Safety Data Sheet

1. Identification of the Substance/Mixture and the Supplier

Supplier	:	National Institute of Advanced Industrial Science and Technology (AIST)
Address	:	1-3-1 Kasumigaseki, Chiyoda, Tokyo, Japan
Office in Charge	:	Reference Materials Office, Center for Quality Management of Metrology, National Metrology Institute of Japan
Person in Charge	:	Certified Reference Material Staff
Telephone No.	:	+81-29-861-4059 Fax No. : +81-29-861-4009
Emergency Contact	:	Same as above
		Prepared on : September 12, 2018
		Revised on : August 31, 2022
		Reference No. : 3406005
Identity of Substance/Mixture	:	Certified reference material NMIJ CRM 3406-e Carbon monoxide
Recommended Use of the Chemical and Restriction on Use	:	This certified reference material (CRM) is for use in calibration of analytical instruments. Do not use this reference material for other purposes than testing/research. This CRM is a reference material (specified in the Japanese Industrial Standard (JIS) Q 0030).

2. Hazards Identification

GHS classification	Flammable gases	:	Class 1
	Gas under pressure	:	Compressed gas
	Acute toxicity (Inhalation, gas)	:	Class 3
	Reproductive toxicity	:	Class 1A
	Specific target organ toxicity/systemic toxicity (Single exposure)	:	Class 1 (Inhalation: Cardiovascular system, Nervous system)
	Specific target organ toxicity /systemic toxicity (Repeated exposure)	:	Class 2 (Inhalation: Heart, blood)

GHS label element :

Signal word	:	Danger
Hazards Statement	:	Extremely flammable gas Gas under pressure: May explode if heated Toxic if inhaled (gas) May damage fertility or the unborn child In case of inhalation exposure: Impairment of cardiovascular organs and nerves May cause impairment of heart and blood through prolonged or repeated exposure

Other Hazards Statement	:	May cause eye damage or loss of vision if gas is blown out from container of gas under pressure and caught in eyes.
Precautionary Statement	:	[Precaution] Do not handle until all safety precautions have been read and understood. Do not eat, drink or smoke when using this reference material. Keep away from ignition sources such as heat, sparks, open flame and hot surfaces. No smoking Use personal protective equipment and ventilation equipment and avoid exposure. Use only outdoors or in a well-ventilated area. Do not breathe gas. Wash hands thoroughly after handling. [Action] Leaking gas fire: Do not extinguish, unless leakage can be stopped safely. Eliminate all ignition sources if safe to do so. If inhaled: Remove victim to fresh air and keep at rest in a position comfortable for breathing. If exposed or concerned: Get medical advice/attention. If you feel unwell: Get medical advice/attention. [Storage] Observe the High Pressure Gas Safety Law when handling. Protect from direct sunlight, and store away from fire at temperatures not exceeding 40 °C in a well-ventilated place. Store locked up. [Disposal] Return the container of this reference material back to the function in charge given in "1. Identification of the Substance/Mixture and the Supplier" when it becomes no longer necessary to use it or when it becomes beyond its expiration date.

The other hazards than the above do not result in classification or are not classifiable.

3. Composition/Information on Ingredients

Substance or mixture	:	Single substance
Chemical name	:	Carbon monoxide
Synonym	:	CO, carbon oxide,
Chemical formula	:	CO
Molecular weight	:	28.01
CAS number	:	630-08-0
Content	:	99.99 %
Reference Number in Gazetted List in Japan	:	Act on the Evaluation of Chemical Substances and Regulation of Their Manufacture, etc. : (1)-168 Industrial Safety and Health Act : (1)-168
Hazardous Component		Carbon monoxide

4. First-aid Measures

If inhaled	:	Move to a fresh air place and rest in an easy-to-breathe posture. If you feel uncomfortable, get medical attention In case of symptoms related to breathing, call a doctor.
If on skin	:	Rinse skin with water and soap promptly. If you feel uncomfortable, get medical attention.
If in eyes	:	Rinse carefully with water for several minutes. If contact lenses are inserted, take them out if possible, and continue to rinse. If eye irritation persists, get medical advice / attention. If you feel uncomfortable, get medical attention.
If swallowed	:	Wash mouth thoroughly with water If you feel uncomfortable, get medical attention
The most important characteristics and symptoms	:	If inhaled: confusion, dizziness, headache, nausea, loss of consciousness, weakness.
Measures to be taken to protect the person applying first aid	:	Use personal protective equipment.

5. Fire-fighting Measures

Extinguishing Media	:	In case of minor fire: Carbon dioxide, Dry chemical extinguisher , Water spray, Alcohol-resistant foam extinguishing agent In case of major fire: Water spray, Water fog
Fire-Specific Hazards	:	May ignite easily. Container may explode if heated. Burst container may fly. In case of fire, may emit irritating, corrosive or toxic gas.
Specific Fire-Fighting Method	:	Eliminate all ignition sources if safe to do so. Move containers away from area of fire if this can be done without risk. Keep cooling container thoroughly with plenty of water even after extinction. Do not spray water directly to gas leaking point or safety device, which may make them frozen. Fight fire from a reasonable distance by using unmanned hose holder and nozzle equipped with monitor. Only experts are allowed to handle damaged container. Do not extinguish, unless leakage can be stopped safely. For initial firefighting, use dry chemical extinguishing system. Wear gas mask, etc.
Protection of Fire-Fighters	:	Fight fire upwind in order to avoid breathing hazardous gas. Wear appropriate compressed air open-circuit self-contained breathing apparatus and chemical-resistant protective clothing during fire-fighting operations.

6. Accidental Release Measures

Personal precautions	:	Eliminate nearby possible ignition sources immediately. Make fire extinguishing tools available to prepare for potential fire. Do not touch or walk in leaked materials. Immediately designate restricted leakage area with appropriate distance taken in every direction. Keep out unauthorized people. Wear appropriate personal protective equipment (See "8. Exposure Controls/Personal Protection") during the operation to avoid contact with eyes and skin and inhalation of gas. Use tightly-sealed impervious protection clothing if fire is not induced by the leakage. Before entering a confined area, ventilate the area Maintain the restricted area until gas disappears. Stay upwind. Evacuate from low-level grounds.
Protective equipment and emergency procedure	:	Ventilate affected areas thoroughly, if it is in an indoor environment, until the clean-up operation is completed. Wear appropriate personal protective equipment during the operation to avoid inhalation of dust and gas.
Environmental precaution	:	Take precautions to prevent leaked materials from draining into rivers etc. to adversely affect the environment.
Recovery, neutralization	:	No data available
Measures to prevent secondary accident	:	Eliminate all ignition sources immediately (no smoking, sparks or flame in surrounding areas). Prevent the leaked materials from entering sewers, drainage systems, basement rooms or confined space. Do not spray water directly to leaked materials or their sources. Maintain the restricted area until gas diffuses.

7. Handling and Storage

Handling

Engineering Precautions	:	Take the engineering precautions stipulated in "8. Exposure Controls/Personal Protection" and wear personal protective equipment.
Local and General Ventilation	:	Provide local and general ventilation stipulated in "8. Exposure Controls/Personal Protection."
Precautions for Safe Handling	:	Obtain information for use before use. Do not handle until all safety precautions have been read and understood. Do not use hot surfaces, sparks or fire in surrounding areas. Contain gas under pressure: May explode if heated. Handle container cautiously and avoid giving a shock or knocking over. Take thorough precautions against leakage when mounting and dismounting container. After use, close container valve firmly and then put valve guard and protection cap in place. Ignition and explosion risk in case of leakage. Provide exhaust ventilation to keep concentrations in air well below occupational exposure limits Avoid contact, inhalation and swallowing of this reference material.

Risk of death if inhaled.
If in eyes or mouth: May cause irritation. Take thorough precautions when using this reference material.
Use only outdoors or in a well-ventilated area.
Wash hands after handling.
Restrict drinking, eating and smoking to a designated area.
Make a place handling this reference material a restricted area to keep out unauthorized people.
Wear appropriate personal protective equipment to avoid inhalation and contact with eyes, skin and clothing.

Storage

Appropriate storage conditions : Keep away from ignition sources such as heat, sparks, open flame and hot surfaces.
No smoking
Store only outdoors or in a well-ventilated area.
Keep away from oxidizers, oxygen, explosive material, halogens, compressed air, acid, alkalis, food chemicals, etc.
Protect from direct sunlight, and store away from fire at temperatures not exceeding 40 °C in a well-ventilated place.
Store locked up.

Safe packaging materials : Use the container specified in the High Pressure Gas Safety Law and the UN Transport Regulations.

※ Refer to the reference material certificate for the precaution statement regarding the appropriate condition of the storage and usage of the reference material.

8. Exposure Controls/Personal Protection

Administrative levels

Not established

Occupational exposure limit (Carbon monoxide)

- ACGIH TLV-TWA : 25 ppm
- Japan Society for Occupational Health Recommended Reference Value : 50 ppm, 57 mg/m^3

Facility engineering control

Ventilation, exhaust : Install explosion-proof local ventilating equipment.
Install eye washer and safety shower in a place storing or handling this reference material.
Handle only in a completely-closed system and completely-closed equipment.
Keep processes closed and/or provide local ventilation and other engineering controls in order to maintain concentrations in the air below recommended threshold limit value/permissible concentration.
In case of gas emission in high-temperature processes, install ventilating equipment in order to keep air pollutant concentrations below threshold limit value/permissible concentration

Safety management, gas detection : Measuring equipment, Detecting tube

Storage precaution : Keep away from ignition sources such as heat, sparks and open

flame. No smoking.
Store in a well-ventilated place.
Keep away from oxidizer, oxygen, explosives, halogen, compressed air, acids, alkalis, food chemicals, etc.
Protect from direct sunlight, and store away from fire at temperatures not exceeding 40 °C.
Keep container tightly closed, and store it in a well-ventilated place.
Store locked up.

Protective equipment

Respiratory organ	:	Appropriative gas mask, Compressed air open-circuit self-contained breathing apparatus
Hand	:	Use appropriate protective gloves as necessary
Eyes	:	Use personal eye protection as necessary
Skin and body	:	Use appropriate protective clothing and face protection as necessary.

Hygiene Measures

Handle in accordance with industrial health and safety codes.

9. Physical and Chemical Properties

Appearance, etc.	:	Compressed gas
Color	:	Colorless transparent
Odor	:	Odorless
pH	:	No data
Melting point	:	−205.0 °C
Boiling point	:	−191.5°C
Flashing point	:	Not applicable
Explosive range	:	Lower limit: 12.5 vol %, upper limit: 74.2 vol %
Vapor pressure	:	30609 hPa (−143 °C)
Relative vapor density(Air=1)	:	0.97
Specific gravity or bulk specific gravity	:	0.814 (liquid, −195°C/4°C)
Solubility	:	2.3 mL/100 mL (20 °C, in water)
n-Octanol/water partition coefficient (Log Po/w)	:	log Pow = 1.78 (surmised value)
Auto-ignition temperature	:	605 °C
Decomposition temperature	:	No data
Flammability	:	No data
Viscosity	:	16.62 μN s/m^2 (273 K)

10. Stability and Reactivity

Stability	:	Stable under normal condition
Reactivity	:	Reacts with strong oxidants, causing fire and explosion hazard.
Possibility of hazardous reactions	:	React with finely dispersed metal powder and produces toxic and flammable carbonyl. It may react violently with oxygen, acetylene, chlorine, fluorine, nitrous oxide.
Conditions to avoid	:	Heating.

		Even if it reaches poisoning concentration, it does not feel odor, so be careful.
Incompatible materials	:	Strong oxidizer, metal powder, oxygen, acetylene, chlorine, fluorine, nitrous oxide.
Hazardous decomposition products	:	When burning, it generates harmful gas carbon dioxide.

11. Toxicological information

Acute Toxicity	:	Oral: Cannot be administered orally as this reference material is hard to be dissolved in water Dermal: Not classifiable due to no experiment data available Inhalation (gas): Classified as Category 3, based on the following data: Rat LC50 (4 hours) 1805 ppm and 1659 ppm Toxic if inhaled (gas) (Category 3)
Skin Corrosion/ Irritation	:	Claimed to be tasteless and odorless gas
Serious Eye Damage/ Eye Irritation	:	Claimed to be tasteless and odorless gas
Respiratory Sensitization	:	No information reported on sensitization although smokers routinely inhale carbon monoxide.
Skin Sensitization	:	No information reported on sensitization
Germ Cell Mutagenicity	:	No classification based on the review of WHO assessment
Carcinogenicity	:	No classification based on the review of WHO assessment
Reproductive Toxicity	:	Classified as Category1A based on the following data: Effects on unborn children were observed in numerous animal studies. Also for humans, effects of maternal smoking were suggested. May damage fertility or the unborn child (Category 1A)
Specific Target Organ Toxicity/Systemic Toxicity (Single Exposure)	:	Classified as Category 1, based on the following data: Inhalation exposure led to increase of carboxyhemoglobin in blood, affected nervous system and cardiovascular system of humans and animals, and impaired intellectual capability, motor ability, hearing ability, etc. Impairment of cardiovascular system and nervous system due to inhalation exposure (Category 1)
Specific Target Organ Toxicity/Systemic Toxicity (Repeated Exposure)	:	Classified as Category 2, based on the following data: In repeated inhalation studies using animals, effects on heart and blood systems were observed at exposure concentrations of 50 ppm - 250 ppm.
Aspiration Hazard	:	Out of the classification scope This reference material is in a gaseous form at room temperature.
Hazard to the Aquatic Environment (Acute Aquatic Toxicity)	:	Not classifiable due to insufficient data
Hazard to the Aquatic Environment	:	Not classifiable due to insufficient data

(Chronic Aquatic Toxicity)

12. Ecological Information

Ecotoxicity	;	No data
Persistence and Degradability	;	No data
Bioaccumulative Potential	;	No data
Mobility in soil	;	No data
Influence to the ozone layer	;	No data

13. Disposal Considerations

Residual Waste	:	Return the unnecessary cylinder to the gas supplier. Dispose of gas under pressure in accordance with the Regulation on Safety of General High Pressure Gas of the High Pressure Gas Safety Law.
Contaminated Container and Package	:	Return this reference material back to the function in charge given in "1. Identification of the Substance/Mixture and the Supplier" when it becomes no longer necessary to use it or when it becomes beyond its shelf life. Container must be disposed of by its owner in accordance with relevant legislation. User of container, therefore, must not dispose of it by his/her discretion.

14. Transport Information

UN Number	:	1016
UN Classification	:	Class 2.3, Subclass 2.1
Material name	:	CARBON MONOXIDE, COMPRESSED
Container grade	:	-
ICAO/IATA	:	Hazard Class 2.3, Subclass 2.1, UN 1016
Marine pollutant	:	Not applicable
Transport by sea	:	Follows the provisions of the ship safety law.
Precautions	:	Transport this reference material carefully while keeping it away from direct sunlight and fire and preventing accidental release due to falling, overturning, etc.

15. Regulatory Information

Industrial Safety and Health Act	:	Specific chemical substance prevention rule: Article 2-1-6, Specific chemical substance, type 3. Dangerous goods/Flammable gas(Enforcement order, Appendix 1-5) Article 57 (Enforcement Order: Article 18) Hazardous substance whose name, etc. must be labeled Article 57-2 (Enforcement Order: Article 18-2), Hazardous substance whose name, etc. must be notified.
High Pressure	:	Compressed gas (Article 2-1)

Gas Safety Law		Flammable gas (General High Pressure Gas Safety Regulation Article 2-1) Toxic gas (General High Pressure Gas Safety Regulation Article 2-2)
Air Pollution Control Act	:	Hazardous air pollutant (Article 17-1, enforcement order article 10)
Civil Aeronautics Act	:	Ban on transportation (Enforcement Order: Article 194)
Ship Safety Law	:	High Pressure Gas (Regulation Article 3 Notification of dangerous goods Appendix No. 1)
Act on Port Regulations	:	Other dangerous goods / high pressure gas (Article21-2)
Road Law	:	Restriction on the passage of vehicles (Article 19-13 of the Enforcement Order, Public Notice of Japan Highway Ownership and Debt Repayment Organization No. 12, Appended Table 2)
Labor Standards Act	:	Disease chemical substance (Article 75-2,Enforcement regulation article 35, Appendix Table 1-2-4, Carbon Monoxide)

◎ **This SDS is originally prepared for the use of the material in Japan, thus the stated laws and regulations are stipulated and carried out in Japan. The use of the material in other countries should be referred to and by application of the relevant laws and regulations of the country in which the material will be used.**

16. Other Information

Others

The information in this document is not intended to be exhaustive and is based on currently available information and data. The measures given in this document are applicable only to normal handling conditions. When handling this reference material under special conditions etc., it is recommended to take safety measures appropriate to each specific application and context of use. This document is intended to provide information and not intended to guarantee anything in handling this reference material.