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

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Identity of Substance/Mixture	:	Certified reference material NMIJ CRM 3402-d Sulfur 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	Gas under pressure	:	Liquefied gas
	Acute toxicity (Inhalation, gas)	:	Class 3
	Severe eye damages/eye irritant	:	Class 2A
	Specific target organ toxicity/systemic toxicity (Single exposure)	:	Class 1 (respiratory system)
	Specific target organ toxicity /systemic toxicity (Repeated exposure)	:	Class 1 (respiratory system)

GHS label element :

Signal word : Danger

Hazards Statement : Gas under pressure : May explode if heated
Toxic if inhaled (gas)
Causes serious eye irritation
Causes impairment of respiratory tract
Causes impairment of respiratory system 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. ・Take precautions to prevent container from falling and being knocked over, and avoid rough handling. ・Do not eat, drink or smoke when using this reference material. ・Thoroughly ventilate handling area. ・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. ・Wash hands thoroughly after handling. [Action] ・In case of gas leakage, close container valve immediately. ・Leaking gas fire: Do not extinguish, unless leakage can be stopped safely. ・Eliminate all ignition sources if safe to do so. ・If exposed or concerned: Get medical advice/attention. [Storage] ・Close container valve, put protection cap in place and store locked up. ・Protect from sunlight, and store away from fire at temperatures not exceeding 40 °C in a well-ventilated place. [Disposal] ・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.

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	:	Sulfur dioxide
Synonym	:	Sulphur dioxide
Chemical formula	:	SO_2
Molecular weight	:	64.07
CAS number	:	7446-09-5
Content	:	99.99 % or more
Reference Number in Gazetted List in Japan	:	Act on the Evaluation of Chemical Substances and Regulation of Their Manufacture, etc. : (1)-536
	:	Industrial Safety and Health Act :published
Hazardous Component	:	Sulfur Dioxide

4. First-aid Measures

If in eyes	:	・Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. ・If eye irritation persists or if you feel unwell, get medical advice/ attention.
If on skin	:	・Rinse skin immediately. ・If you feel unwell, get medical advice/attention.
If inhaled	:	・ Remove victim to fresh air and keep at rest in a position comfortable for breathing. ・If you feel unwell, get medical advice/attention.
If swallowed	:	・Rinse thoroughly mouth with water. ・If you feel unwell, get medical advice/attention.
Expected Acute and Delayed Symptom	:	If inhaled: Coughing, Breathing difficulties, Sore throat, May experience delayed symptoms. If on skin: In contact with liquid : Cryogenic burn If in eyes: Flare, Pain, Severe thermal burn
Most Critical Characteristic and Symptom	:	Symptoms of pulmonary edema are often developed in two to three hours after exposure and they will get worsened unless victim is kept at rest. It is essential, therefore, to keep victim at rest and perform medical follow-up.
Protection of First-Aid Responder	:	Wear personal protective equipment.

5. Fire-fighting Measures

Extinguishing Media	:	・Use extinguishing media appropriate for surrounding fire.
Fire-Specific Hazards	:	・Container may explode if heated. ・Burst container may fly. ・In case of fire, may emit irritating, corrosive or toxic gas.
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. ・Fight fire from a maximum reasonable distance by using unmanned hose holder and nozzle equipped with monitor. ・Do not spray water directly to gas leaking point or safety device, which may make them frozen. ・Only experts are allowed to handle damaged container. ・For initial firefighting, use dry chemical extinguishing system. Wear gas mask, etc. ・Do not pour water into container.
Protection of Fire-Fighters	:	Fight fire upwind in order to avoid breathing hazardous gas. Use personal protective equipment such as fireproof clothing, heat-resistant clothing, protective clothing, compressed air open-circuit self-contained breathing apparatus, compressed oxygen closed-circuit self-contained breathing apparatus, rubber gloves and rubber boots.

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 and keep out unauthorized people. Maintain the restricted area until gas diffuses. ・Before entering a confined area, ventilate the area.
Personal Protective Equipment and Emergency Procedures	:	・ 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. ・Wear tightly-sealed impervious protection clothing if fire is not induced by the leakage. ・Stay upwind. ・Keep away from low-level grounds. ・Before entering a confined area, ventilate the area.
Environmental Precautions	:	・Take precautions to prevent leaked materials from draining into rivers etc. to adversely affect the environment. ・Avoid release to the environment.
Recovery and Neutralization	:	・Ventilation ・ Follow expert instructions for removal and disposal of leaked materials. ・If this reference material leaks from pressurized container, turn the leaking point upward, if possible, in order to prevent the gas from leaking in a liquid form.
Prevention of Secondary Disaster	:	・Prevent leaked materials from entering sewers, drainage systems, basement rooms or confined space. ・Do not spray water directly to leaked materials or their sources.

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	:	・Observe the High Pressure Gas Safety Act when handling. ・Do not contact with, inhale or swallow this reference material. ・Suffocation risk if inhaled in plenty. ・Risk of death if inhaled. ・Risk of materials corrosion in case of leakage. ・Causes inflammation if in contact with skin, mucous membrane, etc. ・Use only outdoors or in a well-ventilated area. ・Wash hands thoroughly after handling. ・Do not eat, drink or smoke when using this reference material. ・Take precautions to prevent container from falling, being knocked over, etc. ・Keep removable protection cap and valve guard firmly in place when not in use.

・Put valve guard and then protection cap after use.
・Install pressure regulator, if in use, in accordance with correct procedures. Loosen pressure adjustment handle of pressure regulator by turning it counterclockwise before opening container valve. Then open container valve slowly.
・It is recommended, if possible, to pump down inside of pressure- reducing valve before opening container valve in order to avoid contamination of this reference material.
・Stand at the side of pressure regulator, not in front of or at the back of pressure regulator, when opening container valve. Close container valve tightly.
・Do not refill container. Do not change, erase or peel off engraved information, label, etc. of container.
・Check joints, hoses, pipes and equipment for leakages before use by using bubble solution such as soap.
・Provide exhaust ventilation to keep concentrations in air well below occupational exposure limits.
・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.

Storage

Engineering Precautions	:	・Observe the High Pressure Gas Safety Act, etc.
Appropriate Storage Conditions	:	・Protect container from sunlight, and store away from fire at temperatures not exceeding 40 °C. ・Avoid exposure to corrosive ambience. ・Close container valve and put protection cap in place. Store locked up.
Safe Container Packaging Material	:	・Use container stipulated in the High Pressure Gas Safety Act and the United Nations Recommendations on the Transport of Dangerous Goods.

※ 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 (Sulfur dioxide)

・ACGIH TLV-TWA	:	TLV-TWA 2 ppm A4 TLV-STEL 5 ppm A4
・Japan Society for Occupational Health Recommended Reference Value	:	Not established (under review)

Facility engineering control

Ventilation, exhaust	:	Use process sealing, local exhaust, and other equipment measures to keep air concentration below the Occupational exposure limit.

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	:	Irritating odor
pH	:	No data
Melting point	:	−75.5 °C
Boiling point	:	−10 °C
Flashing point	:	Nonflammable
Explosive range	:	Nonflammable
Vapor pressure	:	330 kPa (20 °C)
Relative vapor density(Air=1)	:	2.25
Specific gravity or bulk specific gravity	:	1.4 (−10 °C, liquid)
Solubility	:	85 mL/L (25 °C)
n-Octanol/water partition coefficient (Log Po/w)	:	log Pow = −2.20 (surmised value)
Auto-ignition temperature	:	Nonflammable
Decomposition temperature	:	No data
Flammability	:	Nonflammable
Viscosity	:	0.368 mPa・s (0 °C, liquid)

10. Stability and Reactivity

Stability	:	If heated, a pressure increase will occur, and container may burst or explode.
Reactivity	:	Aqueous solution of this reference material is moderately strong acid, reacting intensely with ammonia, acrolein, acetylene, alkali metals, chlorine, ethylene oxide, amines and butadiene. React with water and steam, triggering corrosion risk. Take precautions against contact with halogen.
Conditions to Avoid	:	Heat In presence of water: Causes damage to many metals including

		aluminum, iron, steel, brass, copper and nickel. If in a liquid form: Causes damage to plastic, rubber and film-forming agents.
Hazardous decomposition products	:	No data

11. Toxicological information

Acute Toxicity	:	Classified as Category 3, based on the following data: Inhalation (gas) : It was reported that, in the four-hour inhalation exposure study using rats, no dead rats were observed at the concentration of 593 ppm, three out of eight rats were dead at 965 ppm, five out of eight rats were dead at 1168 ppm, and all of the eight rats were dead at 1319 ppm. Based on these results, the LC_{50} value of this study is determined to be between 593 ppm and 1319 ppm.
Skin Corrosion/ Irritation	:	No data available
Serious Eye Damage/ Eye Irritation	:	Classified as Category 2A, based the following data: It is concluded that severe eye irritation was caused as it was reported that, in the case of human exposure to this reference material of high concentration, reversible conjunctivitis and chemical burn on cornea surface were observed.
Respiratory Sensitization or Skin Sensitization	:	No data available
Skin sensitization	:	No data available
Germ Cell Mutagenicity	:	No data available
Carcinogenicity	:	Concluded as "No classification," based on the followings: Classified as Group 3 by IARC. Classified as A4 by ACGIH.
Reproductive Toxicity	:	Not classifiable due to insufficient data
Specific Target Organ Toxicity/Systemic Toxicity (Single Exposure)	:	Classified as Classified as Category 1 (Respiratory tract), based on the following data: It was reported that, in the inhalation exposure study using guinea pigs, dogs, rabbits or rats, airway mucosa irritation, increase in airway resistance and loss of airway cilia were observed at concentrations within the range of guidance values for Category 1. Also, in the human inhalation exposure study, it was reported that respiratory functional deterioration such as increase in airway resistance was observed. It was also reported that, in the case of accidental exposure to high concentration, pulmonary edema was observed. Impairment of respiratory tract
Specific Target Organ Toxicity/Systemic	:	Classified as Category 1 (Respiratory tract), based on the following data: It was reported that, in the inhalation exposure study using rats

Toxicity (Repeated Exposure)	and guinea pigs, pneumonia and bronchitis were observed at concentrations within the range of guidance values for Category 1. Impairment of respiratory system due to prolonged or repeated exposure

12. Ecological Information

Hazardous to the aquatic environment, short-term (Acute)	:	Classification not possible due to lack of data
Hazardous to the aquatic environment, long-term (Chronic)	:	Classification not possible due to lack of 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.
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	:	1079
UN Classification	:	Class 2.3
Material name	:	SULPHUR DIOXIDE
Container grade	:	-
ICAO/IATA	:	Class 2.3, Sub-class: v8
Marine pollutant	:	Not applicable
Precautions	:	Follows the provisions of the ship safety law. 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) Toxic gas (General High Pressure Gas Safety regulation Article 2-2)
Industrial	:	Article 57-2 (Enforcement Order: Article 18-2) Hazardous substance

Safety and Health Act		whose name, etc. must be notified , No. 414. Specific chemical substance prevention rule: Article 2-1-6, Specific chemical substance, type 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)
Air Pollution Control Act	:	Hazardous air pollutant (Article 17-1, enforcement order article 10)
Labor Standards Act	:	Disease chemical substance (Article 75-2,Enforcement regulation article 35, Appendix Table 1-2-4, Sulfur Dioxide)

◎ **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.