1. Product and Company Identification

BOC Gases, Division of
The BOC Group, Inc.
575 Mountain Avenue
Murray Hill, NJ 07974

TELEPHONE NUMBER: (908) 464-8100
24-HOUR EMERGENCY TELEPHONE NUMBER:
CHEMTREC (800) 424-9300

BOC Gases
Division of
BOC Canada Limited
5975 Falbourne Street, Unit 2
Mississauga, Ontario L5R 3W6

TELEPHONE NUMBER: (905) 501-1700
24-HOUR EMERGENCY TELEPHONE NUMBER:
(905) 501-0802

PRODUCT NAME: CHLORINE

CHEMICAL NAME: Chlorine
COMMON NAMES/SYNONYMS: Bertholite, Molecular Chlorine
TDG (Canada) CLASSIFICATION: 2.3 (5.1)
WHMIS CLASSIFICATION: A, D1A, D2B, E, C

PREPARED BY: Loss Control (908) 464-8100/(905) 501-1700
PREPARATION DATE: 6/1/95
REVIEW DATES: 06/18/04

2. Composition, Information on Ingredients

EXPOSURE LIMITS:

<table>
<thead>
<tr>
<th>INGREDIENT</th>
<th>% VOLUME</th>
<th>PEL-OSHA</th>
<th>TLV-ACGIH</th>
<th>LD_{50} or LC_{50} Route/Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorine</td>
<td>100.0</td>
<td>1 ppm Ceiling</td>
<td>0.5 ppm TWA 1 ppm STEL</td>
<td>LC_{50}; 293 ppm inhalation/rat (1H)</td>
</tr>
</tbody>
</table>

FORMULA: Cl₂
CAS: 7782-50-5
RTECS #: FO2100000

1 Refer to individual state or provincial regulations, as applicable, for limits which may be more stringent than those listed here.
2 As stated in 29 CFR 1910, Subpart Z (revised July 1, 1993)
3 As stated in the ACGIH 2004 Threshold Limit Values for Chemical Substances and Physical Agents.

OSHA Regulatory Status: This material is classified as hazardous under OSHA regulations.
IDLH: 10 ppm

3. Hazards Identification

EMERGENCY OVERVIEW
Greenish yellow gas with bleach-like choking odor. Corrosive and poison gas. Contact may cause severe irritation or corrosive burns to the eyes, skin and mucous membranes. Inhalation may result in chemical pneumonitis, retention of body fluid in the lungs (pulmonary edema), and respiratory collapse. Nonflammable. Oxidizer. May react violently with reducing agents. Can accelerate combustion and increase the risk of fire and explosion in flammable and combustible materials. Contents under pressure. Use and store below 125 °F.
ROUTE OF ENTRY:

<table>
<thead>
<tr>
<th></th>
<th>Skin Contact</th>
<th>Skin Absorption</th>
<th>Eye Contact</th>
<th>Inhalation</th>
<th>Ingestion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

HEALTH EFFECTS:

<table>
<thead>
<tr>
<th></th>
<th>Exposure Limits</th>
<th>Irritant</th>
<th>Sensitization</th>
<th>Teratogen</th>
<th>Reproductive Hazard</th>
<th>Mutagen</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Synergistic Effects

Other agents that irritate the respiratory system

Carcinogenicity: -- NTP: No  IARC: No  OSHA: No

EYE EFFECTS:
Corrosive and irritating to the eyes. Contact with the liquid or vapor causes painful burns and ulcerations. Burns to the eyes result in lesions and possible loss of vision.

SKIN EFFECTS:
Corrosive and irritating to the skin and all living tissue. It hydrolyzes very rapidly yielding hydrochloric acid. Skin burns and mucosal irritation are like that from exposure to volatile inorganic acids. Chlorine burns result in severe pain, redness, possible swelling and early necrosis.

INGESTION EFFECTS:
Ingestion is unlikely.

INHALATION EFFECTS:
Corrosive and irritating to the upper and lower respiratory tract and all mucosal tissue. Symptoms include lacrimation, cough, labored breathing, and excessive salivary and sputum formation. Excessive irritation of the lungs causes acute pneumonitis, pulmonary edema, and respiratory collapse which could be fatal. Residual pulmonary malfunction may also occur. Chemical pneumonitis and pulmonary edema may result from exposure to the lower respiratory tract and deep lung.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: May aggravate pre-existing eye, skin, and respiratory conditions.

POTENTIAL ENVIRONMENTAL EFFECTS: Toxic to fish and wildlife. Chlorine is designated as a marine pollutant by DOT. The LC_{50} in the fathead minnow has been cited as 0.1 mg/L/96 H and an LC_{50} of 0.097 mg/L/30 min has been cited for the Daphnia magna.

4. First Aid Measures

EYES:
PERSONS WITH POTENTIAL EXPOSURE SHOULD NOT WEAR CONTACT LENSES. Flush contaminated eye(s) with copious quantities of water. Part eyelids to assure complete flushing. Continue for a minimum of 30 minutes. Seek immediate medical attention.

SKIN:
Flush affected area with copious quantities of water while removing contaminated clothing. Seek immediate medical attention.

INGESTION:
None required.
5. Fire Fighting Measures

<table>
<thead>
<tr>
<th>Conditions of Flammability: Not flammable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flash point: None</td>
</tr>
<tr>
<td>Method: Not Applicable</td>
</tr>
<tr>
<td>Autoignition Temperature: None</td>
</tr>
<tr>
<td>LEL(%): None</td>
</tr>
<tr>
<td>UEL(%): None</td>
</tr>
<tr>
<td>Hazardous combustion products: None</td>
</tr>
<tr>
<td>Sensitivity to mechanical shock: None</td>
</tr>
<tr>
<td>Sensitivity to static discharge: None</td>
</tr>
</tbody>
</table>

FIRE AND EXPLOSION HAZARDS:
Strong oxidizer. Most combustible materials burn in chlorine as they do in oxygen producing irritating and poisonous gases. Flame impingement upon steel chlorine container will result in iron/chlorine fire causing rupture of the container. Cylinder may vent rapidly or rupture violently from pressure when involved in a fire situation.

EXTINGUISHING MEDIA:
Use media suitable for surrounding materials. If it can be done without risk, stop the flow of chlorine which is accelerating the fire.

FIRE FIGHTING INSTRUCTIONS:
Firefighters should wear respiratory protection (SCBA) and full turnout or Bunker gear with additional chemical protective clothing to prevent exposure to chlorine. Use water spray to keep fire exposed containers cool. Continue to cool fire exposed cylinders until well after flames are extinguished. Control runoff and isolate discharged material for proper disposal.

6. Accidental Release Measures

Evacuate all personnel from affected area. Deny entry to unauthorized and unprotected individuals. Extinguish all ignition sources. No smoking, sparks, flames, or flares in hazard area. Appropriate protective equipment is essential to prevent exposure (See Section 8). Stop the flow of gas or remove cylinder to outdoor location if this can be done without risk. Ventilate enclosed areas. A leak near incompatible, flammable or combustible materials may create a fire or explosion hazard. Consult a HAZMAT specialist and the appropriate emergency telephone number in Section 1 or your closest BOC location. If leak is in user’s equipment, be certain to purge piping with inert gas prior to attempting repairs.

7. Handling and Storage

Electrical classification: Nonhazardous.

Most metals corrode rapidly with wet chlorine. Systems must be kept dry. Lead, gold, tantalum and Hastelloy are most resistant to wet chlorine.
PRODUCT NAME: CHLORINE

Do not inhale. Prevent contact with skin and eyes. Use only in well-ventilated areas. Valve protection caps must remain in place unless container is secured with valve outlet piped to use point. Do not drag, slide or roll cylinders. Use a suitable hand truck for cylinder movement. Use a pressure reducing regulator when connecting cylinder to lower pressure piping or systems. Do not heat cylinder by any means to increase rate of product from the cylinder. Use a check valve or trap in the discharge line to prevent hazardous back flow into cylinder. Do not insert any object (i.e.: screwdriver) into valve cap openings as this can damage the valve causing leakage.

Protect cylinders from physical damage. Store in cool, dry, well-ventilated areas of non-combustible construction away from heavily trafficked areas and emergency exits. Do not allow the temperature where cylinders are stored to exceed 125°F (52°C). Cylinders should be stored upright and firmly secured to prevent falling or being knocked over. Full & 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. Separate from combustibles, organic, and easily oxidizable materials. Isolate from acetylene, ammonia, hydrogen, hydrocarbons, ether, turpentine, finely divided metals, and other incompatible materials. Oxidizer - Post “NO SMOKING OR OPEN FLAMES” signs in storage and use areas. There should be no sources of ignition in areas where this product is being used or stored. Outside or detached storage is preferred.

Never carry a compressed gas cylinder or a container of a gas in cryogenic liquid form in an enclosed space such as a car trunk, van or station wagon. A leak can result in a fire, explosion, asphyxiation or a toxic exposure.

For additional storage recommendations, consult Compressed Gas Association's Pamphlet P-1.

8. Exposure Controls, Personal Protection

ENGINEERING CONTROLS:
Hood with forced ventilation may be used for small quantities. Use local exhaust ventilation in combination with enclosed processes as needed to prevent accumulation above the exposure limit. Exhaust gas should be vented to a gas treatment system.

EYE/FACE PROTECTION:
Gas-tight safety goggles and full faceshield or full-face respirator.

SKIN PROTECTION:
Protective gloves or fully encapsulated vapor protective clothing. (Butyl rubber, neoprene, and Teflon® provide adequate protection for exposures to chlorine greater than 8 hours.)

RESPIRATORY PROTECTION:
For emergency release use a positive pressure NIOSH approved air-supplying respirator systems (SCBA or airline/escape bottle) using a full-face mask and at a minimum Grade D air.

For normal conditions below fifty times the exposure limit but where engineering can not control exposures below the applicable limits, than appropriately selected air-purifying respirators with full-face mask can be used.

OTHER/GENERAL PROTECTION:
Safety shoes, safety shower, eyewash "fountain"
9. Physical and Chemical Properties

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>VALUE</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical state (gas, liquid, solid)</td>
<td>Gas</td>
<td></td>
</tr>
<tr>
<td>Vapor pressure at 70 °F</td>
<td>100.2</td>
<td>psia</td>
</tr>
<tr>
<td>Vapor density at STP (Air = 1)</td>
<td>2.47</td>
<td></td>
</tr>
<tr>
<td>Evaporation point</td>
<td>Not Available</td>
<td></td>
</tr>
<tr>
<td>Boiling point</td>
<td>-29.3</td>
<td>°F</td>
</tr>
<tr>
<td></td>
<td>-34.1</td>
<td>°C</td>
</tr>
<tr>
<td>Freezing point</td>
<td>-149.8</td>
<td>°F</td>
</tr>
<tr>
<td></td>
<td>-101</td>
<td>°C</td>
</tr>
<tr>
<td>pH</td>
<td>Not Available</td>
<td></td>
</tr>
<tr>
<td>Specific gravity</td>
<td>Not Available</td>
<td></td>
</tr>
<tr>
<td>Oil/water partition coefficient</td>
<td>Not Available</td>
<td></td>
</tr>
<tr>
<td>Solubility (H₂O)</td>
<td>Very Soluble</td>
<td></td>
</tr>
<tr>
<td>Odor threshold</td>
<td>Not Available</td>
<td></td>
</tr>
<tr>
<td>Odor and appearance</td>
<td>Greenish-yellow gas with sharp suffocating odor. Liquid is amber colored.</td>
<td></td>
</tr>
</tbody>
</table>

10. Stability and Reactivity

**STABILITY:** Stable

**INCOMPATIBLE MATERIALS:** Strong oxidizer. Will react with organic and other oxidizable materials. Reacts explosively or forms explosive compounds with many common substances including acetylene, ether, turpentine, ammonia, fuel gas, hydrogen and finely divided metals. Reacts with water to form corrosive acidic solution.

**HAZARDOUS DECOMPOSITION PRODUCTS:** Hydrochloric acid on contact with water.

**HAZARDOUS POLYMERIZATION:** Will not occur.

11. Toxicological Information

**INHALATION:** Inhalation of chlorine concentrations as low as 1 ppm may cause nose, throat and conjunctiva irritation. Irritation becomes more pronounced at concentrations of 1.3 ppm and above with coughing and labored breathing. Death may occur after a few breaths at 1000 ppm. Delayed effects following high exposure may include bronchitis, edema, and pneumonia.

**SKIN AND EYE:** Extremely irritating to the skin, eyes, and mucous membranes. Can cause corrosive burns. May cause corrosion of the teeth. Prolonged exposure to low concentrations may cause chloracne.

**OTHER:**
Repeated contact with low concentrations may cause dermatitis.

Equivocal evidence of carcinogenicity for chlorine was noted in an IARC review and a 2-year drinking water study in F344/N rats and B6C3F1 mice by the NTP. Literature references suggest the possibility of mutagenic and teratogenic effects from hypochlorites (a hydrolysis product of chlorine).
12. Ecological Information

Product does not contain Class I or Class II ozone depleting substances. Chlorine is highly toxic to all forms of aquatic life (See Section 3). There is no potential for bioaccumulation or bioconcentration. Chlorine is designated as a hazardous substance under section 311(b)(2)(A) of the Federal Water Pollution Control Act and further regulated by the Clean Water Act Amendments of 1977 and 1978. Listed as a hazardous air pollutant (HAP) and a marine pollutant. Chlorine is listed as an extremely hazardous substance (EHS) subject to state and local reporting under Section 304 of SARA Title III (EPCRA) with a Threshold Planning Quantity (TPQ) of 100 pounds. The CERCLA reportable quantity (RQ) for chlorine is 10 pounds.

13. Disposal Considerations

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 BOC Gases or authorized distributor for proper disposal.

14. Transport Information

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>United States DOT</th>
<th>Canada TDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROPER SHIPPING NAME:</td>
<td>Chlorine</td>
<td>Chlorine</td>
</tr>
<tr>
<td>HAZARD CLASS:</td>
<td>2.3 (8)</td>
<td>2.3 (8)</td>
</tr>
<tr>
<td>IDENTIFICATION NUMBER:</td>
<td>UN 1017</td>
<td>UN 1017</td>
</tr>
<tr>
<td>SHIPPING LABEL:</td>
<td>POISON GAS, CORROSIVE</td>
<td>TOXIC GAS, CORROSIVE</td>
</tr>
</tbody>
</table>

Additional Marking Requirement: “Inhalation Hazard”
  If net weight of product ≥ 10 pounds, the container must be also marked with the letters “RQ”.
  “Marine Pollutant” – For vessel transportation the Marine Pollutant Mark shall be placed in association with the hazard warning labels, or in the absence of any labels, in association with the marked proper shipping name.

Additional Shipping Paper Description Requirement: “Poison-Inhalation Hazard, Zone B”
  If net weight of product ≥ 10 pounds, the shipping papers must be also marked with the letters “RQ”.
  The words “Marine Pollutant” shall be entered in association with the basic description for a material which is a marine pollutant.

15. Regulatory Information

SARA TITLE III NOTIFICATIONS AND INFORMATION
SARA TITLE III - HAZARD CLASSES:
  Acute Health Hazard
  Chronic Health Hazard
  Fire Hazard
  Sudden Release of Pressure Hazard
  Reactivity Hazard
SARA TITLE III - SECTION 313 SUPPLIER NOTIFICATION:
This product contains the following toxic chemicals subject to the reporting requirements of section 313 of the Emergency Planning and Community Right-To-Know Act (EPCRA) of 1986 and of 40 CFR 372:

<table>
<thead>
<tr>
<th>CAS NUMBER</th>
<th>INGREDIENT NAME</th>
<th>PERCENT BY VOLUME</th>
</tr>
</thead>
<tbody>
<tr>
<td>7782-50-5</td>
<td>CHLORINE</td>
<td>100.0</td>
</tr>
</tbody>
</table>

This information must be included on all MSDSs that are copied and distributed for this material.

U.S. TSCA/Canadian DSL: All ingredients are listed on the U.S. Toxic Substances Control Act (TSCA) inventory or exempt from listing and on the Canadian Domestic Substance List (DSL).

California Proposition 65: This product does not contain ingredient(s) known to the State of California to cause cancer or reproductive toxicity.

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

16. Other Information

<table>
<thead>
<tr>
<th>NFPA HAZARD CODES</th>
<th>HMIS HAZARD CODES</th>
<th>RATINGS SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health: 4</td>
<td>Health: 3</td>
<td>0 = No Hazard</td>
</tr>
<tr>
<td>Flammability: 0</td>
<td>Flammability: 0</td>
<td>1 = Slight Hazard</td>
</tr>
<tr>
<td>Instability: 0</td>
<td>Physical Hazard: 2</td>
<td>2 = Moderate Hazard</td>
</tr>
<tr>
<td>OXIDIZER</td>
<td></td>
<td>3 = Serious Hazard</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 = Severe Hazard</td>
</tr>
</tbody>
</table>

Note: Ratings were assigned in accordance with Compressed Gas Association (CGA) guidelines as published in CGA Pamphlet P-19-2004, _CGA Recommended Hazard Ratings for Compressed Gases, 2nd Edition._

ACGIH: American Conference of Governmental Industrial Hygienists
DOT: Department of Transportation
IARC: International Agency for Research on Cancer
NTP: National Toxicology Program
OSHA: Occupational Safety and Health Administration
PEL: Permissible Exposure Limit
SARA: Superfund Amendments and Reauthorization Act
STEL: Short Term Exposure Limit
TDG: Transportation of Dangerous Goods
TLV: Threshold Limit Value
WHMIS: Workplace Hazardous Materials Information System

Compressed gas cylinders shall not be refilled without the express written permission of the owner. Shipment of a compressed gas cylinder which has not been filled by the owner or with his/her (written) consent is a violation of transportation regulations.

DISCLAIMER OF EXPRESSED AND IMPLIED WARRANTIES:
Although reasonable care has been taken in the preparation of this document, we extend no warranties and make no representations as to the accuracy or completeness of the information contained herein, and assume no responsibility regarding the suitability of this information for the user's intended purposes or for the consequences of its use. Each individual should make a determination as to the suitability of the information for their particular purpose(s).