BROMINE

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME
BROMINE

OTHER NAMES

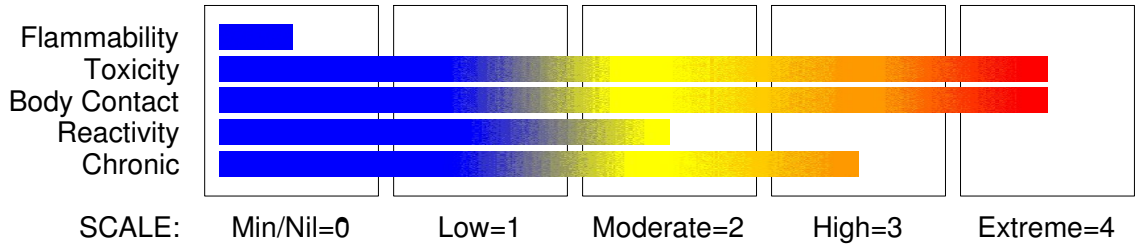
Br2, Br

PROPER SHIPPING NAME
BROMINE
BROMINE SOLUTION
BROMINE or BROMINE SOLUTION

PRODUCT USE
DANGEROUS POISON.
Used in making fumigants, flameproofing agents, water purification compounds, dyes, medicinals, sanitisers, inorganic bromides for photography, and organic bromides such as ethylene dibromide.

SUPPLIER
Company: S D FINE- CHEM LIMITED
Address:
315- 317, T.V. INDUSTRIAL ESTATE,
248, WORLI,
MUMBAI- 400030.INDIA.
technical@sdfine.com
Telephone: 91- 22- 24959898
Telephone: 91- 22- 24959899
Fax: 91- 22- 24937232

HAZARD RATINGS



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Section 2 - HAZARDS IDENTIFICATION

GHS Classification

Acute Aquatic Hazard Category 1
Acute Toxicity (Inhalation) Category 1
Acute Toxicity (Oral) Category 3
Metal Corrosion Category 1
Reproductive Toxicity Category 1B
Skin Corrosion/Irritation Category 1A

EMERGENCY OVERVIEW

HAZARD

DANGER
Determined by using GHS criteria:
H330 H301 H360 H290 H314 H400
Fatal if inhaled
Toxic if swallowed
May damage the unborn child
May be corrosive to metals
Causes severe skin burns and eye damage
Very toxic to aquatic life

PRECAUTIONARY STATEMENTS

Prevention

Wear respiratory protection.
Wear protective gloves/clothing and eye/face protection.
Do not breathe dust/fume/gas/mist/vapours/spray.
Use only outdoors or in a well ventilated area.
Wash thoroughly after handling.
Do not handle until all safety precautions have been read and understood.
Use personal protective equipment as required.
Do not breathe dust or mist.
Obtain special instructions before use.
Wash hands thoroughly after handling.
Do not eat, drink or smoke when using this product.

Response

Absorb spillage to prevent material damage.
Keep container tightly closed.
IF INHALED: Remove to fresh air and keep at rest in a position comfortable for breathing.
IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.

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If exposed or concerned: Get medical attention advice.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
If on skin or hair: remove/take off immediately all contaminated clothing. Rinse with water/shower.
Wash contaminated clothing before reuse.
Immediately call a POISON CENTER or doctor/physician.
Specific treatment: refer to Label or MSDS.
IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician.

Storage

Store locked up.
Store in a corrosive resistant container with a resistant inliner.

Disposal

Dispose of contents and container in accordance with relevant legislation.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
bromine	7726-95-6	> 98

Section 4 - FIRST AID MEASURES

SWALLOWED

· For advice, contact a Poisons Information Centre or a doctor at once.
· Urgent hospital treatment is likely to be needed.
· If swallowed do NOT induce vomiting.
· If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration.
· Observe the patient carefully.
· Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious.
· Give water to rinse out mouth, then provide liquid slowly and as much as casualty can comfortably drink.
· Transport to hospital or doctor without delay.

EYE

If this product comes in contact with the eyes:
· Immediately hold eyelids apart and flush the eye continuously with running water.
· Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
· Continue flushing until advised to stop by the Poisons Information Centre or a doctor, or for at least 15 minutes.
· Transport to hospital or doctor without delay.
· Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

SKIN

If skin or hair contact occurs:
· Immediately flush body and clothes with large amounts of water, using safety shower if

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available.
· Quickly remove all contaminated clothing, including footwear.
· Wash skin and hair with running water. Continue flushing with water until advised to stop by the Poisons Information Centre.
· Transport to hospital, or doctor.

INHALED

· If fumes or combustion products are inhaled remove from contaminated area.
· Lay patient down. Keep warm and rested.
· Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures.
· Apply artificial respiration if not breathing, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary.
· Transport to hospital, or doctor, without delay.

NOTES TO PHYSICIAN

Treat symptomatically.
Bromine is poisonous.
For the treatment of bromine burns:
bromine should be removed from the skin as soon as possible with aqueous sodium bicarbonate.
Blood bromine is not a good indicator of toxicity and should not be measured.
Inhalation Management:
Maintain a clear airway; give humidified 100% oxygen and ventilate if necessary.
If respiratory irritation occurs assess respiratory function and if necessary perform chest X-rays to check for chemical pneumonitis.
Consider the use of steroids to reduce inflammatory response.
Treat pulmonary oedema with PEEP or CPAP ventilation.
Dermal Management:
Remove contaminated clothing, place in double sealed, clear bags and label; store in a secure area away from patients and staff.
Irrigate with copious amounts of water.
Skin burns should be treated symptomatically.
Eye Management:
Irrigate thoroughly with running water or saline for 15 minutes.
Stain with fluorescein and refer to an opthamologist if there is uptake of stain.
Oral Management:
NO GASTRIC LAVAGE OR EMETIC.
Encourage oral fluids, unless perforation is suspected.
Consider plasma extenders/ blood or IV fluids for shock or analgesics for pain.
Consider the use of steroids to reduce the inflammatory response.
Take abdominal X-rays to check for perforation.
If facilities are available, early gastro-oesophagoscopy should be undertaken within 12-24 hours of the event to assess the extent and severity of the injury.

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Section 5 - FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA
· Water spray or fog.
· Foam.
· Dry chemical powder.
· BCF (where regulations permit).
· Carbon dioxide.

FIRE FIGHTING
· Alert Fire Brigade and tell them location and nature of hazard.
· Wear full body protective clothing with breathing apparatus.
· Prevent, by any means available, spillage from entering drains or water course.
· Use fire fighting procedures suitable for surrounding area.
· Do not approach containers suspected to be hot.
· Cool fire exposed containers with water spray from a protected location.
· If safe to do so, remove containers from path of fire.
· Equipment should be thoroughly decontaminated after use.

FIRE/EXPLOSION HAZARD
· Will not burn but increases intensity of fire.
· Heating may cause expansion or decomposition leading to violent rupture of containers.
· Heat affected containers remain hazardous.
· Contact with combustibles such as wood, paper, oil or finely divided metal may produce spontaneous combustion or violent decomposition.
· May emit irritating, poisonous or corrosive fumes.
Decomposition may produce toxic fumes of: hydrogen bromide.
Contains low boiling substance: Closed containers may rupture due to pressure buildup under fire conditions.
May emit corrosive fumes.

FIRE INCOMPATIBILITY
None known.

Personal Protective Equipment
Breathing apparatus.
Gas tight chemical resistant suit.
Limit exposure duration to 1 BA set 30 mins.

Section 6 - ACCIDENTAL RELEASE MEASURES

EMERGENCY PROCEDURES

MINOR SPILLS
· Clean up all spills immediately.
· Avoid breathing vapours and contact with skin and eyes.
· Control personal contact by using protective equipment.
· Contain and absorb spill with sand, earth, inert material or vermiculite.
· Wipe up.
· Place in a suitable labelled container for waste disposal.
Refer to major spills.

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MAJOR SPILLS

· Clear area of personnel and move upwind.
· Alert Fire Brigade and tell them location and nature of hazard.
· Wear full body protective clothing with breathing apparatus.
· Prevent, by any means available, spillage from entering drains or water course.
· Consider evacuation (or protect in place).
· Stop leak if safe to do so.
· Contain spill with sand, earth or vermiculite.
· Collect recoverable product into labelled containers for recycling.
· Neutralise/decontaminate residue.
· Collect solid residues and seal in labelled drums for disposal.
· Wash area and prevent runoff into drains.
· After clean up operations, decontaminate and launder all protective clothing and equipment before storing and re-using.
· If contamination of drains or waterways occurs, advise emergency services.
Chemical Class:acidic compounds, inorganic

For release onto land: recommended sorbents listed in order of priority.

SORBENT TYPE	RANK	APPLICATION	COLLECTION	LIMITATIONS
LAND SPILL - SMALL				
foamed glass - pillows	1	throw	pitchfork	R, P, DGC, RT
expanded mineral - particulate	2	shovel	shovel	R, I, W, P, DGC
foamed glass - particulate	2	shovel	shovel	R, W, P, DGC
LAND SPILL - MEDIUM				
expanded mineral - particulate	1	blower	skiploader	R, I, W, P, DGC
foamed glass- particulate	2	blower	skiploader	R, W, P, DGC
foamed glass - particulate	3	throw	skiploader	R, W, P, DGC

Legend
DGC: Not effective where ground cover is dense
R; Not reusable
I: Not incinerable
P: Effectiveness reduced when rainy
RT:Not effective where terrain is rugged
SS: Not for use within environmentally sensitive sites
W: Effectiveness reduced when windy

Reference: Sorbents for Liquid Hazardous Substance Cleanup and Control;
R.W Melvold et al: Pollution Technology Review No. 150: Noyes Data Corporation 1988.
Environmental hazard - contain spillage.

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Cover spill with a reducer, i.e. thiosulfate, in solution. Allow time for reaction. Beware of heat of reaction.
Use soda ash or dilute acid to neutralise spill.
Collect and seal in drums for disposal.
Wash spill area with detergent and water.

EMERGENCY RESPONSE PLANNING GUIDELINES (ERPG)

The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour WITHOUT experiencing or developing

life-threatening health effects is:
bromine 5 ppm

irreversible or other serious effects or symptoms which could impair an individual's ability to take protective action is:
bromine 0.5 ppm

other than mild, transient adverse effects without perceiving a clearly defined odour is:
bromine 0.1 ppm

The threshold concentration below which most people will experience no appreciable risk of health effects:
bromine 0.1 ppm

American Industrial Hygiene Association (AIHA)

Ingredients considered according to the following cutoffs

Very Toxic (T+)	>= 0.1%	Toxic (T)	>= 3.0%
R50	>= 0.25%	Corrosive (C)	>= 5.0%
R51	>= 2.5%		

else >= 10%

where percentage is percentage of ingredient found in the mixture

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SAFE STORAGE WITH OTHER CLASSIFIED CHEMICALS

X	X	+	X	X	+

+: May be stored together
O: May be stored together with specific preventions
X: Must not be stored together

Personal Protective Equipment advice is contained in Section 8 of the MSDS.

Section 7 - HANDLING AND STORAGE

PROCEDURE FOR HANDLING

DO NOT allow clothing wet with material to stay in contact with skin.
- Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of exposure occurs.
- Use in a well-ventilated area.

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· WARNING: To avoid violent reaction, ALWAYS add material to water and NEVER water to material.
· Avoid smoking, naked lights or ignition sources.
· Avoid contact with incompatible materials.
· When handling, DO NOT eat, drink or smoke.
· Keep containers securely sealed when not in use.
· Avoid physical damage to containers.
· Always wash hands with soap and water after handling.
· Work clothes should be laundered separately. Launder contaminated clothing before re -use.
· Use good occupational work practice.
· Observe manufacturer's storing and handling recommendations.
· Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
Contains low boiling substance:
Storage in sealed containers may result in pressure buildup causing violent rupture of containers not rated appropriately.
· Check for bulging containers.
· Vent periodically
· Always release caps or seals slowly to ensure slow dissipation of vapours.

SUITABLE CONTAINER

DO NOT use aluminium or galvanised containers.
· Lined metal can, lined metal pail/ can.
· Plastic pail.
· Polyliner drum.
· Packing as recommended by manufacturer.
· Check all containers are clearly labelled and free from leaks.
Glass bottle.
Ampoule.
Cylinder.
Lead-lined steel drums.
Check that containers are clearly labelled.
DO NOT use aluminium, galvanised, tin-plated or unlined steel containers.

STORAGE INCOMPATIBILITY

Avoid strong bases.
Avoid any contamination of this material as it is very reactive and any contamination is potentially hazardous.
· Inorganic acids are generally soluble in water with the release of hydrogen ions. The resulting solutions have pH's of less than 7.0.
· Inorganic acids neutralise chemical bases (for example: amines and inorganic hydroxides) to form salts.
· Neutralisation can generate dangerously large amounts of heat in small spaces.
· The dissolution of inorganic acids in water or the dilution of their concentrated solutions with additional water may generate significant heat.
· The addition of water to inorganic acids often generates sufficient heat in the small region of mixing to cause some of the water to boil explosively. The resulting "bumping" can spatter the acid.
· Inorganic acids react with active metals, including such structural metals as aluminum and iron, to release hydrogen, a flammable gas.
· Inorganic acids can initiate the polymerisation of certain classes of organic compounds.
· Inorganic acids react with cyanide compounds to release gaseous hydrogen cyanide.

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· Inorganic acids generate flammable and/or toxic gases in contact with dithiocarbamates, isocyanates, mercaptans, nitrides, nitriles, sulfides, and strong reducing agents.
Additional gas-generating reactions occur with sulfites, nitrites, thiosulfates (to give H2S and SO3), dithionites (SO2), and even carbonates.
· Acids often catalyse (increase the rate of) chemical reactions.
Dangerous goods of other classes.
Avoid storage with reducing agents.
Segregate from common metals such as steel, stainless steel, galvanised iron, copper and copper alloys, aluminium.

STORAGE REQUIREMENTS

· Store in original containers.
· Keep containers securely sealed.
· Store in a cool, dry, well-ventilated area.
· Store away from incompatible materials and foodstuff containers.
· Protect containers against physical damage and check regularly for leaks.
· Observe manufacturer's storing and handling recommendations.
Store away from reducing agents, organic materials, alkali metals, aluminium, finely powdered metals.
Store above -5 deg. C. in a cool area.
DO NOT use aluminium, galvanised, tin-plated or unlined steel containers.
DO NOT store in pits, depressions, basements or areas where vapours may be trapped.

Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS

The following materials had no OELs on our records

• bromine: CAS:7726- 95- 6 CAS:23724- 81- 4

EMERGENCY EXPOSURE LIMITS

Material	Revised IDLH Value (mg/m3)	Revised IDLH Value (ppm)
bromine		3

ODOUR SAFETY FACTOR (OSF)

OSF=2 (BROMINE)
Exposed individuals are NOT reasonably expected to be warned, by smell, that the Exposure Standard is being exceeded.
Odour Safety Factor (OSF) is determined to fall into either Class C, D or E.
The Odour Safety Factor (OSF) is defined as:
OSF= Exposure Standard (TWA) ppm/ Odour Threshold Value (OTV) ppm
Classification into classes follows:

Class	OSF	Description
A	550	Over 90% of exposed individuals are aware by smell that the Exposure Standard (TLV- TWA for example) is being reached, even when distracted by working activities
B	26- 550	As " A" for 50- 90% of persons

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		being distracted
C	1- 26	As " A" for less than 50% of persons being distracted
D	0.18- 1	10- 50% of persons aware of being tested perceive by smell that the Exposure Standard is being reached
E	<0.18	As " D" for less than 10% of persons aware of being tested

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MATERIAL DATA

Sensory irritants are chemicals that produce temporary and undesirable side-effects on the eyes, nose or throat. Historically occupational exposure standards for these irritants have been based on observation of workers' responses to various airborne concentrations. Present day expectations require that nearly every individual should be protected against even minor sensory irritation and exposure standards are established using uncertainty factors or safety factors of 5 to 10 or more. On occasion animal no -observable-effect-levels (NOEL) are used to determine these limits where human results are unavailable. An additional approach, typically used by the TLV committee (USA) in determining respiratory standards for this group of chemicals, has been to assign ceiling values (TLV C) to rapidly acting irritants and to assign short-term exposure limits (TLV STELs) when the weight of evidence from irritation, bioaccumulation and other endpoints combine to warrant such a limit. In contrast the MAK Commission (Germany) uses a five -category system based on intensive odour, local irritation, and elimination half-life. However this system is being replaced to be consistent with the European Union (EU) Scientific Committee for Occupational Exposure Limits (SCOEL); this is more closely allied to that of the USA.
OSHA (USA) concluded that exposure to sensory irritants can:
· cause inflammation
· cause increased susceptibility to other irritants and infectious agents
· lead to permanent injury or dysfunction
· permit greater absorption of hazardous substances and
· acclimate the worker to the irritant warning properties of these substances thus increasing the risk of overexposure.
Odour Threshold Value: 0.046 ppm (recognition)
Toxic effects of bromine are concentration dependent, viz:
0.2-0.5 ppm: Eye irritation and lachrymation
10.0 ppm: Intolerable, severe irritation of the upper respiratory tract.
40-60 ppm: Brief exposure dangerous to life.
1000 ppm: Choking, glottal and pulmonary oedema, rapid death.
Physiological response to various levels suggests the following:
0.1-0.15 ppm: maximal concentration allowable for prolonged exposure.
4.0 ppm: maximal concentration allowable for short exposure (0.5-1hr)
40-60 ppm: dangerous for short exposures
1000 ppm: rapidly fatal for short exposure
Exposure at the TLV-TWA and STEL is thought to prevent injury of the respiratory passages and injury to the lung.

PERSONAL PROTECTION

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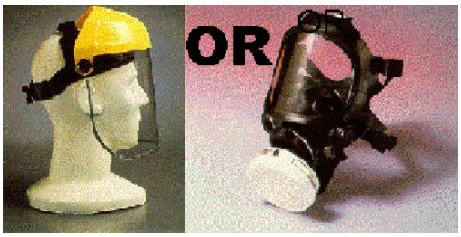

EYE
· Chemical goggles.
· Full face shield may be required for supplementary but never for primary protection of eyes
· Contact lenses may pose a special hazard; soft contact lenses may absorb and concentrate irritants. A written policy document, describing the wearing of lens or restrictions on use, should be created for each workplace or task. This should include a review of lens absorption and adsorption for the class of chemicals in use and an account of injury experience. Medical and first-aid personnel should be trained in their removal and suitable equipment should be readily available. In the event of chemical exposure, begin eye irrigation immediately and remove contact lens as soon as practicable. Lens should be removed at the first signs of eye redness or irritation - lens should be removed in a clean environment only after workers have washed hands thoroughly. [CDC NIOSH Current Intelligence Bulletin 59].

HANDS/FEET
Neoprene rubber gloves.
Suitability and durability of glove type is dependent on usage. Factors such as:
· frequency and duration of contact,
· chemical resistance of glove material,
· glove thickness and
· dexterity,
are important in the selection of gloves.
Elbow length PVC gloves.
When handling corrosive liquids, wear trousers or overalls outside of boots, to avoid spills entering boots.

OTHER
· Overalls.
· PVC Apron.
· PVC protective suit may be required if exposure severe.
· Eyewash unit.
· Ensure there is ready access to a safety shower.

The local concentration of material, quantity and conditions of use determine the type of personal protective equipment required.
For further information consult your
Occupational Health and Safety Advisor.

ENGINEERING CONTROLS
Local exhaust ventilation usually required. If risk of overexposure exists, wear approved respirator. Correct fit is essential to obtain adequate protection. Supplied-air type

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respirator may be required in special circumstances. Correct fit is essential to ensure adequate protection.
An approved self contained breathing apparatus (SCBA) may be required in some situations.
Provide adequate ventilation in warehouse or closed storage area. Air contaminants generated in the workplace possess varying "escape" velocities which, in turn, determine the "capture velocities" of fresh circulating air required to effectively remove the contaminant.

Type of Contaminant:	Air Speed:
solvent, vapours, degreasing etc., evaporating from tank (in still air).	0.25- 0.5 m/s (50- 100 f/min.)
aerosols, fumes from pouring operations, intermittent container filling, low speed conveyer transfers, welding, spray drift, plating acid fumes, pickling (released at low velocity into zone of active generation)	0.5- 1 m/s (100- 200 f/min.)
direct spray, spray painting in shallow booths, drum filling, conveyer loading, crusher dusts, gas discharge (active generation into zone of rapid air motion)	1- 2.5 m/s (200- 500 f/min.)
grinding, abrasive blasting, tumbling, high speed wheel generated dusts (released at high initial velocity into zone of very high rapid air motion).	2.5- 10 m/s (500- 2000 f/min.)

Within each range the appropriate value depends on:

Lower end of the range	Upper end of the range
1: Room air currents minimal or favourable to capture	1: Disturbing room air currents
2: Contaminants of low toxicity or of nuisance value only.	2: Contaminants of high toxicity
3: Intermittent, low production.	3: High production, heavy use
4: Large hood or large air mass in motion	4: Small hood- local control only

Simple theory shows that air velocity falls rapidly with distance away from the opening of a simple extraction pipe. Velocity generally decreases with the square of distance from the extraction point (in simple cases). Therefore the air speed at the extraction point should be adjusted, accordingly, after reference to distance from the contaminating source. The air velocity at the extraction fan, for example, should be a minimum of 1-2 m/s (200-400 f/min) for extraction of solvents generated in a tank 2 meters distant from the extraction point. Other mechanical considerations, producing performance deficits within the extraction apparatus, make it essential that theoretical air velocities are multiplied by factors of 10 or more when extraction systems are installed or used.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE

Heavy mobile, reddish-brown liquid, volatilizing readily at room temperature to a red vapour with a strong disagreeable odour.
A halogen. Its elemental state is Br2 and it is a powerful oxidant.

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Soluble in water, carbon disulfide, ether, alcohol, chloroform, carbon tetrachloride, concentrated hydrochloric acid solution. Bromine corrodes steel, stainless steel, galvanised iron, copper and its alloys.

PHYSICAL PROPERTIES

Liquid.
Mixes with water.
Corrosive.
Toxic or noxious vapours/gas.

Molecular Weight: 79.904
Melting Range (°C): - 7.2
Solubility in water (g/L): Miscible
pH (1% solution): Not available
Volatile Component (%vol): 100
Relative Vapour Density (air=1): 5.51
Lower Explosive Limit (%): Not available
Autoignition Temp (°C): Not available
State: Liquid

Boiling Range (°C): 58.78
Specific Gravity (water=1): 3.12 at 20 C. (l
pH (as supplied): Not applicable
Vapour Pressure (kPa): 23.33 at 21 C.
Evaporation Rate: Not available
Flash Point (°C): Not Applicable
Upper Explosive Limit (%): Not available
Decomposition Temp (°C): Not available
Viscosity: Not Available

Section 10 - CHEMICAL STABILITY AND REACTIVITY INFORMATION

CONDITIONS CONTRIBUTING TO INSTABILITY

- Presence of incompatible materials.
- Product is considered stable.
- Hazardous polymerisation will not occur.

Section 11 - TOXICOLOGICAL INFORMATION

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

Accidental ingestion of the material may be severely damaging to the health of the individual; animal experiments indicate that ingestion of less than 5 gram may be fatal.
The material can produce severe chemical burns within the oral cavity and gastrointestinal tract following ingestion.
Ingestion of acidic corrosives may produce circumoral burns with a distinct discolouration of the mucous membranes of the mouth, throat and oesophagus. Immediate pain and difficulties in swallowing and speaking may also be evident. Oedema of the epiglottis may produce respiratory distress and possibly, asphyxia. Nausea, vomiting, diarrhoea and a pronounced thirst may occur. More severe exposures may produce a vomitus containing fresh or dark blood and large shreds of mucosa. Shock, with marked hypotension , weak and rapid pulse, shallow respiration and clammy skin may be symptomatic of the exposure. Circulatory collapse may, if left untreated, result in renal failure. Severe cases may show gastric and oesophageal perforation with peritonitis, fever and abdominal rigidity. Stricture of the oesophageal, gastric and pyloric sphincter may occur as within several weeks or may be delayed for years. Death may be rapid and often results from

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asphyxia, circulatory collapse or aspiration of even minute amounts. Delayed deaths may be due to peritonitis, severe nephritis or pneumonia. Coma and convulsions may be terminal.

EYE
Irritation of the eyes may produce a heavy secretion of tears (lachrymation).
The material can produce severe chemical burns to the eye following direct contact.
Vapours or mists may be extremely irritating.
When applied to the eye(s) of animals, the material produces severe ocular lesions which are present twenty-four hours or more after instillation.
Direct eye contact with acid corrosives may produce pain, lachrymation, photophobia and burns. Mild burns of the epithelia generally recover rapidly and completely. Severe burns produce long-lasting and possible irreversible damage. The appearance of the burn may not be apparent for several weeks after the initial contact. The cornea may ultimately become deeply vascularised and opaque resulting in blindness.

SKIN
Skin contact with the material may damage the health of the individual; systemic effects may result following absorption.
The material can produce severe chemical burns following direct contact with the skin.
Skin contact with acidic corrosives may result in pain and burns; these may be deep with distinct edges and may heal slowly with the formation of scar tissue.
Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.
Skin contact is not thought to produce harmful health effects (as classified under EC Directives using animal models). Systemic harm, however, has been identified following exposure of animals by at least one other route and the material may still produce health damage following entry through wounds, lesions or abrasions. Good hygiene practice requires that exposure be kept to a minimum and that suitable gloves be used in an occupational setting.

INHALED
Inhalation of vapours or aerosols (mists, fumes), generated by the material during the course of normal handling, may produce severely toxic effects; these may be fatal.
Evidence shows, or practical experience predicts, that the material produces irritation of the respiratory system, in a substantial number of individuals, following inhalation.
In contrast to most organs, the lung is able to respond to a chemical insult by first removing or neutralising the irritant and then repairing the damage. The repair process, which initially evolved to protect mammalian lungs from foreign matter and antigens, may however, produce further lung damage resulting in the impairment of gas exchange, the primary function of the lungs. Respiratory tract irritation often results in an inflammatory response involving the recruitment and activation of many cell types, mainly derived from the vascular system.
Acidic corrosives produce respiratory tract irritation with coughing, choking and mucous membrane damage. Symptoms of exposure may include dizziness, headache, nausea and weakness. In more severe exposures, pulmonary oedema may be evident either immediately or after a latent period of 5-72 hours. Symptoms of pulmonary oedema include a tightness in the chest, dyspnoea, frothy sputum and cyanosis. Examination may reveal hypotension, a weak and rapid pulse and moist rates. Death, due to anoxia, may occur several hours after onset of the pulmonary oedema.

CHRONIC HEALTH EFFECTS
Chronic intoxication with ionic bromides, historically, has resulted from medical use of bromides but not from environmental or occupational exposure; depression, hallucinosis,

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and schizophreniform psychosis can be seen in the absence of other signs of intoxication. Bromides may also induce sedation, irritability, agitation, delirium, memory loss, confusion, disorientation, forgetfulness (aphasias), dysarthria, weakness, fatigue, vertigo, stupor, coma, decreased appetite, nausea and vomiting, diarrhoea, hallucinations , an acne like rash on the face, legs and trunk (seen in 25-30% of case involving bromide ion), and a profuse discharge from the nostrils (coryza). Ataxia and generalised hyperreflexia have also been observed. Correlation of neurologic symptoms with blood levels of bromide is inexact. The use of substances such as brompheniramine, as antihistamines, largely reflect current day usage of bromides; ionic bromides have been largely withdrawn from therapeutic use due to their toxicity. Several cases of foetal abnormalities have been described in mothers who took large doses of bromides during pregnancy.
Limited evidence suggests that repeated or long-term occupational exposure may produce cumulative health effects involving organs or biochemical systems.
Long-term exposure to respiratory irritants may result in disease of the airways involving difficult breathing and related systemic problems.
Repeated or prolonged exposure to acids may result in the erosion of teeth, inflammatory and ulcerative changes in the mouth and necrosis (rarely) of the jaw. Bronchial irritation, with cough, and frequent attacks of bronchial pneumonia may ensue. Gastrointestinal disturbances may also occur. Chronic exposures may result in dermatitis and/or conjunctivitis.
The material may accumulate in the human body and progressively cause tissue damage.
Primary routes of exposure by inhalation and skin contact/absorption.
Bromine is very irritating for the mucous membranes. It has cumulative properties, being deposited in the tissues as bromides and displacing other halogens (iodine and chlorine). Long-term effects include disorders of the nervous system. Chronic exposure to bromine has been associated with headache, joint pain, chest pain, loss of appetite, increasing irritability, loss of corneal reflexes, pharyngitis, vegetative disorders, hypertension and myocardial degeneration, gastrointestinal secretory disorders, leukopoiesis and leukocytosis inhibition and thyroid dysfunction have also been reported.

TOXICITY AND IRRITATION

TOXICITY	IRRITATION
Oral (human) LDLo: 14 mg/kg.	Nil Reported
Inhalation (human) LCLo: 1000 ppm.	
Oral (Human) LD: 14 mg/kg	
Inhalation (Human) LC: 1000 ppm/4h	
Oral (Rat) LD50: 2600 mg/kg	
Inhalation (Rat) LC50: 2700 mg/m³/4h	
Oral (Mouse) LD50: 3100 mg/kg	
Oral (Rabbit) LD50: 4160 mg/kg	
Oral (Guinea pig) LD50: 5500 mg/kg	
None (None) None: None None	

The material may produce severe irritation to the eye causing pronounced inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis.
The material may produce severe skin irritation after prolonged or repeated exposure, and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterised by skin redness (erythema) thickening of the epidermis.

Histologically there may be intercellular oedema of the spongy layer (spongiosis) and intracellular oedema of the epidermis. Prolonged contact is unlikely, given the severity of response, but repeated exposures may produce severe ulceration.
Asthma-like symptoms may continue for months or even years after exposure to the material

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ceases. This may be due to a non-allergenic condition known as reactive airways dysfunction syndrome (RADS) which can occur following exposure to high levels of highly irritating compound. Key criteria for the diagnosis of RADS include the absence of preceding respiratory disease, in a non-atopic individual, with abrupt onset of persistent asthma-like symptoms within minutes to hours of a documented exposure to the irritant. A reversible airflow pattern, on spirometry, with the presence of moderate to severe bronchial hyperreactivity on methacholine challenge testing and the lack of minimal lymphocytic inflammation, without eosinophilia, have also been included in the criteria for diagnosis of RADS. RADS (or asthma) following an irritating inhalation is an infrequent disorder with rates related to the concentration of and duration of exposure to the irritating substance. Industrial bronchitis, on the other hand, is a disorder that occurs as result of exposure due to high concentrations of irritating substance (often particulate in nature) and is completely reversible after exposure ceases. The disorder is characterised by dyspnea, cough and mucus production.

Section 12 - ECOLOGICAL INFORMATION

Prevent, by any means available, spillage from entering drains or water courses.
Do NOT allow product to come in contact with surface waters or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment or disposing of equipment wash-waters.
Wastes resulting from use of the product must be disposed of on site or at approved waste sites.
DO NOT discharge into sewer or waterways.
Following release of ozone-depleting substances into the atmosphere, they eventually enter the troposphere where they persist undegraded. Subsequently they diffuse into the stratosphere and degrade slowly. In the stratosphere, these substances react slowly with oxygen free radicals and release halogen atoms which catalytically destroy ozone, producing irreversible damage. Use of these substances has been restricted by the Montreal Protocol on Substances that Deplete the Ozone Layer (1988) and also by US EPA Regulation 3093/94. Ozone depleters do not degrade readily in the ambient atmosphere; some have a half-life of more than 100 years for the photochemical reaction producing hydroxy radicals.
In th atmosphere, bromine destroys ozone, catalytically; the bromine cycle is thought to be more efficient in ozone destruction than the chlorine cycle.
In water, bromine is slowly reduced to bromide by natural oxidisable materials.
Bromine is harmful to aquatic life at low concentrations.
No standards available for drinking water, soils or air.

Section 13 - DISPOSAL CONSIDERATIONS

· Recycle wherever possible.
· Consult manufacturer for recycling options or consult local or regional waste management authority for disposal if no suitable treatment or disposal facility can be identified.
· Treat and neutralise at an approved treatment plant. Treatment should involve : Neutralisation followed by: Burial in a licenced land-fill or Incineration in a licenced apparatus (after admixture with suitable combustible material)
· Decontaminate empty containers. Observe all label safeguards until containers

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are cleaned and destroyed.
· Containers may still present a chemical hazard/ danger when empty.
· Return to supplier for reuse/ recycling if possible.
Otherwise:
· If container can not be cleaned sufficiently well to ensure that residuals do not remain or if the container cannot be used to store the same product, then puncture containers, to prevent re-use, and bury at an authorised landfill.
· Where possible retain label warnings and MSDS and observe all notices pertaining to the product.

WASTE DISPOSAL PROCEDURES
• Package and collect recoverable quantities of bromine into labelled containers
for recycling or disposal. Wear protective clothing, butyl rubber gloves, and eye protection to control personal contact. Work in a well ventilated area, add (5mL)Bromine to a large container of water. Slowly add 10% sodium bisulfite until the solution is colourless. When all reactions have ceased, neutralise with sodium carbonate and wash into the drain [Armour 1996].

SPILLAGE DISPOSAL
• Clear area of personnel. Wear breathing apparatus, eye protection, nitrile rubber gloves and protective clothing to control personal contact. 1:1:1 mixture
by weight of sodium carbonate or calcium carbonate, calcium bentonite and sand. Scoop the absorbed bromine into a container. In a well ventilated area add the bromine mixture to cold water. Add 10% sodium bisulfite until the bromine solution is colourless. Neutralise with sodium carbonate if necessary. Empty the
solution into the drain and treat the solid residue as normal refuse. Wash the site of spillage thoroughly with soap and water [Armour 1996].

Section 14 - TRANSPORTATION INFORMATION

Labels Required: CORROSIVE,TOXIC
HAZCHEM: 2XE

UNDG:

Dangerous Goods Class:	8	Subrisk:	6.1
UN Number:	1744	Packing Group:	I

Shipping Name:BROMINE
BROMINE SOLUTION
BROMINE or BROMINE SOLUTION

IATA:

Dangerous Goods Class:	8	Subrisk:	6.1
UN Number:	1744	Packing Group:	I

Shipping Name:BROMINE
BROMINE SOLUTION
BROMINE or BROMINE SOLUTION

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Section 14 - TRANSPORTATION INFORMATION

Maritime Transport IMDG:

IMDG Class:	8	IMDG Subrisk:	6.1
UN Number:	1744	Packing Group:	I
EMS Number:	F- A, S- B		

Shipping name:BROMINE
BROMINE SOLUTION
BROMINE or BROMINE SOLUTION

Section 15 - REGULATORY INFORMATION

REGULATIONS

bromine (CAS: 7726-95-6) is found on the following regulatory lists;
OECD Representative List of High Production Volume (HPV) Chemicals

No data available for bromine as CAS: 23724-81-4.

Section 16 - OTHER INFORMATION

INGREDIENTS WITH MULTIPLE CAS NUMBERS

Ingredient Name	CAS
bromine	7726- 95- 6, 23724- 81- 4

The above information is believed to be accurate and represent the best information currently available to us, but does not represent any warranty expressed or implied of the properties of the product. User should make their own investigation to determine the suitability of the information for their particular purpose.

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