concentration of 5 ppm is considered imminently dangerous to life and health (IDLH). Ozone generators are often capable of producing more than 10,000 ppm of ozone. Ozone is typically used for water treatment, and the exposure risk includes off gassing of ozone from the treated water, as well as ozone from the generation system itself. Concentrations well over IDLH levels have been measured within tanks sanitized with ozonated water, and examples of off gassing from external sanitization causing concentrations over the permissible exposure limit have also been documented.

- The contactor tank must be vented outside the building and equipped with an ozone destructor (e.g. carbon filter or UV lamps).
15. Emergency Response Planning and Controls
Site emergency response plans must include plans for all hazardous gas bulk storage and delivery systems following Managing Hazardous Materials Requirements (ES-RQ-190).

Response plans for emergencies related to flammable gas storage or distribution systems must:

- Identify possible leak/release points in the system; and
- Include control measures to prevent ignition risks;

**WARNING:** Because of the dangerous properties of hazardous gases, low volumes are typically maintained. If leaks occur, the Company recommends evacuation of the area, keeping all personnel upwind of leaks, preferably on high ground, and letting the gas vent completely due to the potential risk to personnel who may respond to a leak.

16. Documentation
Maintain the following documentation for each gas distribution system:

- Design and performance criteria (flow rates, static pressures, materials of construction);
- Manufacturer's manuals; and
- Inspection and maintenance records.

17. Training
Ensure that employees and other affected personnel are adequately trained to understand the hazards of, and implement necessary controls for compressed gases, associated storage containers, equipment and systems, to which they may be exposed.

Training must be specific to the expected responsibilities and include:

- **Provide compressed gas awareness training for all site associates.**
- Initial training covering:
  - A review on the hazards associated with compressed gases used on-site (e.g. - oxygen displacement, fire and explosion risks, toxic effects, health hazards);
  - Proper handling techniques;
  - Storage and use controls;
  - Physical hazards associated with pressurized systems; and
  - Emergency response procedures with an emphasis on safe refuge areas for gas releases.
• Refresher training when there is an addition or change to compressed gases in the workplace or the procedures used to control them, or when there is evidence of deficiencies in employees’ knowledge of compressed gas management practices. Refresher training on emergency response procedures must be conducted annually for affected personnel.

• Ensuring that contractors and visitors understand and follow site requirements regarding compressed gas management in compliance with the Contractor and Visitor Management Requirements (ES-RQ-110).

References


American National Standard Method for Automatically fired boilers ANSI/ASME CSD-1

Contractor and Visitor Management Requirements ES-RQ-110

Electrical Safety ES-RQ-120

Fire Control ES-RQ-140

Flammable Liquid ES-RQ-150

Hot Work Requirements ES-RQ-170

Managing Hazardous Materials Requirements ES-RQ-190

Personal Protective Equipment ES-RQ-205

Respiratory Protection Requirements ES-RQ-210

Revision History

<table>
<thead>
<tr>
<th>Revision Date</th>
<th>Summary of Change</th>
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<tr>
<td>11-Jan-2016</td>
<td>Updated content for clarity and risk reduction throughout the document, including the highlighted items below:</td>
</tr>
<tr>
<td></td>
<td>6. Bulk Tank Storage</td>
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<td>7. Boilers and Steam Generators</td>
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17. Training

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<tr>
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<tbody>
<tr>
<td>03-Dec-2010</td>
<td>Revised testing frequencies for pressure relief valves to match industry consensus standards</td>
</tr>
<tr>
<td>01-Jan-2010</td>
<td>Revised document released as part of the TCCMS Redesign - Governance Reset. This document contains content from the previous version with reformatting and significant rewording.</td>
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<tr>
<td>28-Nov-2007</td>
<td>Initial Issue</td>
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Appendix
Definitions

**Compressed gas:** Any material or mixture contained at an absolute pressure of 2.76 bar (40 psi) at 21.1°C (70°F) or 7.17 bars (104 psi) at 54.4°C (130°F). This includes any liquid material that acts as a gas upon release at normal temperature and pressure or is used or handled as a gas, having an absolute pressure exceeding 2.76 bar (40 psi) at 37.8°C (100°F), (e.g., liquefied propane or natural gas fuels).

**Corrosive Gas:** A gas that can cause visible destruction of, or irreversible alterations in, living tissue (e.g., skin, eyes or respiratory system) by chemical action.

**Cutoff room:** A room within a building and having at least one exterior wall.

**Cryogenic Liquids:** Gases condensed to liquid form at extremely low temperatures. Example: Liquid Nitrogen is –196°C (–320°F). The term “cryogenics” applies to all temperatures less than –150°C (–238°F).

**Direct fired vaporizer:** A direct fired vaporizer applies heat (provided by a flame) directly to a pressure vessel containing liquid pre-vaporized LP-Gas.

**Dosing:** Blend with another substance

**Flammable gas:** A gas that can be ignited in air.

**Hazardous gas:** A gas that is included in one or more of the following hazard categories: corrosive, flammable, health hazard, oxidizer, pyrophoric, reactive or toxic.

**IDLH:** An acronym for **Immediately Dangerous to Life or Health**, and is defined by the US National Institute for Occupational Safety and Health (NIOSH) as exposure to airborne contaminants that is “likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment.” Examples include smoke or other poisonous gases at sufficiently high concentrations. (This definition also applies to **IDHL** Immediately Dangerous to Health or Life).

**Instrumentation diagram:** Diagram that shows the process flow of equipment and instrumentation.

**Indirect fired vaporizer:** An indirect vaporizer applies heat (furnished by steam, hot water, the ground, surrounding air, or other heating medium) to a vaporizing chamber or to tubing, pipe coils, or other heat exchange surface containing the liquid to be vaporized into a gas; the heating of the medium used is at a point remote from the vaporizer.

**Personal Protection Equipment:** Equipment such as clothing, shoes, goggles, gloves, hard hats, aprons, ear plugs, dust masks or respirators, designed to protect an employee against contact with or exposure to a toxic or hazardous substance or environment.

**Self-contained breathing apparatus:** an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.