1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND THE COMPANY/UNDERTAKING

Identification of the substance/preparation	:	Carbon monoxide
Chemical formula	:	CO
Other means of identification	:	Carbon monoxide, Carbonic Oxide, Carbon Oxide
Use of the Substance/Mixture	:	General Industrial. Industrial and professional use.
Restrictions on Use	:	No data available.
Manufacturer/Importer/Distributor	:	Air Products Singapore Industrial Gases Pte. Ltd. 2 International Business Park The Strategy, #03-20 Singapore 609930 Toll Free No: 800 448 1755
Email Address – Technical Information	:	GASTECH@airproducts.com
Telephone	:	6332 2440
Emergency telephone number (24h)	:	+65 6853 6800 +1 610 481 7711 International

2. HAZARDS IDENTIFICATION

GHS classification

Flammable gases - Category 1B
Gases under pressure - Compressed gas.
Acute toxicity - Inhalation Category 3
Reproductive toxicity - Category 1A
Specific target organ toxicity - repeated exposure - Category 1

GHS label elements

Hazard pictograms/symbols

Signal Word: Danger

Hazard Statements:

H221:Flammable gas.

H280:Contains gas under pressure; may explode if heated.
H331:Toxic if inhaled.
H360D:May damage the unborn child.
H372:Causes damage to organs through prolonged or repeated exposure

Precautionary Statements:

Prevention : P202:Do not handle until all safety precautions have been read and understood.
P210:Keep away from heat, hot surfaces, sparks, open flames, and other ignition sources. No smoking.
P260:Do not breathe dust, fume, gas, mist, vapours, spray.

Response : P304+P340 :IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
P308+P313 :IF exposed or concerned: Get medical advice/attention.
P377 :Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381 :In case of leakage, eliminate all ignition sources.
P315 :Get immediate medical advice/attention.

Storage : P403:Store in a well-ventilated place.
P405:Store locked up.

Other hazards which do not result in classification

Toxic by inhalation.
High pressure gas.
Extremely flammable.
May form explosive mixtures in air.
Immediate fire and explosion hazard exists when mixed with air at concentrations exceeding the lower flammability limit (LFL).
Do not breathe gas.
Self-contained breathing apparatus (SCBA) may be required.

Environmental Effects

Dangerous for the environment.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Substance/Mixture : Substance

Components	Chemical formula	CAS Number	Concentration (Volume)
Carbon monoxide	CO	630-08-0	100 %

Concentration is nominal. For the exact product composition, please refer to technical specifications.

4. FIRST AID MEASURES

General advice : Remove victim to uncontaminated area wearing self-contained breathing apparatus. Keep victim warm and rested. Call a doctor. Apply artificial respiration if breathing stopped.

Eye contact : In the case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

Keep eye wide open while rinsing.

Skin contact : Flush with copious amounts of water until treatment is available.

Ingestion : Ingestion is not considered a potential route of exposure.

Inhalation : In case of shortness of breath, give oxygen. Move to fresh air. Consult a doctor. If breathing has stopped or is labored, give assisted respirations. Supplemental oxygen may be indicated. If the heart has stopped, trained personnel should begin cardiopulmonary resuscitation immediately.

Notes to physician

Treatment : Hyperbaric oxygen is the most efficient treatment of carbon monoxide and dramatically reduces the biological half-life of carboxyhemoglobin. Although less effective, 100% oxygen by mask is useful if hyperbaric facilities are not available. Stimulant drugs are not indicated. If exposed or concerned: Get medical attention/advice.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media : Shutting off the source of the gas is the preferred method of control.
Be aware of the risk of formation of static electricity with the use of CO2 extinguishers and do not use them in places where a flammable atmosphere may be present.

Extinguishing media which must not be used for safety reasons. : Do not use water jet to extinguish.

Specific hazards : Upon exposure to intense heat or flame, cylinder will vent rapidly and or rupture violently. If flames are accidentally extinguished, explosive re-ignition may occur; therefore, appropriate measures should be taken (e.g. total evacuation to protect persons from cylinder fragments and toxic fumes should a rupture occur). If possible, shut off the source of gas and allow the fire to burn itself out. Do not extinguish a leaking gas flame unless absolutely necessary. Spontaneous/explosive re-ignition may occur. Extinguish any other fire. Extinguish fire only if gas flow can be stopped. Move away from container and cool with water from a protected position. Keep adjacent cylinders cool by spraying with large amounts of water until the fire burns itself out. Combustion by-products may be toxic. Do not allow run-off from firefighting to enter drains or water courses.

Special protective equipment for fire-fighters : Use self-contained breathing apparatus. Standard protective clothing and equipment (Self Contained Breathing Apparatus) for fire fighters. Standard EN 137 - Self-contained open-circuit compressed air breathing apparatus with full face mask. Standard EN 469 - Protective clothing for firefighters. Standard - EN 659: Protective gloves for firefighters.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions : Evacuate personnel to safe areas. Remove all sources of ignition. Approach suspected leak areas with caution. Never enter a confined space or other area where the flammable gas concentration is greater the 10% of its lower flammable limit. Wear self-contained breathing apparatus when entering area unless

atmosphere is proved to be safe. Ventilate the area.

Environmental precautions	:	Should not be released into the environment. Prevent further leakage or spillage if safe to do so. Prevent from entering sewers, basements and workpits, or any place where its accumulation can be dangerous.
Methods for cleaning up	:	Ventilate the area. Approach suspected leak areas with caution.
Additional advice	:	If possible, stop flow of product. Increase ventilation to the release area and monitor concentrations. If leak is from cylinder or cylinder valve, call the emergency telephone number. If the leak is in the user's system, close the cylinder valve, safely vent the pressure, and purge with an inert gas before attempting repairs.

7. HANDLING AND STORAGE

Handling

Protect cylinders from physical damage; do not drag, roll, slide or drop. Do not allow storage area temperature to exceed 50°C (122°F). Only experienced and properly instructed persons should handle compressed gases/cryogenic liquids. Before using the product, determine its identity by reading the label. Know and understand the properties and hazards of the product before use. When doubt exists as to the correct handling procedure for a particular gas, contact the supplier. Do not remove or deface labels provided by the supplier for the identification of the cylinder contents. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders. Leave valve protection caps in place until the container has been secured against either a wall or bench or placed in a container stand and is ready for use. Use an adjustable strap wrench to remove over-tight or rusted caps. Before connecting the container, check the complete gas system for suitability, particularly for pressure rating and materials. Before connecting the container for use, ensure that back feed from the system into the container is prevented. Ensure the complete gas system is compatible for pressure rating and materials of construction. Ensure the complete gas system has been checked for leaks before use. Employ suitable pressure regulating devices on all containers when the gas is being emitted to systems with lower pressure rating than that of the container. Never insert an object (e.g. wrench, screwdriver, pry bar, etc.) into valve cap openings. Doing so may damage valve, causing a leak to occur. Open valve slowly. If user experiences any difficulty operating cylinder valve discontinue use and contact supplier. Close container valve after each use and when empty, even if still connected to equipment. Never attempt to repair or modify container valves or safety relief devices. Damaged valves should be reported immediately to the supplier. Close valve after each use and when empty. Replace outlet caps or plugs and container caps as soon as container is disconnected from equipment. Do not subject containers to abnormal mechanical shock. Never attempt to lift a cylinder by its valve protection cap or guard. Do not use containers as rollers or supports or for any other purpose than to contain the gas as supplied. Never strike an arc on a compressed gas cylinder or make a cylinder a part of an electrical circuit. Do not smoke while handling product or cylinders. Never re-compress a gas or a gas mixture without first consulting the supplier. Never attempt to transfer gases from one cylinder/container to another. Always use backflow protective device in piping. Purge air from system before introducing gas. Installation of a cross purge assembly between the cylinder and the regulator is recommended. When returning cylinder install valve outlet cap or plug leak tight. Never use direct flame or electrical heating devices to raise the pressure of a container. Containers should not be subjected to temperatures above 50°C (122°F). Ensure equipment is adequately earthed.

Storage

Containers should be stored in a purpose build compound which should be well ventilated, preferably in the open air. Full containers should be stored so that oldest stock is used first. Observe all regulations and local requirements regarding storage of containers. Stored containers should be periodically checked for general condition and leakage. Local codes may have special requirements for toxic gas storage. Protect containers stored in the open against rusting and extremes of weather. Containers should not be stored in conditions likely to encourage corrosion. Containers should be stored in the vertical position and properly secured to prevent toppling.

The container valves should be tightly closed and where appropriate valve outlets should be capped or plugged. Container valve guards or caps should be in place. Keep containers tightly closed in a cool, well-ventilated place. Store containers in location free from fire risk and away from sources of heat and ignition. Full and empty cylinders should be segregated. Do not allow storage temperature to exceed 50°C (122°F). Smoking should be prohibited within storage areas or while handling product or containers. Display "No Smoking or Open Flames" signs in the storage areas. The amounts of flammable or toxic gases in storage should be kept to a minimum. Return empty containers in a timely manner.

Technical measures/Precautions

Containers should be segregated in the storage area according to the various categories (e.g. flammable, toxic, etc.) and in accordance whit local regulations. Provide sufficient air exchange and/or exhaust in work rooms. Keep away from combustible material. All electrical equipment in the storage areas should be compatible with flammable materials stored. Containers containing flammable gases should be stored away from other combustible materials. Where necessary containers containing oxygen and oxidants should be separated from flammable gases by a fire resistant partition.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering measures

Handle product only in closed system or provide appropriate exhaust ventilation at machinery.
Provide natural or mechanical ventilation to prevent accumulation above exposure limits.

Personal protective equipment

Respiratory protection	:	Keep self-contained breathing apparatus readily available for emergency use. Users of breathing apparatus must be trained. Use gas filters and full face mask, where exposure limits may be exceeded for a short-term period, e.g. connecting or disconnecting containers. Gas filters do not protect against oxygen deficiency. Gas filters may be used if all surrounding conditions e.g. type and concentration of the contaminant(s) and duration of use are known. Standard EN 14387 - Gas filter(s), combined filter(s) and full face mask - EN 136. Consult respiratory device supplier´s product information for the selection of the appropriate device. Self-contained breathing apparatus is recommended, where unknown exposure may be expected, e.g. during maintenance activities on installation systems. Standard EN 137 - Self-contained open-circuit compressed air breathing apparatus with full face mask.
Hand protection	:	Wear work gloves when handling gas containers. Standard EN 388 - Protective gloves against mechanical risk.
Eye protection	:	Safety glasses recommended when handling cylinders. Standard EN 166 - Personal eye-protection.
Skin and body protection	:	Flame retardant antistatic protective clothing. Consider the use of flame resistant anti-static safety clothing. Standard EN ISO 14116 - Limited flame spread materials. Standard EN ISO 1149-5 - Protective clothing: Electrostatic properties. Safety shoes are recommended when handling cylinders. Standard EN ISO 20345 - Personal protective equipment - Safety footwear.
Special instructions for protection and hygiene	:	Ensure adequate ventilation, especially in confined areas. Provide good ventilation and/or local exhaust to prevent accumulation of concentrations above exposure limits.

Exposure limit(s)

Carbon monoxide	Time Weighted Average (TWA): EU SCOELS	20 ppm	23 mg/m3
Carbon monoxide	Short Term Exposure Limit (STEL) EU SCOELS	100 ppm	117 mg/m3
Carbon monoxide	Short Term Exposure Limit (STEL) EH40 WEL	100 ppm	117 mg/m3
Carbon monoxide	Time Weighted Average (TWA): EH40 WEL	20 ppm	23 mg/m3

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Compressed gas. Colorless gas
Odor	:	No odor warning properties.
Odor threshold	:	No data available.
pH	:	Not applicable.
Melting point/range	:	-337 °F (-205.1 °C)
Boiling point/range	:	-313 °F (-191.5 °C)
Flash point	:	Not applicable.
Evaporation rate	:	Not applicable.
Flammability (solid, gas)	:	Refer to product classification in Section 2
Upper/lower explosion/flammability limit	:	74 %(V) / 10.9 %(V)
Vapor pressure	:	Not applicable.
Water solubility	:	0.030 g/l
Relative vapor density	:	0.967 (air = 1) Lighter or similar to air.
Relative density	:	0.79 (water = 1)
Partition coefficient: n-octanol/water [log Kow]	:	Not applicable.
Auto-ignition temperature	:	607 °C
Decomposition temperature	:	No data available.
Viscosity	:	Not applicable.
Molecular Weight	:	28 g/mol
Density	:	0.075 lb/ft3 (0.0012 g/cm3) at 70 °F (21 °C) Note: (as vapor)

Specific Volume	:	13.80 ft3/lb (0.8615 m3/kg) at 70 °F (21 °C)

10. STABILITY AND REACTIVITY

Chemical Stability	:	Stable under normal conditions. Stable.
Conditions to avoid	:	Heat, flames and sparks.
Reactivity/Incompatible Materials	:	Iron. Natural rubber. Neoprene. Nickel. Oxygen. Oxidizing agents.

11. TOXICOLOGICAL INFORMATION

Likely routes of exposure

Effects on Eye	:	In case of direct contact with eyes, seek medical advice.
Effects on Skin	:	No data available.
Inhalation Effects	:	May be fatal if inhaled.
Ingestion Effects	:	Ingestion is not considered a potential route of exposure.
Symptoms	:	No data available.

Acute toxicity

Acute Oral Toxicity	:	No data is available on the product itself.
Inhalation	:	LC50 (1 h) : 3760 ppm Species : Rat.
Acute Dermal Toxicity	:	No data is available on the product itself.
Serious eye damage/eye irritation	:	No data available.
Sensitization.	:	No data available.

Chronic toxicity or effects from long term exposures

Carcinogenicity	:	No data available.
Reproductive toxicity	:	No data is available on the product itself.
Germ cell mutagenicity	:	No data is available on the product itself.

Specific target organ systemic toxicity (single exposure)	:	No data available.
Specific target organ systemic toxicity (repeated exposure)	:	Prolonged or repeated inhalation may cause damage to the heart. Inhalation may damage fertility or the unborn child (Increased risk of preterm birth; risk of cardiac defects).
Aspiration hazard	:	No data available.

12. ECOLOGICAL INFORMATION

Ecotoxicity effects

Aquatic toxicity	:	No data is available on the product itself.
Toxicity to other organisms	:	No data available.

Persistence and degradability

Biodegradability	:	No data is available on the product itself.
Mobility	:	Carbon Monoxide will not be mobile in the environment. Because of its high volatility, the product is unlikely to cause ground pollution.
Bioaccumulation	:	Does not bioaccumulate. Refer to Section 9 "Partition Coefficient (n-octanol/water)".

Further information

This product has no known eco-toxicological effects.

13. DISPOSAL CONSIDERATIONS

Waste from residues / unused products	:	In accordance with local and national regulations. Contact supplier if guidance is required. Return unused product in original cylinder to supplier. Must not be discharged to atmosphere. Refer to the EIGA code of practice Doc. 30 "Disposal of Gases", downloadable at http://www.eiga.org for more guidance on suitable disposal methods. List of hazardous waste codes: 16 05 04*: gases in pressure containers (including halons) containing hazardous substances.
Contaminated packaging	:	Return cylinder to supplier.

14. TRANSPORT INFORMATION

ADR

UN/ID No.	:	UN1016
Proper shipping name	:	CARBON MONOXIDE, COMPRESSED
Class or Division	:	2
Tunnel Code	:	(B/D)
Label(s)	:	2.3 (2.1)
ADR/RID Hazard ID no.	:	263
Marine Pollutant	:	No

IATA

Transport forbidden

IMDG

UN/ID No.	:	UN1016
Proper shipping name	:	CARBON MONOXIDE, COMPRESSED
Class or Division	:	2.3
Label(s)	:	2.3 (2.1)
Marine Pollutant	:	No
Segregation Group	:	None

RID

UN/ID No.	:	UN1016
Proper shipping name	:	CARBON MONOXIDE, COMPRESSED
Class or Division	:	2
Label(s)	:	2.3 (2.1)
Marine Pollutant	:	No

Further Information

Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. The transportation information is not intended to convey all specific regulatory data relating to this material. For complete transportation information, contact customer service.

15. REGULATORY INFORMATION

Workplace Safety and Health Act & Workplace Safety and Health (General Provisions) Regulations

Workplace Health and Safety Act , SS586 Labeling.

Flammable Materials Regulation Licensable Chemicals (Singapore Civil Defense Force).

Poison Act (Health Sciences Authority).

Country	Regulatory list	Notification
USA	TSCA	Included on Inventory.
EU	EINECS	Included on Inventory.
Canada	DSL	Included on Inventory.
Australia	AICS	Included on Inventory.
Japan	ENCS	Included on Inventory.
South Korea	ECL	Included on Inventory.
China	SEPA	Included on Inventory.
Philippines	PICCS	Included on Inventory.

16. OTHER INFORMATION

Ensure all national/local regulations are observed.

Prepared by : Air Products and Chemicals, Inc. Global EH&S Department

For additional information, please visit our web site at http://www.airproducts.com.