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 : November 30, 2017
		Revised on : August 31, 2022
		Reference No. : 3407002
Identity of Substance/Mixture	:	Certified reference material NMIJ CRM 3407-b Carbon dioxide
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	:	Not classified
	Oxidizing gas	:	Not classified
	Gas under pressure	:	Liquefied gas
	Acute toxicity (Oral)	:	Not applicable
	Acute toxicity (Dermal)	:	Not applicable
	Acute toxicity (Inhalation, gas)	:	Not classified
	Skin corrosivity/irritant	:	Not applicable
	Severe eye damages/eye irritant	:	Not applicable
	Specific target organ toxicity/systemic toxicity (Single exposure)	:	Class 3 (Narcotic effects)
	Specific target organ toxicity /systemic toxicity (Repeated exposure)	:	Not applicable
	Hazardous to the aquatic environment, acute hazard	:	Not applicable
	Hazardous to the aquatic environment, long-term hazard	:	Not applicable

GHS label element	:	
Signal word	:	Warning
Hazard and toxicity	:	May explode when heated. May be drowsy or dizzy
Other hazard and toxicity	:	If gas blowouts from the high-pressure gas container and enters the eyes, there is a risk of eye damage or loss of vision.
Precautionary statement	:	[Preventive measures] Use it in a well-ventilated place. Wear personal protective equipment. Avoid breathing gas. [First-aid measures] If inhaled: If breathing is difficult, move air to a fresh place and rest in an easy-to-breathe posture. In case of symptoms related to breathing, call a doctor. [Storage] Handle in accordance with the High Pressure Gas Safety Act. Storage of containers should be done in a well-ventilated area at 40 ° C or less without direct sunlight and without fire. Close the container valve, protect it with cap, lock it and keep it safe. [Disposal] When disposing of the content, discharge it little by little in a place with good ventilation with no flame and inflammable material around it, to avoid danger. Dispose of this CRM in accordance with applicable legislation and local government ordinance. Entrust disposal of this CRM to a professional waste disposal company licensed by the prefectural governor. Inside Japan, return the cylinder of this CRM to the supplier when it is no longer needed or exceeds its shelf life. Hazardous and toxic properties not specified in the above are not subject to the classification or not classifiable.

3. Composition/Information on Ingredients

Substance or mixture	:	Single substance
Chemical name	:	Carbon dioxide
Synonym	:	Carbon dione, Methanedione, Dioxocarbon
Chemical formula	:	CO_2
Molecular weight	:	44.01
CAS number	:	124-38-9
Content	:	99.99 %
Reference Number in Gazetted List in Japan	:	Act on the Evaluation of Chemical Substances and Regulation of Their Manufacture, etc. : (1)-169
	:	Industrial Safety and Health Act : (1)-169
Hazardous Component		

4. First-aid Measures

If Inhaled	:	Remove victim to fresh air and keep at rest and warm. If you feel unwell: Call a doctor/physician.
If on Skin	:	Rinse thoroughly with clean water. If skin irritation occurs: Get medical advice/attention.
If in Eyes	:	Rinse cautiously with water for several minutes. If eye irritation persists: Get medical advice/attention.
If swallowed	:	Rinse mouth with water. If you feel unwell: Get medical advice/attention.
The Most Critical Characteristics and Symptoms of Expected Acute Symptoms and Delayed Symptoms	:	If inhaled: Dizziness, Headache, Blood pressure rise, Tachycardia, Suffocation, Unconsciousness If on skin: Cryogenic burn (in contact with liquid) If in eyes: Cryogenic burn (in contact with liquid) In case of inhalation of high-concentration gas: May cause unconsciousness. May affect metabolism.
Protection of First-Aid Provider	:	Wear personal protective equipment.

5. Fire-fighting Measures

Extinguishing Media	:	Water fog, Foam extinguishing agent, Dry chemical extinguisher, Carbon dioxide, Dry sands Unsuitable extinguishing media: Direct water jet
Fire-Specific Hazards	:	In case of fire: May emit irritating, corrosive and toxic gas. Container may explode if heated. Burst container may fly.
Specific Fire-Fighting Method	:	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.
Protection of Fire-Fighters	:	Only experts are allowed to handle damaged container. Wear appropriate compressed air open-circuit self-contained breathing apparatus and thermal-resistant protective clothing.

6. Accidental Release Measures

Personal Precaution	:	Do not touch or walk in leaked materials. Immediately designate restricted leakage area with appropriate distance taken in every direction. Keep out unauthorized people. Stay upwind. Evacuate from low-level grounds. Ventilate affected areas. Maintain the restricted area until gas diffuses.
Personal Protective Equipment and Emergency	:	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.

Procedures		
Environmental Precautions	:	Take precautions to prevent leaked materials from draining into rivers etc. to adversely affect the environment. Take precautions to prevent untreated contaminated wastewater from being released into the surrounding environment.
Recovery and Neutralization	:	Stop leakage if safe to do so. If possible, turn leaking container so as to let gas, instead of liquid, be released.
Prevention of Secondary Disaster	:	Prevent leaked materials from entering sewers, drainage systems, basement rooms or confined space. Issue a warning to people in residential and industrial areas and evacuate from danger area.

7. Handling and Storage

Handling

Technological counter measures	:	Take the engineering precautions stipulated in "8. Exposure Controls/Personal Protection" and wear personal protective equipment.
Local ventilation/ general ventilation	:	Provide local and general ventilation stipulated in "8. Exposure Controls/Personal Protection."
Precautions for safe handling	:	Wash hands thoroughly after handling. Restrict drinking, eating and smoking to designated areas. Avoid breathing gas. Use only outdoors or in well-ventilated areas. Do not treat the container roughly, no dropping, knocking down or dragging Close the container valve securely after use. Do not enter anyone other than authorized person in the place of handling. Use appropriate protective equipment to prevent inhaling, coming in contact with eyes, skin and the clothing. Refer to description in "10. Stability and Reactivity."

Storage

Appropriate condition	:	Protect from direct sunlight and keep temperatures at 40 °C or below. Store in a well-ventilated place. Lock it and keep it safe.
Safe packing material	:	Use the container specified by the High Pressure Gas Safety Act and the UN Transport Regulations.

※ See the Certificate for the details on appropriate storage conditions and instructions for use as a reference material.

8. Exposure Controls/Personal Protection

Administrative levels

Not established

Occupational exposure limit (Carbon dioxide)

・ACGIH TLV-TWA	:	TWA 5000 ppm, STEL 30000 ppm (2009)
・Japan Society for Occupational Health	:	5000 ppm, 30000 ppm (2009)

Recommended Reference Value

Facility engineering control

Ventilation, exhaust : Local ventilation system or General ventilation system

Safety management, gas detection : Measuring equipment, Detecting

Storage precaution : Install eyewash and a safety shower in the workplace where this material is stored or handled.

Protective equipment

Respiratory organ : Wear appropriate respiratory protective equipment such as air respirator if necessary.

Hand : Wear leather gloves etc.

Eyes : Wear eye / face protection such as safety goggles.

Skin and body : Wear appropriate protective equipment such as safety shoes.

Hygiene Controls

Handle this reference material in accordance with industrial health and safety standards.

9. Physical and Chemical Properties

Appearance, etc.	:	Compressed gas
Color	:	Colorless transparent
Odor	:	Odorless
pH	:	3.7～3.2
Melting point	:	−56.56 °C
Boiling point	:	−78.5 °C
Flashing point	:	Nonflammable
Explosive range	:	Nonflammable
Vapor pressure	:	No data
Relative vapor density(Air=1)	:	48300 mmHg (25 °C)
Specific gravity or bulk specific gravity	:	1.522 (21°C)
Solubility	:	1480 mg/L (in water)
n-Octanol/water partition coefficient (Log Po/w)	:	No data
Auto-ignition temperature	:	No data
Decomposition temperature	:	No data
Flammability	:	Nonflammable

10. Stability and Reactivity

Stability	:	Stable under normal condition
Reactivity	:	Stable under normal condition
Possibility of hazardous reactions	:	It decomposes on heating above 2000 ° C producing toxic carbon monoxide. The container may rupture with heat.
Conditions to avoid	:	Heating to over 2000 ° C
Incompatible materials	:	No data
Hazardous	:	Carbon monoxide

decomposition products

11. Toxicological information

Acute Toxicity	:	No classification, based on the following data: Oral: No data available Dermal: No data available Inhalation: Rat LC50 value 470000 ppm/0.5 hour = 167857 ppm/4 hour [PATTY (5th, 2001)],
Skin corrosivity/ irritation	:	No data
Severe damage to eyes/ eye irritation	:	No data
Respiratory sensitization	:	No data
Skin sensitization	:	No data
Germ cell mutagenicity	:	No data
Carcinogenicity	:	No data
Reproductive toxicity	:	Classification not possible due to lack of data
Specific Target Organ Toxicity/Systemic Toxicity (Single Exposure)	:	Classified as Category 3 (Narcotic effects), based on the following data: It was reported that human exposure to high-concentration carbon dioxide stimulated respiratory center and induced weak narcotic effects (ACGIH (2001)). A case involving two men was reported. Probably due to exposure to excessive carbon dioxide, they lost consciousness all of sudden, and in repeated eye examinations after the exposure, visual field constriction, blind spot enlargement and photophobia were observed as well as headache, insomnia and personality change (HSDB (2008)). These symptoms are considered to be attributed to impairment of retinal ganglion cells and central nervous system. When exposed to carbon dioxide at concentration of 11%, inability of normal regulation was observed and unconsciousness was developed after ten minutes. At carbon dioxide concentration of 25 % - 30 %, respiratory elimination, blood pressure drop, Coma areflexia and anesthesia were observed and the victim died after several hours ("Occupational Health Journal" vol.15-3 (1974)).
Specific Target Organ Toxicity/Systemic Toxicity (Repeated Exposure)	:	Not classifiable due to insufficient data As shown below, there is only limited information on repeated exposure, most of which is old, and the findings, except for minor effects, are inconsistent. After exposure to 1.5 % carbon dioxide during physical exercise for 42 days, mild stress response was observed but significant deterioration was not detected in basic physiology or psychomotor function (ACGIH (2001)). When diver volunteers were exposed to 1 % carbon dioxide for 22 days, only metabolic stress was observed (ACGIH (2001)). After exposure to 2 % carbon dioxide, deep breathing was observed. Along with rise of carbon dioxide concentration, breathing resistance

increased. When carbon dioxide concentration exceeded 3 %, adverse effects were inevitable (ACGIH (2001)).
It was reported that, in the case of exposure to 3 % carbon dioxide in submarine during World War II, initial symptom of excitation was gradually replaced by inhibition, developing such symptoms as increase of subcutaneous blood flow, drop of body temperature, drop of blood pressure, increase of breathing quantity and decline of mental function (PATTY (5th, 2001)).
Meanwhile it was reported that prolonged continuous exposure to the air containing 1 % to 2 % carbon dioxide resulted in acidosis and impairment of adrenal cortex (ACGIH (2001)).

Aspiration Hazard	:	-
Hazard to the Aquatic Environment (Acute Aquatic Toxicity)	:	Crustacea (Gammaridae family) 96 hours EC50 = 0.0127 mg/l (CERI・NITE)
Hazard to the Aquatic Environment (Chronic Aquatic Toxicity)	:	Although bioaccumulation potential is low (BCF = 330), no rapid degradability is observed (Degradability based on BOD: 0 %).

12. Ecological Information

Hazardous to the aquatic environment, short-term (Acute)	:	No data
Hazardous to the aquatic environment, long-term (Chronic)	:	No data

13. Disposal Consideration

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 Act.
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	:	1013
UN Classification	:	Class 2.2
Material name	:	CARBON DIOXIDE
Container grade	:	-
ICAO/IATA	:	Hazard Class = 2.2, UN1013
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

High Pressure Gas Safety Act	:	Liquefied gas (Article 2-3)
Ship Safety Law	:	High Pressure Gas (Regulation Article 3 Notification of dangerous goods Appendix No. 1)
Civil Aeronautical Act	:	High Pressure Gas (Regulation Article 194 Notification of dangerous goods Appendix No. 1)
Act on Port Regulations	:	Other dangerous goods / high pressure gas (Article21-2)

◎ **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.