



BROMINE

Material Safety Data Sheet

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name BROMINE

Product Code(s) 1003

UN-Number UN1744

Recommended Use Compressed gas.

Supplier Address* Linde Gas North America LLC - Linde Merchant Production Inc. - Linde LLC
575 Mountain Ave.
Murray Hill, NJ 07974
Phone: 908-464-8100
www.lindeus.com

Linde Gas Puerto Rico, Inc.
Las Palmas Village
Road No. 869, Street No. 7
Catano, Puerto Rico 00962
Phone: 787-641-7445
www.pr.lindegas.com

Linde Canada Limited
5860 Chedworth Way
Mississauga, Ontario L5R 0A2
Phone: 905-501-1700
www.lindecana.com

* May include subsidiaries or affiliate companies/divisions.

For additional product information contact your local customer service.

Chemical Emergency Phone Number Chemtrec: 1-800-424-9300 for US/ 703-527-3887 outside US

2. HAZARDS IDENTIFICATION

DANGER!

Emergency Overview

Fatal if inhaled
Corrosive
Accelerates combustion and increases risk of fire
The product causes burns of eyes, skin and mucous membranes
Keep at temperatures below 52°C / 125°F

Appearance Reddish-brown in air

Physical State Liquid.

Odor Pungent

OSHA Regulatory Status

This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Potential Health Effects

Principle Routes of Exposure	Eye contact. Skin contact. Inhalation.
Acute Toxicity	
Inhalation	Fatal if inhaled. Inhalation of corrosive fumes/gases may cause coughing, choking, headache, dizziness, and weakness for several hours. Pulmonary edema may occur with tightness in the chest, shortness of breath, bluish skin, decreased blood pressure, and increased heart rate. Chemical pneumonitis and pulmonary edema result from exposure to the lower respiratory tract and deep lung. Residual pulmonary malfunction might occur.
Eyes	Corrosive to the eyes and may cause irreversible eye damage.
Skin	Contact with liquid causes severe corrosive action.
Skin Absorption Hazard	No known hazard in contact with skin.
Ingestion	Not an expected route of exposure. Ingestion causes burns of the upper digestive and respiratory tract.
Chronic Effects	Chronic exposure to corrosive fumes/gases may cause erosion of the teeth followed by jaw necrosis. Bronchial irritation with chronic cough and frequent attacks of pneumonia are common. Gastrointestinal disturbances may also be seen
Aggravated Medical Conditions	Skin disorders. Pre-existing eye disorders. Respiratory disorders.
Environmental Hazard	Very toxic to aquatic organisms. See Section 12 for additional Ecological Information.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS-No	Volume %	Chemical Formula
Bromine	7726-95-6	>99	Br ₂

4. FIRST AID MEASURES

General Advice	Immediate medical attention is required. Show this safety data sheet to the doctor in attendance.
Eye Contact	Immediate medical attention is required. In case of contact with substance, immediately flush eyes with running water for at least 30 minutes. Keep eye wide open while rinsing.
Skin Contact	Immediate medical attention is required. Wash off immediately with soap and plenty of water for at least 30 minutes while removing all contaminated clothing and shoes.
Inhalation	PROMPT MEDICAL ATTENTION IS MANDATORY IN ALL CASES OF INHALATION OVEREXPOSURE. RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS. Conscious inhalation victims should be assisted to an uncontaminated area and inhale fresh air. If breathing is difficult, administer oxygen. Unconscious persons should be moved to an uncontaminated area and, as necessary, given artificial resuscitation and supplemental oxygen. Treatment should be symptomatic and supportive.
Ingestion	None under normal use. Immediate medical attention is required. Do NOT induce vomiting. Never give anything by mouth to an unconscious person.
Notes to Physician	Product is a corrosive material. Use of gastric lavage or emesis is contraindicated. Possible perforation of stomach or esophagus should be investigated. Do not give chemical antidotes. Asphyxia from glottal edema may occur. Marked decrease in blood pressure may occur with moist rales, frothy sputum, and high pulse pressure. Treat symptomatically.

Protection of First-aiders	Use personal protective equipment. Avoid contact with skin, eyes and clothing.
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5. FIRE-FIGHTING MEASURES

Flammable Properties	Oxidizer. May vigorously accelerate combustion.
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Suitable Extinguishing Media	Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
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Explosion Data

Sensitivity to Mechanical Impact	None
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Sensitivity to Static Discharge	None
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Specific Hazards Arising from the Chemical	Will support and accelerate combustion of combustible materials (wood, paper, oil, debris, etc). Continue to cool fire exposed cylinders until flames are extinguished. Cylinders may rupture under extreme heat. Damaged cylinders should be handled only by specialists.
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Protective Equipment and Precautions for Firefighters	As in any fire, wear self-contained breathing apparatus and full protective gear. Corrosive hazard. Wear protective gloves/clothing and eye/face protection.
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6. ACCIDENTAL RELEASE MEASURES

Personal Precautions	Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Ensure adequate ventilation. Do not touch or walk through spilled material. Use personal protective equipment. Avoid contact with skin, eyes and clothing.
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Environmental Precautions	Prevent further leakage or spillage if safe to do so. Prevent spreading of vapors through sewers, ventilation systems and confined areas. Do not allow material to contaminate ground water system. Prevent product from entering drains. Should not be released into the environment.
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Methods for Containment	Stop the flow of gas or remove cylinder to outdoor location if this can be done without risk. If leak is in container or container valve, contact the appropriate emergency telephone number in Section 1 or call your closest Linde location.
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Methods for Cleaning Up	Return cylinder to Linde or an authorized distributor.
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Other Information	Refer to protective measures listed in Sections 7 and 8.
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7. HANDLING AND STORAGE

Handling	Use only in ventilated areas. Do not breathe gas. Avoid contact with skin, eyes and clothing. Never attempt to lift a cylinder by its valve protection cap. Protect cylinders from physical damage; do not drag, roll, slide or drop. When moving cylinders, even for short distance, use a cart designed to transport cylinders. Use equipment rated for cylinder pressure. Use backflow preventive device in piping. Never insert an object (e.g. wrench, screwdriver, pry bar, etc.) into valve cap openings. Doing so may damage valve, causing leak to occur.
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Use an adjustable strap wrench to remove over-tight or rusted caps. Close valve after each use and when empty. If user experiences any difficulty operating cylinder valve discontinue use and contact supplier.

Never put cylinders into trunks of cars or unventilated areas of passenger vehicles. Never attempt to refill a compressed gas cylinder without the owner's written consent. Never strike an arc on a compressed gas cylinder or make a cylinder a part of an electrical circuit.

Storage

Bromine should be stored in a cool, dry place away from excessive heat. Keep away from heat and direct sunlight. Container should remain closed while in storage. Storage in a chemical-only refrigerator is recommended.

Protect from physical damage. Cylinders should be stored upright with valve protection cap in place and firmly secured to prevent falling. Store in cool, dry, well-ventilated area of non-combustible construction away from heavily trafficked areas and emergency exits. Keep at temperatures below 52°C / 125°F. Full and empty cylinders should be segregated. Use a "first in-first out" inventory system to prevent full cylinders from being stored for excessive periods of time. Always store and handle compressed gas cylinders in accordance with Compressed Gas Association, pamphlet CGA-P1, Safe Handling of Compressed Gases in Containers.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Exposure Guidelines

Chemical Name	ACGIH TLV	OSHA PEL	NIOSH IDLH
Bromine 7726-95-6	STEL: 0.2 ppm TWA: 0.1 ppm	TWA: 0.1 ppm TWA: 0.7 mg/m ³ (vacated) STEL: 0.3 ppm (vacated) STEL: 2 mg/m ³	IDLH: 3 ppm TWA: 0.1 ppm TWA: 0.7 mg/m ³ STEL: 0.3 ppm STEL: 2 mg/m ³

Immediately Dangerous to Life or Health.

Other Exposure Guidelines

Vacated limits revoked by the Court of Appeals decision in AFL-CIO v. OSHA, 965 F.2d 962 (11th Cir., 1992).

Engineering Measures

Showers. Eyewash stations. Ventilation systems. Exhaust gas should be vented to a gas treatment system.

Ventilation

Use ventilation adequate to keep exposures below recommended exposure limits.

Personal Protective Equipment

Eye/Face Protection

Tightly fitting safety goggles. Face-shield.

Skin and Body Protection

Appropriate protective and chemical resistant gloves, clothing and splash protection, or fully encapsulating vapor protective clothing to prevent exposure. For materials of construction consult protective clothing manufacturer's specifications.

Respiratory Protection

General Use

If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn. Positive-pressure supplied air respirators may be required for high airborne contaminant concentrations. Respiratory protection must be provided in accordance with current local regulations.

Emergency Use

Use positive pressure air line respirator or self-contained breathing apparatus for exposure over exposure limits or emergency use. For exposures above IDLH, an additional escape bottle is required.

Hygiene Measures

When using, do not eat, drink or smoke. Remove and wash contaminated clothing before re-use. Keep away from food, drink and animal feeding stuffs. Provide regular cleaning of equipment, work area and clothing. Avoid contact with skin, eyes and clothing. Wear suitable gloves and eye/face protection.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Reddish-brown in air.	Odor	Pungent.
Odor Threshold	0.01-0.46 ppm	Physical State	Liquid
Flash Point	Not applicable.	Autoignition Temperature	No information available.
Decomposition Temperature	No information available.	Boiling Point/Boiling Range	59.5 °C / 139.1 °F
Freezing Point	-7.25 °C / 18.95 °F	Molecular Weight	159.82
Water Solubility	Reacts with water	Evaporation Rate	No information available
Vapor Pressure	671 mmHg @ 55°C	Vapor Density	7.14 (air = 1)
VOC Content (%)	Not applicable.	Flammability Limits in Air	
		Upper	Not applicable
		Lower	Not applicable

10. STABILITY AND REACTIVITY

Stability	Stable under recommended storage conditions.
Incompatible Products	Alkalis. Organic material. Reducing agents.
Conditions to Avoid	Keep away from direct sunlight.
Hazardous Decomposition Products	Halogenated compounds.
Hazardous Polymerization	Hazardous polymerization does not occur.

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

LD50 Oral:
2600 mg/kg

LD50 Dermal: No information available.

LC50 Inhalation: No information available.

Inhalation Aproximately 50% of mice exposed to bromine at 240 ppm for 2 hr died within 30 days after the exposure. At 750 ppm, a 7-min exposure of mice was lethal to approximately 40% within 30 days after the exposure.

Repeated Dose Toxicity No information available.

Chronic Toxicity

Chronic Toxicity Chronic exposure to corrosive fumes/gases may cause erosion of the teeth followed by jaw necrosis. Bronchial irritation with chronic cough and frequent attacks of pneumonia are common. Gastrointestinal disturbances may also be seen.

Carcinogenicity Contains no ingredient listed as a carcinogen.

Irritation No information available.

Sensitization	No information available.
Reproductive Toxicity	No information available.
Developmental Toxicity	No information available.
Synergistic Materials	None known.
Target Organ Effects	Eyes. Respiratory system. Skin.

12. ECOLOGICAL INFORMATION

Ecotoxicity

Harmful to aquatic organisms. Very toxic to aquatic organisms.

Ozone depletion potential; ODP; (R-11 = 1): Does not contain ozone depleting chemical (40 CFR Part 82).

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods	Do not attempt to dispose of residual waste or unused quantities. Return in the shipping container PROPERLY LABELED WITH ANY VALVE OUTLET PLUGS OR CAPS SECURED AND VALVE PROTECTION CAP IN PLACE to Linde for proper disposal.
Contaminated Packaging	Do not re-use empty containers.

14. TRANSPORT INFORMATION

DOT

Proper shipping name	Bromine
Hazard Class	8
Subsidiary Class	6.1
UN-Number	UN1744
Packing Group	I
Description	UN1744,Bromine,8,(6.1),PG I,Marine Pollutant
Emergency Response Guide Number	154

TDG

Proper Shipping Name	Bromine
Hazard Class	8
Subsidiary Class	(6.1)
UN-Number	UN1744
Packing Group	I
Description	UN1744,BROMINE,8(6.1),PG I,Marine Pollutant

MEX

Proper Shipping Name	Bromine
Hazard Class	8
Subsidiary Class	6.1
UN-Number	UN1744
Description	UN1744 Bromine,8(6.1),I

Packing Group I

IATA

UN-Number UN1744
 Proper Shipping Name Bromine
 Hazard Class 8
 Subsidiary Class 6.1
 ERG Code 8P
 Description UN1744,Bromine,8(6.1)
 Maximum Quantity for Passenger Forbidden
 Maximum Quantity for Cargo Only Forbidden
 Limited Quantity No information available.

IMDG/IMO

Proper Shipping Name Bromine
 Hazard Class 8
 Subsidiary Class 6.1
 UN-Number UN1744
 Packing Group I
 EmS No. F-A, S-B
 Description UN1744, Bromine,8(6.1),PG I,Marine Pollutant

ADR

Proper Shipping Name Bromine
 Hazard Class 8
 UN-Number UN1744
 Packing Group I
 Classification Code CT1
 Description UN1744 Bromine,8(6.1),I
 ADR/RID-Labels 6.1

15. REGULATORY INFORMATION

International Inventories

TSCA	Complies
DSL	Complies
EINECS/ELINCS	Complies

Legend

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
 DSL/NDL - Canadian Domestic Substances List/Non-Domestic Substances List
 EINECS/ELINCS - European Inventory of Existing Commercial Chemical Substances/EU List of Notified Chemical Substances

U.S. Federal Regulations

SARA 313

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product contains a chemical or chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372:

Chemical Name	CAS-No	SARA 313 - Threshold Values %
Bromine	7726-95-6	1.0

SARA 311/312 Hazard Categories

Acute Health Hazard	Yes
Chronic Health Hazard	Yes
Fire Hazard	Yes
Sudden Release of Pressure Hazard	Yes
Reactive Hazard	No

Clean Water Act

This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42).

Risk and Process Safety Management Programs

This material, as supplied, contains one or more regulated substances with specified thresholds under 40 CFR Part 68 or regulated as a highly hazardous chemical pursuant to the 29 CFR Part 1910.110 with specified thresholds:

Chemical Name	U.S. - CAA (Clean Air Act) - Accidental Release Prevention - Toxic Substances	U.S. - CAA (Clean Air Act) - Accidental Release Prevention - Flammable Substances	U.S. - OSHA - Process Safety Management - Highly Hazardous Chemicals
Bromine	10000 lbs		1500 lb

Clean Air Act, Section 112 Hazardous Air Pollutants (HAPS) (see 40 CFR 61)

This product does not contain any substances regulated as hazardous air pollutants (HAPS) under Section 112 of the Clean Air Act Amendments of 1990.

CERCLA/SARA

This material, as supplied, contains one or more substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355):

Chemical Name	Hazardous Substances RQs	Extremely Hazardous Substances RQs	TPQ
Bromine		500 lb	500 lb TPQ

U.S. State RegulationsCalifornia Proposition 65

This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

Chemical Name	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Bromine	X	X	X		X

International Regulations

Chemical Name	Carcinogen Status	Exposure Limits
Bromine		Mexico: TWA 0.1 ppm Mexico: TWA 0.7 mg/m ³ Mexico: STEL 0.3 ppm Mexico: STEL 2 mg/m ³

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Hazard Class
A Compressed gases
E Corrosive material
D1A Very toxic materials



Chemical Name	NPRI
Bromine	X

Legend

NPRI - National Pollutant Release Inventory

Prepared By Product Stewardship
 23 British American Blvd.
 Latham, NY 12110
 1-800-572-6501

Issuing Date 14-Feb-2011

Revision Date 27-Sep-2013

Revision Number 1

Revision Note Not applicable.

<u>NFPA</u>	Health Hazard 3	Flammability 0	Stability 0	Physical and Chemical Hazards OX
<u>HMIS</u>	Health Hazard 3	Flammability 0	Physical Hazard 1	Personal Protection -

Note: Ratings were assigned in accordance with Compressed Gas Association (CGA) guidelines as published in CGA Pamphlet P-19-2009, CGA Recommended Hazard Ratings for Compressed Gases, 3rd Edition.

General Disclaimer

For terms and conditions, including limitation of liability, please refer to the purchase agreement in effect between Linde LLC, Linde Merchant Production, Inc. or Linde Gas North America LLC (or any of their affiliates and subsidiaries) and the purchaser.

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End of Safety Data Sheet