1. Chemical Product and Company Identification				
Product Name:	Carbon dioxide, re No. P-6227)	frigerated liquid (MSDS	Trade Name:	Not applicable
Chemical Name:	Mixture of carbon	dioxide and impurities	Synonyms:	Not applicable
Formula:	Mixture of CO ₂ , CH ₃ SH, CH ₃ SCH ₃ , CH ₃ CH ₂ S, H ₂ S, C ₆ H ₁₄ , & COS		Chemical Family:	Not applicable
Telephone:	Emergencies: CHEMTREC: Routine:	1-800-645-4633* 1-800-424-9300* 1-800-PRAXAIR	Company Name:	Praxair, Inc. 39 Old Ridgebury Road Danbury, CT 06810-5113

Praxair Material Safety Data Sheet

* Call emergency numbers 24 hours a day only for spills, leaks, fire, exposure, or accidents involving this product. For routine information, contact your supplier, Praxair sales representative, or call 1-800-PRAXAIR (1-800-772-9247).

2. Composition/Information on Ingredients

For custom mixtures of this product, request an MSDS for each component. See section 16 for important information about mixtures.

INGREDIENT	CAS NUMBER	CONCENTRATION	OSHA PEL	ACGIH TLV-TWA
Carbon Dioxide	124-38-9	>99%*	5000 ppm	5000 ppm (See section 3.)
Impurities	See section 3.			
* The symbol	· maana "araatar	then" the symbol . "	loop thop "	

* The symbol > means "greater than"; the symbol <, "less than."

3. Hazards Identification

	EMERGENCY OVERVIEW	
×	DANGER! Toxic, cold liquid and gas under pressure. Harmful if inhaled.	×
	Can cause rapid suffocation.	
	Call cause itosipile.	
	may increase respiration and neart rate.	
	May cause eye, skin, and respiratory tract injury.	
	May cause red blood cell and nervous system damage.	
	May cause dizziness and drowsiness.	
Self-co	ontained breathing apparatus and protective clothing must be wo	rn by
	rescue workers.	
	Odor: Rotten eggs	

THRESHOLD LIMIT VALUE: Carbon dioxide TLV-TWA 5,000 ppm (ACGIH 1998). Short Term Exposure Limit (STEL), 15 min, 30,000 ppm. TLV-TWAs should be used as a guide in the control of health hazards and not as fine lines between safe and dangerous concentrations.

Major impurities in this mixture are listed below:

	CAS			
INGREDIENT	NUMBER	% BY WT	OSHA PEL	ACGIH TLV-TWA
Dimethyl Sulfide	75-18-3	<0.5%	None currently established	None currently established
Propyl Mercaptans	107-03-9	<0.255%	None currently established	None currently established
Methyl Mercaptan	74-93-1	<0.1%	10 ppm ceiling**	0.5 ppm
Ethyl Mercaptan	75-08-1	<0.05%	10 ppm ceiling**	0.5 ppm
Diethyl Sulfide	110-54-3	<0.05%	None currently established	None currently established
Butyl Mercaptans	109-79-5	<0.015%	10 ppm	0.5 ppm
Hydrogen Sulfide	7783-06-4	<0.01%	20 ppm (ceiling)**	10 ppm; 15 ppm, 15-min STEL

463-58-1 <0.0005% None currently established None currently established Carbonyl Sulfide

* The symbol > means "greater than;" the symbol <, "less than."

**Ceiling values are not Time-Weighted Average (TWA)

*** See section 3.

EFFECTS OF A SINGLE (ACUTE) OVEREXPOSURE:

INHALATION–*Carbon Dioxide:* Asphyxiant. Effects are due to lack of oxygen. Carbon dioxide is also physiologically active, affecting circulation and breathing. Moderate concentrations may cause headache, drowsiness, dizziness, stinging of the nose and throat, excitation, rapid breathing and heart rate, excess salivation, vomiting, and unconsciousness. Lack of oxygen can kill. *Impurities:* May irritate the respiratory tract producing headache, dizziness, nausea, and vomiting. Pulmonary edema (fluid in the lungs) may occur; onset may be delayed. In high concentrations, the methyl mercaptan component irritates the mucous membranes and attacks the central nervous system, causing muscular weakness, tremors, unconsciousness, and respiratory paralysis.

SKIN CONTACT–Impurities in vapor may irritate the skin and mucous membranes. Prolonged contact with carbon dioxide crystals (snow) could cause frostbite. Cold gas, or liquid or solid carbon dioxide may cause severe frostbite.

SWALLOWING-An unlikely route of exposure; this product is a gas at normal temperature and pressure. But severe frostbite of the lips and mouth may result from contact with the liquid or solid. Ingestion of impurities may cause irritation, injury, and organ damage that could prove fatal.

EYE CONTACT-Vapor may irritate the eyes. Cold gas, or liquid or solid carbon dioxide may cause severe frostbite. Repeated exposure to low concentrations of the hydrogen sulfide component may cause painful conjunctivitis (inflammation of the soft inner tissues of the eyelids) and corneal injury with vesiculation of the corneal epithelium (blistering of the outer surface of the eyeball).

EFFECTS OF REPEATED (CHRONIC) OVEREXPOSURE: Carbon Dioxide: No harm expected to healthy individuals. Where competent medical authority deems that such illness would be aggravated by exposure to carbon dioxide, persons in ill health should be restricted from working with or handling this product. Impurities: The hydrogen sulfide component may cause permanent eye injury. (See EYE CONTACT.)

OTHER EFFECTS OF OVEREXPOSURE: Damage to retinal or ganglion cells and the central nervous system may occur with overexposure to carbon dioxide.

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: Inhalation of impurities may aggravate asthma and inflammatory or fibrotic pulmonary disease. The skin irritating properties of methyl mercaptan and other impurities may aggravate an existing dermatitis.

SIGNIFICANT LABORATORY DATA WITH POSSIBLE RELEVANCE TO HUMAN HEALTH HAZARD EVALUATION: A single study has shown an increase in heart defects in rats exposed to 6% carbon dioxide in air for 24 hours at different times during gestation. There is no evidence that carbon dioxide is teratogenic in humans.

CARCINOGENICITY: None of the components of this product is listed by NTP, OSHA, or IARC.

4. First Aid Measures

INHALATION: Immediately remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, qualified personnel may give oxygen. Call a physician.

SKIN CONTACT: For exposure to liquid, immediately warm frostbite area with warm water not to exceed $105^{\circ}F$ ($41^{\circ}C$). In case of massive exposure, remove contaminated clothing while showering with warm water. Call a physician.

SWALLOWING: An unlikely route of exposure. This product is a gas at normal temperature and pressure.

EYE CONTACT: Immediately flush eyes thoroughly with warm water for at least 15 minutes. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly. See a physician, preferably an ophthalmologist, immediately.

NOTES TO PHYSICIAN: In normal concentrations, the impurities methyl mercaptan, hydrogen sulfide, and carbonyl sulfide can cause delayed-onset pulmonary edema for up to 72 hours after exposure. Consider keeping victims of overexposure under observation. There is no specific antidote. Treatment of overexposure should be directed at the control of symptoms and the clinical condition of the patient.

5. Fire Fighting Measures			
FLASH POINT (test method): Not applicable	Not applicable		
AUTOIGNITION TEMPERATURE: Not applicable	Not applicable		
FLAMMABLE LIMITS IN AIR, % by volume: Not applicable	LOWER: Not applicable UPPER: Not applicable		

EXTINGUISHING MEDIA: This product cannot catch fire. Use media appropriate for surrounding fire.

SPECIAL FIRE FIGHTING PROCEDURES: DANGER! Toxic, cold liquid and gas under

pressure. Evacuate all personnel from danger area. Immediately spray container with water from maximum distance until cool, taking care not to direct spray onto vents on container. Do not discharge sprays into liquid carbon dioxide. Liquid carbon dioxide will freeze water rapidly. Self-contained breathing

apparatus and protective clothing must be worn by rescue workers. On-site fire brigades must comply with OSHA 29 CFR 1910.156.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Liquid or vapor cannot catch fire. Heat of fire can build pressure in container and cause it to vent excessively or rupture. Toxic vapors may spread from leaking or venting container. No part of a container should be subjected to a temperature higher than 125°F (52°C). Containers are equipped with pressure relief devices.

HAZARDOUS COMBUSTION PRODUCTS: None known.

6. Accidental Release Measures

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED: DANGER! Toxic, cold liquid and gas under pressure. Asphyxiant. Lack of oxygen can kill. Evacuate all personnel from danger area. Self-contained breathing apparatus and protective clothing must be worn by rescue workers. Liquid carbon dioxide will not "spill." Flakes of solid carbon dioxide will form at pressures below 67 psig (461.95 kPa) and fall as snow. Toxic vapors may spread from spill. Shut off leak if you can do so without risk. Ventilate area or move container to a well-ventilated area. Test for sufficient oxygen, especially in confined spaces, before allowing reentry.

WASTE DISPOSAL METHOD: Prevent waste from contaminating the surrounding environment. Keep personnel away. Discard any product, residue, disposable container, or liner in an environmentally acceptable manner, in full compliance with federal, state, and local regulations. If necessary, call your local supplier for assistance.

7. Handling and Storage

PRECAUTIONS TO BE TAKEN IN STORAGE: Store and use with adequate ventilation. Do not store in a confined space. Cryogenic containers are each equipped with a pressure relief device and a pressure controlling valve. Under normal conditions, these containers will periodically vent product. Avoid incompatible materials in systems or piping; some metals such as carbon steel may fracture easily at low temperature. Use adequate pressure relief devices in systems and piping to prevent pressure buildup; entrapped liquid can generate extremely high pressures when vaporized by warming.

PRECAUTIONS TO BE TAKEN IN HANDLING: Never allow any unprotected part of your body to touch uninsulated pipes or vessels containing cryogenic fluids. Flesh will stick to the extremely cold metal and will tear when you try to pull free. For other precautions in using this product, see section 16.

8. Exposure Controls/Personal Protection

VENTILATION/ENGINEERING CONTROLS:

LOCAL EXHAUST – Use a local exhaust ventilation to a well-ventilated area if necessary to control the concentration of carbon dioxide and impurities.

MECHANICAL (general) – Inadequate.

SPECIAL – None

OTHER – None

RESPIRATORY PROTECTION: For concentrations up to 10 times the applicable exposure limit, any NIOSH/MSHA-approved supplied-air respirator is recommended. For up to 50 times the exposure limit, a

NIOSH/MSHA-approved respirator with a full facepiece or a self-contained breathing apparatus is recommended. Respirators must be acceptable to MSHA and NIOSH. Respiratory protection must conform to OSHA rules as specified in 29 CFR 1910.134.

SKIN PROTECTION: Wear insulated neoprene gloves.

EYE PROTECTION: Safety glasses and a full face shield are recommended. Select in accordance with OSHA 29 CFR 1910.133.

OTHER PROTECTIVE EQUIPMENT: Metatarsal shoes for container handling; high-top shoes are preferred. Protective clothing where needed. Cuffless trousers should be worn outside the shoes. Select in accordance with OSHA 29 CFR 1910.132 and 1910.133. Regardless of protective equipment, never touch live electrical parts.

9. Physical and Chemical Proper	rties
SPECIFIC GRAVITY (H ₂ O = 1) at -12.9°F (-24.9°C) and 230 psig (1586 kPa):	1.05
SPECIFIC GRAVITY (Air = 1) at 70°F (21.1°C) and 1 atm:	1.53
SOLUBILITY IN WATER:	0.2101 in ³ /lb (7.59 cm ³ /kg)
PERCENT VOLATILES BY VOLUME:	100
pH:	3.7 at 1 atm (for carbonic acid)
SUBLIMATION TEMPERATURE at 1 atm:	-109.3°F (-78.5°C)

APPEARANCE, ODOR, AND STATE: Colorless liquid and gas. Gas converts to white crystalline particles when discharged from container. Gas has an offensive odor described as that of rotten eggs.

10. Stability and Reactivity				
STABILITY:	Unstable	⊠ Stable		
INCOMPATIBILITY (materials to avoid):	None known.			
HAZARDOUS DECOMPOSITION PRODUCTS:	None known.			
HAZARDOUS POLYMERIZATION:	🗌 May Occur	🛛 Will Not Occur		
CONDITIONS TO AVOID:	None known.			

11. Toxicological Information

Carbon Dioxide. Carbon dioxide is an asphyxiant. It initially stimulates respiration and then causes respiratory depression. High concentrations result in narcosis. Symptoms in humans are as follows:

EFFECT:	CONCENTRATION:
Breathing rate increases slightly	1%
Breathing rate increases to 50% above normal level. Prolonged exposure can cause headache, tiredness.	2%
Breathing increases to twice normal rate and becomes labored. Weak narcotic effect. Impaired hearing, headache, increased blood pressure and pulse rate.	3%
Breathing increases to approximately four times normal rate, symptoms of intoxication become evident, and slight choking may be felt.	4 - 5%
Characteristic sharp odor noticeable. Very labored breathing, headache, visual impairment, and ringing in the ears. Judgment may be impaired, followed within minutes by loss of consciousness.	5 - 10%
Unconsciousness occurs more rapidly above 10% level. Prolonged exposure to high concentrations may eventually result in death from asphyxiation.	50 - 100%

Impurities. Methyl mercaptan, LC ₅₀, inhalation, rat = 675 ppm. Dimethyl sulfide, LC ₅₀, 1 hr, rat = 40,250 ppm; LD₅₀, 1 hr, rat = 535 mg/kg. Ethyl mercaptan, LC ₅₀, 1 hr, rat = 8,840 ppm; LD₅₀, 1 hr, rat = 682 mg/kg. Carbonyl sulfide, LC ₅₀, inhalation, 1 hr, mouse = 1,700 ppm.

12. Ecological Information

This product does not contain any Class I or Class II ozone-depleting chemicals. The methyl mercaptan, ethyl mercaptan, and dimethyl sulfide impurities are listed as marine pollutants by DOT.

13. Disposal Considerations

WASTE DISPOSAL METHOD: See section 6.

14. Transport Information				
DOT/IMO SHIPPING NAME:	Carbon dioxide, refrigerated liquid			
HAZARD CLASS: 2.2	IDENTIFICATION NUMBER:	UN 2187	PRODUCT RQ:	Not applicable
SHIPPING LABEL(s):	NONFLAMMABLE GAS			
PLACARD (when required):	NONFLAMMABLE	GAS		

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position, in a well-ventilated vehicle. Cylinders transported in an enclosed, nonventilated compartment of a vehicle can present serious safety hazards.

Shipment of compressed gas cylinders that have been filled without the owner's consent is a violation of federal law [49 CFR 173.301(b)].

15. Regulatory Information

The following selected regulatory requirements may apply to this product. Not all such requirements are identified. Users of this product are solely responsible for compliance with all applicable federal, state, and local regulations.

U.S. FEDERAL REGULATIONS:

EPA (ENVIRONMENTAL PROTECTION AGENCY)

CERCLA: COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT OF 1980 (40 CFR Parts 117 and 302):

Reportable Quantity (RQ): Methyl mercaptan and hydrogen sulfide impurities, 100 lbs (45.4 kg); carbonyl sulfide impurity, 1 lb (0.454 kg).

SARA: SUPERFUND AMENDMENT AND REAUTHORIZATION ACT:

SECTIONS 302/304: Require emergency planning based on Threshold Planning Quantity (TPQ) and release reporting based on Reportable Quantities (RQ) of extremely hazardous substances (40 CFR Part 355):

Threshold Planning Quantity (TPQ): 500 lbs (227 kg), methyl mercaptan, hydrogen sulfide.

Extremely Hazardous Substances (40 CFR 355): None

SECTIONS 311/312: Require submission of MSDSs and chemical inventory reporting with identification of EPA hazard categories. The hazard categories for this product are as follows:

IMMEDIATE: Yes	PRESSURE: Yes
DELAYED: Yes	REACTIVITY: No
	FIRE: No

SECTION 313: Requires submission of annual reports of release of toxic chemicals that appear in 40 CFR Part 372.

This product requires reporting under Section 313 because of the methyl mercaptan, hydrogen sulfide, and carbonyl sulfide impurities.

40 CFR 68: RISK MANAGEMENT PROGRAM FOR CHEMICAL ACCIDENTAL

RELEASE PREVENTION: Requires development and implementation of risk management programs at facilities that manufacture, use, store, or otherwise handle regulated substances in quantities that exceed specified thresholds.

Carbonyl sulfide and hydrogen sulfide are listed as regulated substances in quantities of 10,000 lbs (4536 kg) or greater.

TSCA: TOXIC SUBSTANCES CONTROL ACT: The components of his product are listed on the TSCA inventory.

OSHA: OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:

29 CFR 1910.119: PROCESS SAFETY MANAGEMENT OF HIGHLY HAZARDOUS

CHEMICALS: Requires facilities to develop a process safety management program based on Threshold Quantities (TQ) of highly hazardous chemicals.

Impurities in this product are listed in Appendix A as highly hazardous chemicals: Methyl mercaptan, 5,000 lbs (2270 kg); hydrogen sulfide, 1,500 lbs (681 kg).

STATE REGULATIONS:

CALIFORNIA: None of the components of this product is listed by California under the SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT OF 1986 (Proposition 65).

PENNSYLVANIA: This product is subject to the PENNSYLVANIA WORKER AND COMMUNITY RIGHT-TO-KNOW ACT (35 P.S. Sections 7301-7320).

16. Other Information

Be sure to read and understand all labels and instructions supplied with all containers of this product.

OTHER HAZARDOUS CONDITIONS OF HANDLING, STORAGE, AND USE: *Toxic, cold liquid and gas under pressure.* Harmful if inhaled. Contact may cause frostbite. Do not breathe gas. Use only with adequate ventilation or respiratory protection. (See section 8.) Do not get liquid or vapor in eyes, on skin, or on clothing. (See section 3.) Use piping and equipment adequately designed to withstand pressures to be encountered. Avoid materials incompatible with cryogenic use; some metals such as carbon steel may fracture easily at low temperature. *Gas can cause rapid suffocation due to oxygen deficiency*. Store and use with adequate ventilation. Carbon dioxide is heavier than air. It tends to accumulate near the floor of an enclosed space, displacing air and pushing it upward. This creates an oxygen-deficient atmosphere near the floor. Ventilate space before entry. Verify sufficient oxygen concentration. Close cylinder valve after each use; keep closed even when empty. *Prevent reverse flow*. Reverse flow into container may cause rupture. Use a check valve or other protective device in any line or piping from the cylinder. *Never work on a pressurized system*. If there is a leak, close applicable valves. Blow the system down in a safe and environmentally sound manner in compliance with all federal, state, and local laws; then repair the leak.

MIXTURES: When you mix two or more gases or liquefied gases, you can create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an industrial hygienist or other trained person when you evaluate the end product. Remember, gases and liquids have properties that can cause serious injury or death.

HAZARD RATING SYSTEMS:

NFPA RATINGS:		HMIS RATINGS:	
HEALTH	= 3	HEALTH	= 3
FLAMMABILITY	= 0	FLAMMABILITY	= 0
REACTIVITY	= 0	REACTIVITY	= 0
SPECIAL	= None		

Ask your supplier about free Praxair safety literature as referred to in this MSDS and on the label for this product. Further information about this product can be found in the following pamphlets published by the

Product: Sour Carbon Dioxide (Liquid)

Compressed Gas Association, Inc. (CGA), 1725 Jefferson Davis Highway, Arlington, VA 22202-4102, Telephone (703) 412-0900.

AV-1	Safe Handling and Storage of Compressed Gases
G-6	Carbon Dioxide
G-6.1	Standard for Low Pressure Carbon Dioxide Systems at Customer Sites
G-6.2	Commodity Specification for Carbon Dioxide
P-1	Safe Handling of Compressed Gases in Containers
P-14	Accident Prevention in Oxygen-Rich, Oxygen-Deficient Atmospheres
SB-2	Oxygen-Deficient Atmospheres
V-1	Compressed Gas Cylinder Valve Inlet and Outlet Connections
V-7	Standard Method of Determining Cylinder Valve Outlet Connections for Industrial Gas
	Mixtures
	Handbook of Compressed Gases, Third Edition

Praxair asks users of this product to study this MSDS and become aware of product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this MSDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.

The opinions expressed herein are those of qualified experts within Praxair, Inc. We believe that the information contained herein is current as of the date of this Material Safety Data Sheet. Since the use of this information and the conditions of use of the product are not within the control of Praxair, Inc., it is the user's obligation to determine the conditions of safe use of the product.

Praxair MSDSs are furnished on sale or delivery by Praxair or the independent distributors and suppliers who package and sell our products. To obtain current Praxair MSDSs for these products, contact your Praxair sales representative or local distributor or supplier. If you have questions regarding Praxair MSDSs, would like the form number and date of the latest MSDS, or would like the names of the Praxair suppliers in your area, phone or write the Praxair Call Center (**Phone:** 1-800-PRAXAIR; **Address:** Praxair Call Center, Praxair, Inc., PO Box 44, Tonawanda, NY 14150-7891).

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