

# Lab Safety Plan for MOCVD Room (Rm115)

## 1. Basic Information

**1.1 Laboratory Locations Covered by this Plan.** Nanophotonics Center (Engineering & Technology Lab Building) Rm 115 (MOCVD Room).

### 1.2 Location of (M)SDSs, and any Other Laboratory Documents for this Room

In the Literature Holder mounted on the wall next to the door

## 2. Emergency Assistance Information

### 2.1 Group's Emergency Contact Information

Prof. Jing Li                      806-401-9289

Weiping Zhao                    806-317-5636

### 2.2 Advisors

Prof. Hongxing Jiang    806-834-5739 (Office)

Prof. Jingyu Lin            806-834-5383 (Office)

### 2.3 Secretary

Qing Feng                      806-834-2094 (Office)

### 2.4 TTU Environmental Health and Safety (EH&S)

Daytime Emergencies (M-F, 8:00 am -5:00 pm)      806-742-3876

Non-daytime Emergencies (24 hrs/day, 7 days/week)      806-742-3328

### 2.5 TTU Emergency Maintenance

Any Time                      806-742-3328

### 2.6 TTU Police (UPD)

Emergency 9-911

Non-Emergency 806-742-3931

**3. Required Training for Working in this Room**

3.1 Safety Awareness Training

3.2 Hazard Communication

3.3 Chemical Hygiene Plan Training

3.4 Laboratory Safety

**4. Standard Operating Procedures (Attached)**

**5. Record of Training (in the literature holder mounted on the wall next to the door)**

## SAFETY PRECAUTIONS FOR MOCVD SYSTEM

Do not operate an MOCVD system if you are alone in room 115. We require at least 2 people in room 115 while operating the system.

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The first and foremost area where one has to be careful while operating the system is while Turning on/Turning off the system.

Procedure for turning on the MOCVD system

Step 1 (Very important for everyone's safety):

1. Check and make sure that exhaust fans are on and operating. If they are not on, **do not** operate MOCVD until they have been returned to operation.

Step 2 (power on the MOCVD system):

1. Turn on the chiller placed behind the MOCVD system.
2. Turn on the power supply for the RF generator.
3. Power on the main controller of the MOCVD by pushing two buttons on the right middle of the main control panel and by switching in three bar-switches on the right bottom of the main control panel.

Step 3 (pump Hydrogen purifier):

1. Turn on the small pump by pushing the S-pump button placed on the glove box.

2. Open the red valve (connecting the tube from MO sources to the small pump) located at the front of the small pump

3. Open the green valve located at near Hydrogen cylinder (behind the MOCVD).

Whenever this green valve open hydrogen cylinder has to be closing.

4. open two green valves located at up behind hydrogen purifier

5. Wait for 2 min to see the temperature increase from the front panel of hydrogen purifier

6. close two green valves in #4.

7. close the green valve in # 3 and then close the red valve in #2

8. Turn off the small pump by pushing the S-pump button.

#### Step 4 :

1. open the 5.0 grade Nitrogen cylinder and open the screw valve by rotating , finally adjusting outlet pressure

2. Repeat #1 for 5.0 Hydrogen and for normal nitrogen.

#### Step 4 (Hydrogen purifier)

1. Open two red valves located at each end of oxygen trap.

2. open the green valve located at the next to the red valve after oxygen trap.

3. open the screw valve by rotating located on the front of the hydrogen purifier.

4. open the green valve located at down behind hydrogen purifier

5. set the flow rate of breed gas to around 0.5l/min. The setting valve is on the right down of the hydrogen purifier front side.

### ***EMERGENCY PROCEDURES:***

#### **IF HYDROGEN ALARM(ON PURIFIER) SOUNDS**

**1. CLOSE TMGa(if open)**

- a. Turn off Valve H1 on switch board-if in computer program switch to manual first.
- b. Close valves on TMGa source.
- c. Turn off valve H2 on switch board
- d. Same procedure for any MO Source open

**2. Switch to Nitrogen flow(if hydrogen was flowing)**

- a. Turn off valve A1 and open Valve A3

**3. Turn off RF generator**

**4. Shut down Hydrogen**

- a. Close ultra pure hydrogen valve and bleed valve on Purifier
- b. Close all Hydrogen feed valves(hand operated)
- c. Close valve on Hydrogen Tank.

In case of severe Emergency call 911.

#### GENERAL PRECAUTIONS:

- 1.Never leave the machine when it is running.
- 2.Always check to make sure the exhaust fans are operating.
- 3.Always have an eye on the temperature(during high temperature growth) and on the system pressure.
- 4.In case of any abnormalities resort to emergency shut down.
- 5.Never touch the RF coil when the MOCVD is operating.
- 6.Always wear a robe and lab footwear and goggles while inside the MOCVD room and doing growth.
- 7.If you have a doubt on the operating procedures do not hesitate to ask the seniors.
- 8.The MOCVD ROOM IS SUPPOSED TO BE KEPT CLEAN OF DUST ALL THE TIME.Lock the door whenever you use it.

#### Procedures for handling the MO Sources:

- 1.Always use the MO sources in accordance with the Material Safety Data sheet.So go through it before you start work.
- 2.The MO sources are spontaneously combustible so pack them carefull after use and store them in the big yellow cabinets provided for that purpose.

3.Keep the MO sources under inert atmosphere and keep their containers dry always as it is dangerous when they are wet.

#### TRAINING RULES FOR NEW STUDENTS IN MOCVD GROWTH

- 1.The training phase for a new student in the MOCVD growth typically last for about an year wherein the new student has to spend time observing a senior operate the system.The new student is required to make a note of all the controls/processes involved in the lab notebook provided.
- 2.Always read the Material Safety and Data Sheets before you enter the lab to watch/learn how to operate the MOCVD system.
- 3.When you are new, never touch or try to operate anything unless you have the go ahead from our Advisors and the person who has trained you.
- 4.During the training period,make sure you operate any equipment only under an experienced person's supervision.NEVER operate it even though YOU feel comfortable doing it.

5. Understand the safety precautions to be followed while dealing with the M.O. sources and the other gases that we use in the MOCVD room.

6. Be very careful when you are turning on/off any of the valves when you are new because a fraction of second in negligence and you will be putting yourself and others around you in risk.

7. Make a note of the procedures involved in operating the MOCVD in the lab note book provided to you. This should serve as a reference manual too when you start running the machine independently.

8. Make a sketch of the MOCVD system and the gas flow lines in the lab note book so that you will understand the flow better and the important valves/lines to watch out for.

9. Always be attentive when you are in the room and do not take your eyes off the system pressure/flow meters.

10. Follow proper dress code and when in doubt always consult with the seniors.

## MO Bubbler change procedure

The following bubbler change steps are intended to be an official record of how we change the bubblers of the MOCVD machines at our facility and also as a reference for new students who work on our MOCVD.

The bubbler change steps are explained taking TMGa (trimethyl gallium) as an example.

**WEARING A LAB COAT, GLOVES, FACE MASK, SAFETY GOGGLES, AND PROPER FOOTWEAR IS A MUST**

**In order to change the TMGa source and replace it with a new one:**

1. Pump down the gas at low pressure
2. Close both Hydrogen ( $H_2$ ) and Nitrogen ( $N_2$ )
3. Open Ga-1, Ga-3 valves and the corresponding mass flow controller (MFC) keeping the butterfly valve open
4. Keep pumping down until you notice that the MFC reading becomes quite low
5. Fill with  $N_2$  by closing the butterfly valve
6. Now open the Ga source after closing Ga-1
7. Carefully remove the TMGa source from the chiller. After it is removed from the system, weight it, and mark down the weight and the date it was taken out of the system. Carefully place it in the MO source drum and seal the drum
8. Now install the new TMGa source. Always use new washers while replacing a MO source
9. After installing the new MO source, open Ga-3 valve
10. Close  $N_2$  and pump down
11. After a few minutes open  $H_2$  for a few seconds and close it (keeping butterfly valve open). Repeat for 3 -4 times
12. Now close Ga-3 valve and  $H_2$  and fill with  $N_2$  and then close the butterfly valve



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# Anhydrous Ammonia

MSDS Number 2001 (Revised April 23, 2008)

10 Pages

## 1. CHEMICAL PRODUCT and EMERGENCY TELEPHONE CONTACT

Product Name:..... Anhydrous Ammonia  
 Chemical Family:..... Inorganic Nitrogen Compound  
 Synonyms:..... Ammonia, Liquid Ammonia, Nitro-Sil, Spirit of Hartshorn, NH<sub>3</sub>  
 Formula:..... NH<sub>3</sub>  
 Product Use:..... Fertilizers; Fibers and Plastics; Explosives; Animal Feed; SCR NO<sub>x</sub> Control

### EMERGENCY TELEPHONE NUMBER

CHEMTREC (U.S.):..... 800-424-9300  
 CANUTEC (Canada):..... 613-996-6666

## 2. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient Name/CAS Number	Concentration	Exposure Limits
Ammonia #7664-41-7	99-100%	25 ppm TWA 35 ppm STEL 50 ppm PEL 300 ppm IDLH

## 3. HAZARDS IDENTIFICATION

### EMERGENCY OVERVIEW

Colorless gas and liquid (liquid under pressure). Vapor is toxic and irritating to eyes, nose, throat and skin. Liquid will burn skin and eyes and cause frostbite. Vapor is flammable under limited conditions. Use water to control fire and disperse vapors. Do not put water on liquid ammonia.

NFPA Hazard Classification	Health Hazard (Blue) .....	3
	Flammability (Red) .....	1
	Reactivity (Yellow) .....	0

## **POTENTIAL HEALTH EFFECTS**

**Primary Routes of Entry:** Inhalation, skin contact/absorption and eye contact.

**General Acute Exposure:** Anhydrous ammonia reacts with moisture in mucosal surfaces (eyes, skin, and respiratory tract) to produce ammonium hydroxide, which may cause caustic injury. The severity of injury depends upon the concentration and duration of exposure. The extent of injury ranges from mild cough to laryngeal edema and life-threatening pulmonary edema.

### **Inhalation:**

**Acute Exposure:** Ammonia is toxic and a severe irritant of the respiratory tract. It may cause a running nose, coughing, chest pain, cessation of respiration and death. It may cause severe breathing difficulties, which may be delayed in onset. **ADDITIONAL MEDICAL INFORMATION:** Bronchospasm, laryngitis, tracheitis, wheezing, dyspnea, and laryngeal stridor may be noted. Mucosal burns to the tracheobronchial tree, Pulmonary Edema, and associated hypoxemia frequently occur following exposure to concentrated ammonia.

### **Skin:**

**Acute Contact:** Ammonia is a severe irritant of the skin. Skin exposure to high concentrations of the gas may cause burning and blistering. Contact with liquid may cause severe skin burns. **ADDITIONAL MEDICAL INFORMATION:** Concentrated ammonia may produce liquefaction necrosis and deep penetrating burns.

### **Eye:**

**Acute Contact:** Exposure to the eyes (>700 ppm) may cause temporary or permanent blindness. **ADDITIONAL MEDICAL INFORMATION:** Eye exposure may result in conjunctivitis, lacrimation and/or corneal irritation. Total corneal epithelial loss may occur.

### **Neurologic:**

**Acute Exposure:** An altered mental status (coma) may be seen, but is not characteristic unless hypoxemia occurs.

### **Gastrointestinal:**

**Acute Exposure:** Nausea and vomiting occurs frequently following ingestion. Swelling of the lips, mouth, and larynx, and oral or esophageal burns may occur if concentrated ammonia solutions are ingested.

### **Genitourinary:**

**Acute Exposure:** Urinary retention may occur.

**Note to the Physician:** Pneumonitis should be anticipated after inhalation or ingestion. If severe exposure is suspected, observe for 48-72 hours for delayed pulmonary edema.

### **Carcinogenicity:**

NTP: ..... Not Listed  
IARC: ..... Not Listed  
OSHA: ..... Not Regulated

**Medical Conditions Aggravated by Exposure:** Chronic respiratory or skin disease

#### 4. FIRST AID MEASURES

**First Aid for Eyes:** Immediately flush eyes with copious amounts of tepid water for at least 15 minutes. If irritation, pain, swelling, excessive tearing, or light sensitivity persists, the patient should be seen in a health care facility and referral to an ophthalmologist considered.

**First Aid for Skin:** Immediately flush exposed area with copious amounts of tepid water for at least 15 minutes followed by washing area thoroughly with soap and water. The patient should be seen in a health care facility if irritation or pain persists.

**First Aid for Inhalation:** Move patient to fresh air. Monitor for respiratory distress. If cough or difficulty in breathing develops, evaluate for respiratory tract irritation, bronchitis, or pneumonitis. If trained to do so administer supplemental oxygen with assisted ventilation as required. Administer artificial respiration if patient is not breathing.

**First Aid for Ingestion:** Call a physician. If conscious, give the patient 4 to 8 ounces of milk or water to drink immediately. Do not induce vomiting.

**Caution:** Clothing frozen to the skin should be thawed before being removed.

#### 5. FIRE FIGHTING MEASURES

Flash Point: .....	Not Applicable
Lower Flammable Limit: .....	15.5 % Volume in Air
Upper Flammable Limit:.....	27.0 % Volume in Air
Autoignition Temperature.....	1204° F (651° C)

**Extinguishing Media:** Stopping the flow of gas rather than extinguishing the fire is usually the best procedure to follow when escaping gas is burning.

Small Fire:..... Dry chemical or CO<sub>2</sub>

Large Fire:..... Water spray, fog or foam

##### **Special Fire Fighting Procedures:**

- a. Do not get water inside container.
- b. Move container from fire area if you can do it without risk.
- c. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks due to exploding potential when tanks are involved in a fire.
- d. Isolate area until gas has dispersed.
- e. Use water spray or foam to control vapors.
- f. Positive pressure self-contained breathing apparatus (SCBA) should be used when there is a potential for inhalation of vapors and/or fumes.
- g. Chemical protective clothing that is safe for use with ammonia involved in a fire should be worn.

**CAUTION:**

- a. With proper training, structural fire fighter's protective clothing and SCBA used in conjunction with water spray will provide limited protection for short-term exposure to ammonia vapors.
- b. Liquid ammonia may cause protective equipment to become brittle.
- c. Use of welding or flame cutting equipment on or in ammonia container is not recommended unless all ammonia has been purged, rinsed with water, and any oil residue removed.

Runoff from fire control or dilution water may cause pollution.

**6. ACCIDENTAL RELEASE MEASURES**

**Spill or Leak Measures:** Stop leak if you can do so without risk. Keep unnecessary people away, isolate hazard area and deny entry. Stay upwind, out of low areas, and ventilate closed spaces before entering. Evaluate the affected area to determine whether to evacuate or shelter-in-place by taping windows and doors, shutting off outside air intakes (attic fans, etc.), and placing a wet towel or cloth over the face (if needed). With proper training, self-contained breathing apparatus (SCBA) and structural firefighter's protective clothing used in conjunction with water spray will provide limited protection in outdoor releases for short-term exposure. Fully encapsulating, vapor-protective clothing should be worn for spills and leaks with no fire. Use water spray or foam to control vapors. Mixing of water and liquid ammonia will increase vaporization rate. Do not put water on liquid ammonia unless more than 100 volumes of water are available for each volume of liquid ammonia.

**CAUTION:**

- a. Personal protective clothing may become brittle when exposed to liquid ammonia.
- b. Runoff from vapor control or dilution may cause pollution.

**Determining Spill Size:** Generally, a small spill is one that involves a single, small container (55-gallon capacity or less), or a small (non-continuing) leak from a larger tank or vessel.

**Small Spill:**

- a. Flush area with flooding amounts of water.
- b. First isolate 100 feet in all directions and then protect persons downwind 0.1 miles during daylight and 0.1 miles at night.

**Large Spill:**

- a. Dike far ahead of liquid spill for later disposal.
- b. Follow local emergency protocol for handling.
- c. First isolate 200 feet in all directions, than protect persons downwind 0.4 miles during daylight and 1.4 miles at night.

## 7. HANDLING AND STORAGE

Follow the current ANSI-K61.1 Standard, "Safety Requirements for the Storage and Handling of Anhydrous Ammonia", or applicable Ammonia Manufacturing Industry Standards. (See Section 15 for information on Equipment, Pressure Vessels and Testing).

**Handling Precautions:** Use proper personal protective equipment when working with or around ammonia. See Section 8.

## 8. EXPOSURE CONTROLS, PERSONAL PROTECTION

### **Respiratory Protection Requirements:**

- <25 ppm: No protection required.
- 25 to 35 ppm: Protection required if the daily TWA is exceeded.
- 35 to 50 ppm: Protection required if exposed for more than 15 minutes.
- 50 to 250 ppm: Minimum of an air-purifying respirator equipped with ammonia canister(s) or cartridge(s).
- 250 to 300 ppm: Minimum of a full-face air-purifying respirator equipped with ammonia canister(s) or cartridge(s).
- >300 ppm: A fresh air supply system must be used (i.e. positive pressure self contained breathing apparatus).

**Skin Protection Requirements:** Skin protection is required for exposure to liquid, mist, and > 1000 ppm of ammonia gas or vapors. Neoprene or rubber gauntlet-type gloves, ammonia resistant clothing (overalls, jacket, and boots) or vapor suit, as required.

**Eye Protection Requirements:** Use chemical (indirectly vented) goggles when there is a potential for contact with liquid or mist. A full-face shield is recommended in addition to goggles for added protection.

**Other Protective Equipment:** Safety shower and eyewash fountain should be provided in the ammonia handling area. In agricultural distribution, provide easily accessible shower and/or at least 100 gallons of clean water in open top container (check regulations). When transporting, provide at least 5 gallons of readily accessible, clean water and personal protective equipment.

**Engineering Controls:** Maintain adequate ventilation to keep ammonia concentrations below applicable standards when possible.

**NOTE:** See Section 2 for regulatory exposure limits.

## 9. PHYSICAL AND CHEMICAL PROPERTIES

Physical Form:	Gas (liquid under pressure)
Color:	Colorless gas and liquid, forms white vapor in contact with moisture
Odor:	Strong pungent penetrating odor, ammonia.
Boiling Point:	-28.1° F (-33° C) at 1 atm
Melting point:	-107.9° F (-78° C)
Ph:	Approximately 12.0 (neat)
Solubility:	510 - 530 g/L @ 20° C
Specific Gravity:	0.6818 @ -33.35° C and 1 atm
Vapor Density:	0.597 @ 0° C (0.60 @ 60° F)
Vapor Pressure:	7,600 mm Hg @ 25° C (93 psig @ 60° F)
% Volatile by Volume:	100
Molecular Weight:	17.03
Density:	0.696 g/L @ 20° C (5.14 lb./gal. @ 60° F)
Critical Temperature:	271° F (133° C)
Critical Pressure:	1636 psia

## 10. REACTIVITY

Stability: ..... This is a stable material.  
Hazardous Polymerization: ..... Will not occur.

**Decomposition:** Hydrogen is released on heating above 850° F (454° C). The decomposition temperature may be lowered to 575° F (300° C) by contact with certain metals such as nickel. At 1290° F (690° C) or in the presence of an electric spark, ammonia decomposes into nitrogen and hydrogen gases, which may form a flammable mixture in the air.

### **Incompatibilities:**

- Ammonia has potentially explosive or violent reactions with interhalogens, strong oxidizers, Nitric Acid, Fluorine, and Nitrogen Oxide.
- Ammonia forms sensitive explosive mixtures with air and hydrocarbons, Ethanol and Silver Nitrate, and Chlorine; and explosive products are formed by the reaction of ammonia with Silver Chloride, Silver Oxide, Bromine, Iodine, Gold, Mercury, and Tellurium Halides.
- Ammonia is incompatible or has potentially hazardous reactions with Silver, Acetaldehyde, Acrolein, Boron, Halogens, Perchlorate, Chloric Acid, Chlorine Monoxide, Chlorites, Nitrogen Tetroxide, Tin, and Sulfur.

**NOTE:** The incompatibilities above are a partial list taken from two books by Sax & Lewis: "Dangerous Properties of Industrial Materials", 7th. ed., 1989 and "Hawley's Condensed Chemical Dictionary", 11th. ed. 1987, both published by Van Nostrand Reinhold Company, New York. It is recommended that if additional information is required, the reader refer to these and other published information.

## 11. TOXICOLOGICAL INFORMATION

### Toxicity

#### Acute Inhalation Toxicity

LC<sub>50</sub> Rat, mouse:..... 4,200 - 19,060 mg NH<sub>3</sub>/m<sup>3</sup> (1 hr)

#### Acute Toxicity, Other Routes

LC<sub>50</sub> Rat, mouse:..... 45.5 - 195.1 mg NH<sub>3</sub>/kg bw (I hr intravenous)

#### Corrosiveness / Irritation

Skin Irritation / Corrosion:..... Corrosive to skin

Eye Irritation / Corrosion:..... Subacute and chronic exposure to 200 – 1,000 ppm produced eye damage. 100 – 200 ppm produced moderate to severe irritation.

#### Repeated Dose Toxicity

Rats, guinea pigs, rabbits, etc:.....No mortality (Inhalation up to 770 mg/m<sup>3</sup>)

#### Genetic Toxicity *in vitro*

*Salmonella typhimurium*, etc:.....Negative (Bacterial gene mutation assay)

Chick fibroblasts:.....Induced chromosomal clumping, polyploidy, and arrested spindle formation. No data showing that ammonia is mutagenic in mammals. (Cytogenetic assay)

#### Genetic Toxicity *in vivo*

*Drosophila melanogaster*:.....No evidence for mutagenicity

#### Carcinogenicity

All:.....No carcinogenic effects

#### Toxicity to Reproduction

Pig:.....Temporarily depressed mean daily gain (MDG) at 35 mg/kg in gilts (One generation study)

#### Human Experience

Inhalation, human volunteers:.....Nasal and pulmonary irritation at concentrations of about 100 ppm and higher.

### Ecotoxicity

#### Acute Toxicity to Fish

LC<sub>50</sub> Many species:..... 0.09 – 3.51 mg un-ionized NH<sub>3</sub>/L (96 hr)

#### Acute Toxicity to Aquatic Invertebrates

LC<sub>50</sub> *Daphnia magna*:..... 2.94 mg un-ionized NH<sub>3</sub>-N/L (48 hr)

#### Toxicity to Aquatic Plants

LOEC Benthic diatoms:..... 0.5 – 1.0 mg N/L (Up to 25 days)

LOEC *Chlorella vulgaris*:..... 500 mg N/L (21 days)

#### Toxicity to Bacteria

EC<sub>50</sub> *Photobacterium phosphoreum*:..... 1.49 mg un-ionized NH<sub>3</sub>/L (5 min)

Chronic Toxicity to Fish

NOEC Many species: .....0.025 – 1.2 mg un-ionized NH<sub>3</sub>/L (Varied 12 days – 5 years)

Chronic Toxicity to Aquatic Invertebrates

NOEC *Daphnia magna* and others:.....0.163 – 0.42 mg un-ionized NH<sub>3</sub>/L (Varied 21 days – 76 weeks)

Toxicity to Terrestrial Plants

LOEC Many species .....3 – 250 ppm (Varied 4 min – 16 hrs)

Toxicity to Other Non-Mammalian Terrestrial Species

LD<sub>50</sub> *G. Domesticus*:.....2.72 mM (1 hr injections)

Source: TFI Product Testing Program April 2003

**12. ECOLOGICAL INFORMATION**

- a. Ammonia is harmful to aquatic life in very low concentrations and may be hazardous if it enters water intakes.
- b. Local health and wildlife authorities, as well as operators of water intakes in the vicinity, should be notified of water releases.
- c. Waterfowl toxicity may occur at elevated concentrations.
- d. Ammonia does not concentrate in the food chain.
- e. The conversion of ammonia to nitrites/nitrates by bacteria in aquatic systems can reduce the concentration of dissolved oxygen (referred to as nitrogenous oxygen demand).

Effect on water treatment process: Chlorination will produce chloramines, which are more readily detected by taste and odor.

**Note:** See Ecotoxicity information in section 11.

**13. DISPOSAL CONSIDERATIONS**

Reclaim as fertilizer if possible. Waste must be disposed of in accordance with federal, state, and local environmental control regulations.

**14. TRANSPORTATION INFORMATION**

U.S. DOT and Canadian TGD Act

Shipping Name:..... Ammonia, anhydrous

Shipping Class/Division:..... 2.2 (U.S.); 2.3 (8) (Canada)

Hazard Class: ..... Non-Flammable Gas (U.S.); Toxic Gas (Canada)

Product Identification Number (PIN): ..... UN1005

DOT Placard: ..... Non-Flammable Gas 2.2, color: green (U.S.); Class 2.3 or UN1005, color: white (Canada)

DOT Special Provision: ..... 13, "Inhalation Hazard"

OSHA Label Required: ..... Yes

RQ (Reportable Quantity):..... 100 pounds

STCC Number: ..... 4904210

## 15. **REGULATORY INFORMATION**

**Controlled Products Regulations Classification:** A: Compressed Gas; E: Corrosive

**OSHA:** This product is considered a hazardous material under criteria of the Federal OSHA Hazard Communication Standard 29 CFR 1910.1200 (Toxic; Corrosive), and is listed as a Highly Hazardous Chemical subject to the requirements of the Process Safety Management Standard 29 CFR 1910.119.

**CAA Chemical Accident Prevention:** Ammonia is considered a regulated substance subject to the Chemical Accident Prevention provisions of 40 CFR Part 68. The threshold quantity for this substance is 10,000 lbs.

### **SARA TITLE III:**

- a. EHS (Extremely Hazardous Substances) List: Listed (EPA, 1992a)
- b. SARA RQ (Reportable Quantity): 100 pounds
- c. TPQ (Threshold Planning Quantity): 500 pounds
- d. Regulation: "Emergency Planning and Notification" - 40 CFR Part 355 (Appendices A and B).
- e. Section 313: "Specific Toxic Chemical Listings" - 40 CFR Part 372  
Ammonia is subject to the reporting requirements of Section 313 "Specific Toxic Chemical Listings" 40 CFR Part 372. Terra is required by 40 CFR 372.45 to notify certain customers as to which of its mixture or trade name products contain those chemicals. The purpose of that notification is to ensure that facilities that may be subject to the reporting requirements of Section 313 and that use products of unknown formulation will have knowledge that they are receiving products that contain chemicals subject to those reporting requirements.

### **CERCLA Hazardous Substances List:**

- a. CERCLA RQ (Reportable Quantity): 100 pounds
- b. Regulation: "Designation, Reportable Quantities, Notification" - 40 CFR 302

**TSCA Inventory:** Listed (RTECS)

### **Chemical Facility Anti-Terrorism Standard (CFATS) / 6 CFR Part 27:**

Ammonia (anhydrous) is listed in Appendix A as a Chemical of Interest (COI) due to threat of "Release"

Screening Threshold Quantity (STQ): 10,000 pounds

**Equipment, Pressure Vessels, Testing, Etc.:** All equipment used to handle, store, transfer or apply anhydrous ammonia must be properly engineered, constructed and maintained in compliance with all applicable regulations and standards. Pressure vessels, piping and appurtenances should be regularly inspected and tested using methods designed to reveal external and internal deterioration or defects that may impair the integrity of the equipment such that an unintended release of anhydrous ammonia may result. Consult with your State Department of Agriculture and other experts, as applicable, concerning the methods that would be most appropriate given the particular circumstances. Refer to 29 CFR 1910.111, *Storage and Handling of Anhydrous Ammonia*; 29 CFR 1910.119, *Process Safety Management of Highly Hazardous Materials*; and the current ANSI standard K61.1, *Safety Requirements for the Storage and Handling of Anhydrous Ammonia*, for additional information.

## **16. OTHER INFORMATION**

- Dec. 18, 1995: The MSDS was rewritten to comply with ANSI Standard Z400.1-1993.
- July 1, 2003: Added toxicity information from the TFI Product Testing Program April 2003.
- October 4, 2006: Added NFPA hazard classification information and updated isolation / protective action distances per ERG 2004.
- Dec. 19, 2006: Added Equipment, Pressure Vessel and Testing Information.
- August 24, 2007: Reviewed and revised.
- January 2, 2008: Revised 15. Regulatory Information to add CFATS requirements
- April 23, 2008: Revised 14. Transportation Information to change Canadian TDG requirements

The information and recommendations herein are taken from data contained in independent, industry-recognized references including but not limited to NIOSH, OSHA, ANSI, NFPA, DOT ERG, the TFI Product Testing Program, Global Engineering Documents, MEDITEXT, HAZARDTEXT, SARATEXT, CHRIS, OHM/TADS, and IRIS. Terra Industries Inc. makes no guarantee, warranty or other representation concerning this substance, since conditions of its use are beyond the control of the company. Terra Industries Inc. disclaims any liability for loss or damage incurred in connection with the use of this substance.



## CP2MG SSG (BIS CYCLOPENTADIENYL MAGNESIUM)

### 1. CHEMICAL PRODUCT AND COMPANY INFORMATION

<b>Product name</b> CP2MG SSG (BIS CYCLOPENTADIENYL MAGNESIUM)	<b>Chemical description</b> Bis(cyclopentadienyl)magnesium
<b>Synonym</b> CP2MG Select Semiconductor Grade	<b>Chemical formula</b> (C5 H5)2 Mg
<b>CAS number</b> 1284-72-6	<b>Chemical family</b> Magnesium alky
<b>Supplier</b> Akzo Nobel Polymer Chemicals LLC 300 South Riverside Plaza Chicago, IL 60606 USA	
<b>Medical/Handling Emergency</b> + 1-914-693-6946 Dobbs Ferry, NY USA	<b>Transportation Emergency</b> CHEMTREC - USA: 1-800-424-9300 CANUTEC - CANADA: 1-613-996-6666
<b>Product use</b> Semiconductors	<b>Product/technical Information</b> 1-800-828-7929
<b>Date of first issue</b> - -	<b>Date of last issue / Revision #</b> 10-20-2000 / 1.00

### 2. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient	Percentage(s)	CAS number
Bis(cyclopentadienyl)magnesium (Cp2Mg)	100.00	1284-72-6

### 3. HAZARDS IDENTIFICATION

<p><b>Emergency overview</b>          White crystals.  <b>DANGER!</b>  <b>EXTREMELY FLAMMABLE. CATCHES FIRE IF EXPOSED TO AIR.</b>  <b>CAUSES SKIN AND EYE BURNS.</b>  <b>REACTS VIOLENTLY WITH WATER.</b>          Metal alkyls are pyrophoric. The metal alkyl reacts spontaneously with air and/or moisture resulting in ignition. In case of fire, reignition of the metal alkyl may occur after the fire has been extinguished.</p>
<p><b>Health effects</b>          Skin and eye contact are the primary routes of exposure to this product.          Inhalation of the metal alkyl in this product is unlikely due to the highly reactive nature of the metal alkyl with air and its low vapor pressure.          This material will react with moisture in or on the skin to produce thermal burns.          This product will react with moisture in the eyes to produce severe thermal burns.          Ingestion will result in burning of the mouth, throat and any part of the gastrointestinal system with which the material comes in contact. Nausea and vomiting may occur.</p>

<b>Carcinogenicity</b>	
<b>Description</b>	<b>Applicable</b>
IARC	no
NTP	no



## CP2MG SSG (BIS CYCLOPENTADIENYL MAGNESIUM)

OSHA	no
ACGIH	no

### 4. FIRST AID MEASURES

#### Inhalation

Remove victim to fresh air while protecting yourself from exposure with an appropriate respirator. Remove any contaminated clothing to prevent further inhalation exposure. Use gloves to avoid contaminating yourself. If not breathing, clear victim's airway and start artificial respiration. Avoid inhaling expired air. Artificial respiration may be supplemented by the use of a bag-mask respirator or manually triggered oxygen supply capable of delivering one liter per second or more. If victim is breathing, supplemental oxygen may be given from a demand-type or continuous-flow inhaler, preferably with a physician's advice. Monitor breathing and pulse. If victim stops breathing, restart artificial respiration. If heart has stopped, begin cardiopulmonary resuscitation immediately. Keep person warm and at rest. Get medical attention immediately.

#### Skin

Immediately, without delay, very gently blot excess chemical from skin while wearing impervious gloves and air tight safety goggles. If victim is wearing air tight safety goggles, do not remove them. Take care not to contaminate the victim's healthy skin and eyes. Wash all affected areas with plenty of water for at least 15 minutes. Do not break open blisters or remove skin. If clothing is stuck to the skin after flushing with water, do not remove it. Do not attempt to neutralize with chemical agents. Wash or discard contaminated clothing and shoes. Obtain medical advice immediately.

#### Eye

Immediately flush eyes with large quantities of running water for a minimum of 15 minutes. If the victim is wearing contact lenses, remove them. Take care not to contaminate the victim's healthy skin and eyes. Hold the eyelids apart during the flushing to ensure rinsing of the entire surface of the eye and lids. DO NOT let victim rub eye(s). Do not attempt to neutralize with chemical agents. Get medical attention immediately. Oils or ointments should not be used at this time. Continue flushing for an additional 15 minutes if a physician is not immediately available.

#### Ingestion

Do NOT induce vomiting. Call a physician or a poison control center immediately. Give victim plenty of water to drink. Never give anything by mouth to an unconscious or convulsing person. Get medical attention immediately.

#### Note to physician

There are no data available that address medical conditions that are generally recognized as being aggravated by exposure to this product.

Attending physician should treat exposed patients symptomatically. Treat thermal burns, if present. Flush eyes with buffered or plain irrigating solutions. If any ulceration or conjunctival injury is present, have an ophthalmologist examine the patient.

### 5. FIRE-FIGHTING MEASURES

<b>Flash point</b> Pyrophoric! (ignites in air.)	<b>Autoignition temperature</b> Ignites spontaneously in air
<b>Flash Method</b> N/A	<b>Explosion limits</b> lower: N/D upper: N/D
<b>Extinguishing media</b> THE MOST EFFECTIVE FIRE EXTINGUISHING AGENT IS DRY CHEMICAL POWDER PRESSURIZED WITH NITROGEN. Vermiculite or dry sand may also be used. CAUTION: REIGNITION MAY OCCUR. DO NOT USE FOAM, WATER (except as explained below), CARBON TETRACHLORIDE OR CHLOROBROMOMETHANE extinguishing agents as product either reacts violently or liberates toxic fumes and vapors on contact with these agents.	



## CP2MG SSG (BIS CYCLOPENTADIENYL MAGNESIUM)

### Fire fighting procedures

Protecting against fire by strict adherence to safe operating procedures and proper equipment are the best ways to minimize the possibility of fire damage. Immediate action should be taken to confine the fire. All lines and equipment which could contribute to the fire should be shut off.

Standard fireman's bunker gear is recommended for fighting metal alkyl fires. If the fire cannot be controlled with extinguishing agents, keep a safe distance, protect adjacent property and allow burn until consumed.

Human exposure must be prevented and nonessential personnel evacuated from the immediate area.

Breathing vapors from metal alkyl/hydrocarbon fires should be avoided by using proper respiratory equipment.

A NIOSH approved, positive-pressure/pressure demand, air-supplied, full-face respirator should be used.

### Fire and explosion hazards

Metal alkyls are pyrophoric. The metal alkyl reacts spontaneously with air and/or moisture resulting in ignition. In case of fire, reignition of the metal alkyl may occur after the fire has been extinguished.

This material reacts with air, water and compounds containing active hydrogen such as alcohols and acids.

Compounds containing oxygen or organic halide may react upon contact with this product.

Do not cut, grind, drill or weld on or near the container (even empty) of this product because an explosion may result. Keep away from heat, sparks and flame.

### Hazardous products of combustion

Products of complete combustion are carbon dioxide, water and magnesium oxide. Additionally, products of incomplete combustion may include carbon monoxide, elemental carbon and hydrocarbons (alkanes and alkenes).

### NFPA ratings

Hazard	Rating
Health	3
Flammability	3
Reactivity	3
Other	-W

## 6. ACCIDENTAL RELEASE MEASURES

### Methods for cleaning up

Appropriate personal protective equipment (PPE) should be worn while working with spilled material. Block off source of spill. Spilled material will likely give off smoke and fumes. Ignition may occur immediately.

Spill may be washed away cautiously with large quantities of water. Use water spray to reduce vapors.

CAUTION: Water may cause ignition/ reignition to occur. Dike water for later disposal. Do not allow contaminated water to enter waterways.

## 7. HANDLING AND STORAGE

### Handling

Electrically grounded tanks and containers should always be used as should non-sparking, electrically grounded hand tools and appliances. Ground or bond to ground all vessels when transferring to prevent the accumulation of static electricity. See National Electric Code.

### Storage

Store under an inert atmosphere. Nitrogen with less than 5 ppm each moisture and oxygen is recommended.

Containers should be stored in a cool, well-ventilated area away from flammable materials and sources of heat.

Exercise due caution to prevent damage or leakage from the container.

### Maximum storage temperature

not determined

### General comments

Under inert conditions the product is not corrosive to metals commonly used in construction. Some plastics and elastomers may be attacked. Contact Akzo Nobel Polymer Chemicals LLC for specific recommendations regarding suitable materials for use with this product.



## CP2MG SSG (BIS CYCLOPENTADIENYL MAGNESIUM)

### 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

#### Respiratory protection

This material is normally handled under nitrogen and closed process conditions. In an emergency where adequate ventilation is not available and conditions could generate fume, mist or aerosol, inhalation must be prevented through the use of NIOSH-approved organic vapor/ acid gas respirators with dust, mist and fume filters to reduce potential for exposure. Where exposure potential necessitates a higher level of protection, use a NIOSH-approved, positive-pressure/ pressure-demand, air-supplied respirator.

When using respirator cartridges or canisters, they must be changed frequently (following each use or at the end of the workshift) to assure breakthrough exposure does not occur.

#### Skin protection

Skin contact must be prevented through the use of fire-retardant clothing. During sampling, disconnecting lines or opening connections, additional protective outerwear including a full-face shield, impervious gloves, aluminized suit, a hard hat, steel toed safety shoes that cover the ankles and chemical safety glasses should also be worn.

#### Eye protection

Because eye contact with this product may cause severe and possibly permanent damage, chemical goggles and/or a full face shield must be worn whenever handling this product.

#### Ventilation protection

This material is normally handled under closed process conditions.

#### Other information

This product should not be used until all personnel handling it have been thoroughly trained. Contact Akzo Nobel Polymer Chemicals LLC, Chicago, IL. Additional information on safety and handling of organometallics is available in the Akzo Nobel Polymer Chemicals LLC brochure on metal alkyls.

During the development of safe handling procedures, consideration should be given to the need for cleaning of equipment and piping systems to render them nonhazardous before maintenance and repair activities are performed. Waste resulting from these procedures should be handled in an environmentally safe manner.

All food and smoking materials should be kept in a separate area away from the storage/use location. Eating, drinking and smoking should be prohibited in areas where there is a potential for exposure to this material. Before eating, hands and face should be thoroughly washed.

Safety showers, with quick opening valves which stay open, and eye wash fountains, or other means of washing the eyes with a gentle flow of cool to tepid tap water, should be readily available in all areas where this material is handled or stored. Water should be supplied through insulated and heat-traced lines to prevent freezeups in cold weather.

#### Applicable exposure limits

Other than any exposure limits which may be displayed in Section 8, there are no other known exposure limits applicable to this product.

Agency	Value/Unit of measurement
PEL = Permissible Exposure Limit TLV = Threshold Limit Value TWA = Time Weighted Average STEL = Short Term Exposure Limit CEIL = Ceiling Exposure Limit REL = Recommended Exposure Limit WEEL = Workplace Environmental Exposure Limit IDLH = Immediate Dangerous to Life and Health	

### 9. PHYSICAL AND CHEMICAL PROPERTIES

<b>Appearance and Odor</b> White crystals.	<b>pH value</b> not determined
<b>Odor threshold (ppm)</b> not determined	<b>Relative vapor density (air=1)</b> not determined



## CP2MG SSG (BIS CYCLOPENTADIENYL MAGNESIUM)

<b>Volatile %</b> approx. 100 % by weight	<b>Vapor pressure (mm Hg)</b> approx. 0.043 @ 25 C
<b>Boiling point/range</b> > 572.00 °F 300.00 °C @ 760 mm Hg (Decomposes)	<b>Evaporation rate</b> not determined
<b>Melting point/range</b> 348.80 °F 176.00 °C	
<b>Cloud point</b> not determined	<b>Pour point</b> not determined
<b>Flash point</b> Pyrophoric! (ignites in air.)	<b>Solubility in water</b> Reacts violently
<b>Flash method</b> N/A	<b>Solubility in other solvents</b> Miscible in sat hydrocarbons
<b>Autoignition temperature</b> Ignites spontaneously in air	
<b>Specific Gravity/Density</b> not determined	<b>Partition coefficient n-octanol/water</b> not determined
<b>Bulk density</b> not determined	
	<b>Explosion limits</b> lower: N/D upper: N/D

### 10. STABILITY AND REACTIVITY

<b>Stability</b> This product is stable when stored under a dry, inert atmosphere and away from heat. Nitrogen containing less than 5 ppm each moisture and oxygen is recommended. This product is not sensitive to impact.
<b>Incompatibilities</b> This product may react violently with air, water, and compounds containing active hydrogen such as alcohols and acids. Compounds containing oxygen or organic halide may react vigorously upon contact with the product.
<b>Polymerization</b> Hazardous polymerization is not expected to occur.
<b>Decomposition</b> Magnesium alkyls from Akzo Nobel Polymer Chemicals LLC are thermally stable products. Most show little or no decomposition at temperatures at least up to 140 C (284 F). Products of thermal decomposition include magnesium hydride and olefins.
<b>Conditions to avoid</b> Avoid contact with incompatible material, excessive heat and flames.

### 11. TOXICOLOGICAL INFORMATION

<b>Oral LD50</b>	Ingestion toxicity data are not available for this product.
<b>Dermal LD50</b>	Dermal toxicity data are not available for this product.
<b>Inhalation LC50</b>	Inhalation toxicity data are not available for this product.
<b>Skin</b>	Chronic dermal exposure effects for this product are not known. Skin contact with this product will cause severe chemical burns.



## CP2MG SSG (BIS CYCLOPENTADIENYL MAGNESIUM)

<b>Eye</b>	The acute eye effects of this product have not been determined. However, severe chemical and thermal burns can occur and may cause permanent eye damage.
<b>Chronic toxicity/carcinogenicity</b>	<p>Chronic ingestion effects of this product are not known. Ingestion will result in burns of the mouth, throat, esophagus and digestive tract.</p> <p>Chronic inhalation exposure effects for this product are not known.</p> <p>The carcinogenic/mutagenic properties of this product are not known.</p> <p>The reproductive toxicity of this product is not known.</p> <p>The neurotoxic effects of this product are not known.</p> <p>Overexposure to this product may affect the skin, eyes and respiratory system.</p>
<b>Other toxicological information</b>	No other toxic effects for this product are known.

## 12. ECOLOGICAL INFORMATION

<b>Ecotoxicological information</b>	The ecological toxicity of this product is not known.
<b>Bioaccumulation</b>	Chemical fate information on this product is not known.
<b>Other information</b>	Other ecological information on this product is not known.

## 13. DISPOSAL CONSIDERATIONS

<p><b>Waste disposal in accordance with regulations</b></p> <p>Incineration by controlled feed of air and product is a suitable disposal procedure. Alternately, deactivation can be achieved by diluting the product with hydrocarbon (heptane, etc.) to less than 5 weight percent metal alkyl concentration and treating the hydrocarbon solution with water under a nitrogen atmosphere in a vented and agitated container. Always add the diluted metal alkyl solution to a large excess of water. Allow for the generation of heat and flammable hydrocarbons when treating with water. Conduct water treatment in the absence of air to avoid possible ignition of flammable material. The products from hydrolysis are hydrocarbons and magnesium oxide.</p> <p>Consult RCRA hazardous waste regulations prior to deactivation for potential treatment permitting considerations.</p> <p>Should the unused product become a waste material, it would meet the characteristics of an ignitable and reactive waste per 40 CFR 261, Subpart C. It is the responsibility of the waste generator to determine if his wastes are hazardous by characteristics or listing.</p> <p>Note: A technical bulletin (No. 95-90) is available from Akzo Nobel Polymer Chemicals LLC describing details of disposal of laboratory quantities of metal alkyls.</p>
<p><b>Container disposal</b></p> <p>Bubbler cylinders containing residue are returnable to Akzo Nobel Polymer Chemicals LLC, 730 Battleground Road, Deer Park, TX 77536. Return shipments of containers are to be in compliance with DOT regulations.</p>



## CP2MG SSG (BIS CYCLOPENTADIENYL MAGNESIUM)

### 14. TRANSPORT INFORMATION

<b>Shipping description</b>	METAL ALKYLs, WATER-REACTIVE, N.O.S. (BIS(CYCLOPENTADIENYL)MAGNESIUM) 4.2; UN2003; I  North American Emergency Response Guide NO. 135
<b>Required labels</b>	Primary Label: SPONTANEOUSLY COMBUSTIBLE Subsidiary Label: DANGEROUS WHEN WET
<b>Environmentally hazardous substance</b>	This product does not contain an environmentally hazardous substance per 49 CFR 172.101, Appendix A.

### 15. REGULATORY INFORMATION

Products and/or components listed below are subject to the following:

Hazard classes	
Description	Applicable
HMIS Hazard Rating Source	HMIS
HMIS Health	3
HMIS Flammability	3
HMIS Reactivity	3
WHMIS Hazard Class	B-6; D-2B; E; F

#### Other regulatory information

Bis(cyclopentadienyl)magnesium is on the TSCA inventory.

### 16. OTHER INFORMATION

#### Other information

No other information is available.

#### Created by

PRODUCT SAFETY 914/674-5000

The information in this material safety data sheet should be provided to all who will use, handle, store, transport or otherwise be exposed to this product. All information concerning this product and/or suggestions for handling and use contained herein are offered in good faith and are believed to be reliable as of the date of publication. However, no warranty is made as to the accuracy of and/or sufficiency of such information and/or suggestions as to the merchantability or fitness of the product for any particular purpose, or that any suggested use will not infringe any patent. Nothing in here shall be construed as granting or extending any license under any patent. Buyer must determine for himself, by preliminary tests or otherwise, the suitability of this product for his purposes, including mixing with other products. The information contained herein supersedes all previously issued bulletins on the subject matter covered. If the date on this document is more than three years old, call to make certain that this sheet is current.

# MATERIAL SAFETY DATA SHEET

Date prepared: November 9, 1999

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## 1. Product and Company Identification

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PRODUCT IDENTIFIER: **Triethylborane (TEB)**

PRODUCT USE: Chemical intermediate

MANUFACTURED BY: Callery Chemical Company  
Division of Mine Safety Appliances Company  
PO Box 429; Pittsburgh, PA 15230  
Callery Customer Service: 1-412-967-4141  
Callery 24-Hour Telephone: 1-412-967-4100  
Transportation Emergency: 1-800-424-9300 in USA or 1-703-527-3887 outside USA

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## 2. Composition/Information on Ingredients

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	<u>wt%</u>	<u>Synonym(s)</u>
Triethylborane (CASRN: 97-94-9)	>99 wt%	TEB

OSHA REGULATORY STATUS: Hazardous by definition of Hazard Communication Standard, 29 CFR 1910.1200.

Indications of danger (Annex II): Highly flammable, Harmful

Nature of special risk attributed to dangerous substances (Annex III): R17, R34, R22

Safety advice concerning dangerous chemical substances (Annex IV): S6, S7/8, S23, S36, S43, S33

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## 3. Hazards Identification

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EMERGENCY OVERVIEW: Clear, colorless liquid with pungent odor. Pyrophoric liquid. Extremely flammable. Catches fire if exposed to air. Causes severe eye, skin, and respiratory tract burns. Vapor may cause respiratory tract irritation and central nervous system effects such as excitation. Harmful if swallowed.

PHYSICAL HAZARDS: Pyrophoric liquid. Extremely flammable. Catches fire if exposed to air.

POTENTIAL HEALTH EFFECTS: Causes eye, skin, and respiratory tract burns.

Primary Routes of Entry: Eye and skin contact, inhalation, ingestion

Target Organs: Eyes, skin, respiratory tract, central nervous system

Medical Conditions Generally Recognized as Aggravated by Exposure: Persons with preexisting skin and respiratory conditions may be more susceptible to the effects of this product.

Carcinogenicity: Triethylborane is not listed in the National Toxicology Program (NTP) Annual Report on Carcinogens, not found to be a potential carcinogen in the International Agency for Research on Cancer (IARC) Monographs, and not listed as an OSHA carcinogen.

POTENTIAL ENVIRONMENTAL EFFECTS: No environmental toxicity data for the product.

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## 4. First Aid Measures

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CAUSES THERMAL BURNS! SEND TO A PHYSICIAN IN ALL CASES.

Eyes: Immediately flush eyes with plenty of water for at least 20 minutes while holding eyelids open.

Skin: Immediately flush skin with plenty of cool water for at least 20 minutes while removing contaminated clothing and shoes. Dispose of contaminated clothing and shoes in compliance with all local, state, and federal laws and regulations.

Ingestion: For any accidental contamination of the mouth, gargle with water and rinse mouth thoroughly for at least 20 minutes. If swallowed, do not induce vomiting. Give demulcent such as milk, olive oil, or margarine in small amounts up to 2 or 3 ounces. Never give anything by mouth to an unconscious person.

Inhalation: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.

**(TEB)**

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## 5. Fire Fighting Measures

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**FLAMMABLE PROPERTIES:** Pyrophoric liquid. Extremely flammable. Catches fire if exposed to air.

Flashpoint (Setaflash closed cup): <0°C/<32°F

Flammable Limits: Spontaneous ignition in air at partial pressures of approximately one mm Hg (1300 ppm)

Autoignition Temperature: -20°C/-4°F

**EXTINGUISHING MEDIA:** Shut off source as soon as possible without risk. Control and confine the fire. Use water spray to control heat and protect equipment. If practical, allow fire to burn itself out. Temporary control may be obtained with foam, water spray, dry chemical, or carbon dioxide; but TEB may reignite when extinguisher is discontinued. DO NOT use halogenated fire extinguishing agents.

**UNUSUAL FIRE AND EXPLOSION HAZARDS:** Catches fire if exposed to air. Detonations or violent reactions may occur when mixed with strong oxidizing agents or halogenated hydrocarbons. TEB floats on water and use of water as an extinguishing agent may spread the fire. TEB burns with a green and yellow flame and produces a dense black smoke.

**PROTECTION OF FIRE FIGHTERS:** Wear full protective clothing, including protective gloves and boots. For respiratory protection, wear a NIOSH approved self-contained breathing apparatus with full facepiece operated in a positive-pressure mode.

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## 6. Accidental Release Measures

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**PROCEDURES FOR CLEANUP:** Wear recommended personal protective equipment. Be prepared to fight fire.

Eliminate ignition sources. Spills of TEB will ignite. See Section 5, "Fire Fighting Measures". Properly dispose of all residues immediately. Handle in compliance with all local, state, and federal laws and regulations.

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## 7. Handling And Storage

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**HYGIENIC PRACTICES:** Do not get in eyes, on skin, or on clothing. Wash thoroughly after handling. Keep container tightly closed. Do not breathe vapor or mist. Use only with adequate ventilation. Do not take internally.

**STORAGE:** Do not expose to air. Handle and store in a DRY closed system under DRY nitrogen gas. Do not store residues. Properly dispose of all residues immediately.

**WORK PRACTICES:** Keep away heat, sparks, flame, air, oxidizers, halogenated hydrocarbons, and combustible materials. Do not expose to air. Handle and store in a DRY closed system under DRY nitrogen gas in a cool, dry, well-ventilated area. Use only with clean, completely enclosed systems that have been purged with DRY nitrogen gas to inert containers, transfer lines, vessels, tanks, etc., such that the atmosphere stays below 3% oxygen. Use packless valves, welded piping, and other leakproof construction. Maintain a leakproof system. Use non-sparking tools when opening or closing containers. Bond and ground all systems when handling. Since empty containers retain product residue, follow label warnings even after container is emptied.

**PROTECTIVE MEASURES DURING REPAIR AND MAINTENANCE OF CONTAMINATED EQUIPMENT:** See Section 8.

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## 8. Exposure Controls/Personal Protection

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**ENGINEERING CONTROLS:** Maintain a leakproof system. Use packless valves, welded piping, and other leakproof construction. Use only with clean, completely enclosed systems that have been thoroughly purged with DRY nitrogen gas including containers, transfer lines, vessels, tanks, etc., such that the atmosphere stays below 3% oxygen. Handle in a DRY closed system under DRY nitrogen gas. Provide adequate local exhaust ventilation to minimize worker exposure. Prevent electrostatic charge buildup by using common bonding and grounding techniques.

**EXPOSURE CONTROLS:** None established for TEB.

**PERSONAL PROTECTIVE EQUIPMENT:**

**(TEB)**

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**Normal Use & Handling:** When exposure to eyes and skin is possible, wear chemical protective goggles with a faceshield and flame-retardant protective clothing. Glove permeation data does not exist for this product. Exposure limits have not been established for Triethylborane. When inhalation of vapor or mist is possible, wear a NIOSH-approved self-contained breathing apparatus with full facepiece operated in a positive-pressure mode. Eye wash and safety showers must be available and in good working order.

**Emergency Handling:** For firefighting, wear full protective clothing, including protective gloves and boots. For chemical spills, wear special protective clothing (vapor-protective suit with additional chemical flash fire escape protection, as specified in NFPA 1991). For respiratory protection, wear a NIOSH-approved self-contained breathing apparatus with full facepiece operated in a positive-pressure mode.

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## 9. Physical And Chemical Properties

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APPEARANCE: Clear, colorless liquid

ODOR: Pungent odor

FREEZING POINT: -135°F/-93°C

BOILING POINT: 95°C/203°F

VAPOR PRESSURE @ 20°C: 42.6 mm Hg

REID VAPOR PRESSURE @ 100°F: 14 psia

DENSITY @ 25°C: 0.68 gm/cm<sup>3</sup>

VISCOSITY @ 25°C: 0.30 centipoise

HEAT OF COMBUSTION: 20,230 BTU/pound (net); 115,500 BTU/gallon (net)

STABILITY TO AIR: Liquid will ignite when exposed to air

STABILITY TO WATER: No reaction, immiscible

STABILITY TO HEAT: Slow decomposition begins above 200°F/93.3°C

MOLECULAR WEIGHT: 98

FORMULA: (C<sub>2</sub>H<sub>5</sub>)<sub>3</sub>B

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## 10. Stability And Reactivity

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STABILITY (CONDITIONS TO AVOID): Stable. Keep away from heat, sparks, and flame.

INCOMPATIBILITY (SPECIFIC MATERIALS TO AVOID): Air, oxidizers, halogenated hydrocarbons, temperatures above 200°F/94°C (slow decomposition above this temperature; rate reported to be 4% in 60 hours at 212°F/100°C).

HAZARDOUS DECOMPOSITION PRODUCTS: Carbon monoxide, carbon dioxide, boron compounds

HAZARDOUS POLYMERIZATION: Not expected to occur.

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## 11. Toxicological Information

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TEB is pyrophoric and exposure can cause eye, skin, and mucous membrane burns.

Oral LD50 for rat of 235 mg/kg; toxic to animals when dose was administered directly into the stomach; unlikely that humans could be exposed to toxic oral dose since liquid TEB is pyrophoric. Inhalation LC50 rat of 700 ppm (four hours exposure), is not defined as toxic or highly toxic via inhalation route; vapor is pyrophoric at 1300 ppm. No dermal toxicity, skin or ocular irritation, or skin sensitization testing reported because exposure to skin and eyes would cause immediate, deep burns and subsequent scarring if not treated immediately.

Animals exposed to low non-pyrophoric concentrations of TEB in air became excited and had nasal irritation; at high concentration, some animals frothed at the mouth and/or nose, had convulsions. Death occurred in some animals but not all which showed frothing or had convulsions. Humans would be expected to have irritation of nose, throat, and mucous membranes and central nervous symptoms. Liquid splashed on the skin or in the eyes is expected to cause a fire and burns.

TOXICOLOGY DATA: For triethylborane, LD50(oral-rat)= 235 mg/kg  
LC50(inh-rat)= 700 ppm/4H

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## 12. Ecological Information

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ECOLOGICAL DATA: No environmental toxicity data for the product.

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### 13. Disposal Considerations

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WASTE DISPOSAL: Do not flush to sewer. Dispose in compliance with all local, state, and federal laws and regulations.

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### 14. Transport Information

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UPS and air shipments are forbidden.

HAZARDOUS MATERIALS/DANGEROUS GOODS CLASSIFICATION:

Proper Shipping Name: Pyrophoric liquid, inorganic, n.o.s. (triethylborane)  
Hazard Class: 4.2  
Packaging Group: I  
Identification Number: UN3194  
Labels: Spontaneously combustible

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### 15. Regulatory Information

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TSCA: Triethylborane is listed on the TSCA Public Inventory.

SARA 313 INFORMATION: Triethylborane does not contain a toxic chemical or chemicals subject to the reporting requirements of section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR 372.

CERCLA/SUPERFUND: Contains no CERCLA Extremely Hazardous Substances.

EINECS: 202-620-9 for triethylborane

EUROPEAN LABEL INFORMATION:

Symbols: F, Xn

Indications of danger (Annex II): Highly flammable, Harmful

Nature of special risk attributed to dangerous substances (Annex III):

R17 Spontaneously combustible in air.

R34 Causes burns.

R22 Harmful if swallowed.

Safety advice concerning dangerous chemical substances (Annex IV):

S6 Keep under DRY nitrogen.

S7/8 Keep container tightly closed and dry.

S23 Do not breathe vapor.

S36 Wear suitable protective clothing.

S43 In case of fire, do not use halogenated fire extinguishing agents.

S33 Take precautionary measures against static discharge.

NEW JERSEY: This product does not contain a chemical listed on the New Jersey Department of Health Hazard Right-to-Know Program Hazardous Substance List.

PENNSYLVANIA: This product does not contain a chemical subject to the Pennsylvania Worker and Community Right-to-Know Act.

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### 16. Other Information

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**WARNING:** This is a dangerous chemical product. By following the directions and warnings provided with this product, the dangers associated with the use of this product can be greatly reduced but never entirely eliminated. Callery Chemical Company makes no warranties, expressed or implied, with respect to this product and EXPRESSLY DISCLAIMS THE WARRANTY OF MERCHANTABILITY AND ANY WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE. Users assume all risks in handling, using or storing this product.

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file: TEB-MSDS-ANSI-98-R0



## TMAL SSG (TRIMETHYLALUMINUM)

### 1. CHEMICAL PRODUCT AND COMPANY INFORMATION

<b>Product name</b> TMAL SSG (TRIMETHYLALUMINUM)	<b>Chemical description</b> Trimethylaluminum
<b>Synonym</b> TMAL Select Semiconductor Grade	<b>Chemical formula</b> C <sub>3</sub> H <sub>9</sub> Al
<b>CAS number</b> 75-24-1	<b>Chemical family</b> Aluminum alkyl
<b>Supplier</b> Akzo Nobel Polymer Chemicals LLC 300 South Riverside Plaza Chicago, IL 60606 USA	
<b>Medical/Handling Emergency</b> + 1-914-693-6946 Dobbs Ferry, NY USA	<b>Transportation Emergency</b> CHEMTREC - USA: 1-800-424-9300 CANUTEC - CANADA: 1-613-996-6666
<b>Product use</b> Semiconductors	<b>Product/technical Information</b> 1-800-828-7929
<b>Date of first issue</b> 11-08-1994	<b>Date of last issue / Revision #</b> 06-20-2000 / 8.00

### 2. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient	Percentage(s)	CAS number
Trimethylaluminum	100.00	75-24-1

### 3. HAZARDS IDENTIFICATION

<p><b>Emergency overview</b>          Clear, colorless liquid  <b>DANGER!</b>  <b>EXTREMELY FLAMMABLE. CATCHES FIRE IF EXPOSED TO AIR.</b>  <b>CAUSES SKIN AND EYE BURNS.</b>  <b>REACTS VIOLENTLY WITH WATER.</b>          Metal alkyls are pyrophoric. The metal alkyl reacts spontaneously with air and/or moisture resulting in ignition. In case of fire, reignition of the metal alkyl may occur after the fire has been extinguished.</p>
<p><b>Health effects</b>          Skin and eye contact are the primary routes of exposure to this product.          Inhalation of this metal alkyl is unlikely due to the highly reactive nature of the metal alkyl with air and its low vapor pressure.          This material will react with moisture in or on the skin to produce thermal and chemical burns.          This product will react with moisture in the eyes to produce severe chemical and thermal burns.          Ingestion will result in burning of the mouth, throat and any part of the gastrointestinal system with which the material comes in contact. Nausea and vomiting may occur.</p>

Carcinogenicity	
Description	Applicable
IARC	no
NTP	no



## TMAL SSG (TRIMETHYLALUMINUM)

OSHA	no
ACGIH	no

### 4. FIRST AID MEASURES

#### Inhalation

Remove victim to fresh air while protecting yourself from exposure with an appropriate respirator. Remove any contaminated clothing to prevent further inhalation exposure. Use gloves to avoid contaminating yourself. If not breathing, clear victim's airway and start artificial respiration. Avoid inhaling expired air. Artificial respiration may be supplemented by the use of a bag-mask respirator or manually triggered oxygen supply capable of delivering one liter per second or more. If victim is breathing, supplemental oxygen may be given from a demand-type or continuous-flow inhaler, preferably with a physician's advice. Monitor breathing and pulse. If victim stops breathing, restart artificial respiration. If heart has stopped, begin cardiopulmonary resuscitation immediately. Keep person warm and at rest. Get medical attention immediately.

#### Skin

Very quickly and without touching the victim, wash victim down with large amounts of cold water from a hand-held hose, as if to flush away the chemical. CAUTION: Do not spray victim from the front. The flames will increase in intensity when water is first applied, but will quickly die out. Lay the victim flat on his back on a stretcher without removing the burnt clothing. Turn head to the side. Cover victim with a sterile sheet or a clean, dry cloth. Obtain medical attention immediately.

#### Eye

Immediately flush eyes with large quantities of running water for a minimum of 15 minutes. If the victim is wearing contact lenses, remove them. Take care not to contaminate the victim's healthy skin and eyes. Hold the eyelids apart during the flushing to ensure rinsing of the entire surface of the eye and lids. DO NOT let victim rub eye(s). Do not attempt to neutralize with chemical agents. Get medical attention immediately. Oils or ointments should not be used at this time. Continue flushing for an additional 15 minutes if a physician is not immediately available.

#### Ingestion

Because of the reactive nature of this material, ingestion is unlikely, however, if swallowed DO NOT INDUCE VOMITING. Call a physician or a poison control center immediately. Give victim plenty of water to drink. Never give anything by mouth to an unconscious or convulsing person. Get medical attention immediately.

#### Note to physician

There are no data available that address medical conditions that are generally recognized as being aggravated by exposure to this product.

Attending physician should treat exposed patients symptomatically. Chemical burns on the skin should be treated as thermal burns. Flush eyes with buffered or plain irrigating solutions. If any ulceration or conjunctival injury is present, have an ophthalmologist examine the patient.

### 5. FIRE-FIGHTING MEASURES

<b>Flash point</b> PYROPHORIC! (ignites in air)	<b>Autoignition temperature</b> Ignites spontaneously in air.
<b>Flash Method</b> Not Applicable	<b>Explosion limits</b> lower: Not applicable upper: Not applicable
<b>Extinguishing media</b> THE MOST EFFECTIVE FIRE EXTINGUISHING AGENT IS DRY CHEMICAL POWDER PRESSURIZED WITH NITROGEN. Vermiculite or dry sand may also be used. CAUTION: REIGNITION MAY OCCUR. DO NOT USE FOAM, WATER (except as explained below), CARBON TETRACHLORIDE OR CHLOROBROMOMETHANE extinguishing agents as product either reacts violently or liberates toxic fumes and vapors on contact with these agents.	



## TMAL SSG (TRIMETHYLALUMINUM)

### Fire fighting procedures

Protecting against fire by strict adherence to safe operating procedures and proper equipment are the best ways to minimize the possibility of fire damage. Immediate action should be taken to confine the fire. All lines and equipment which could contribute to the fire should be shut off.

Standard fireman's bunker gear is recommended for fighting metal alkyl fires. If the fire cannot be controlled with extinguishing agents, keep a safe distance, protect adjacent property and allow burn until consumed.

Human exposure must be prevented and nonessential personnel evacuated from the immediate area.

Breathing vapors from metal alkyl/hydrocarbon fires should be avoided by using proper respiratory equipment.

A NIOSH approved, positive-pressure/pressure demand, air-supplied, full-face respirator should be used.

### Fire and explosion hazards

Metal alkyls are pyrophoric. The metal alkyl reacts spontaneously with air and/or moisture resulting in ignition. In case of fire, reignition of the metal alkyl may occur after the fire has been extinguished.

This material may react with air, water and compounds containing active hydrogen such as alcohols and acids. Reaction with water and air liberates flammable hydrocarbon gas and alcohol. Compounds containing oxygen or organic halide may react upon contact with the product.

Do not use welding or cutting torch on or near any container of this material, even empty, because an explosion could occur. Do not store near heat or open flame.

### Hazardous products of combustion

Products of complete combustion are carbon dioxide, water and aluminum oxide. Additionally, products of incomplete combustion may include carbon monoxide, elemental carbon and hydrocarbons (alkanes and alkenes).

### NFPA ratings

Hazard	Rating
Health	3
Flammability	4
Reactivity	3
Other	-W

## 6. ACCIDENTAL RELEASE MEASURES

### Methods for cleaning up

Appropriate personal protective equipment (PPE) should be worn while working with spilled material. Block off source of spill. Spilled material will very likely give off smoke and fumes and may ignite spontaneously. After fire is extinguished or has been allowed to burn out, wash spill away with copious amounts of water (See Section 5, Fire Fighting Measures). CAUTION: Water may cause ignition/ reignition to occur. Dike water for later disposal. Do not allow contaminated water to enter waterways.

## 7. HANDLING AND STORAGE

### Handling

Electrically grounded tanks and containers should always be used as should non-sparking, electrically grounded hand tools and appliances. Ground or bond to ground all vessels when transferring to prevent the accumulation of static electricity. See National Electric Code.

### Storage

Store under an inert atmosphere. Dry nitrogen is a suitable inert gas. Containers should be stored in a cool, well-ventilated area away from flammable materials and sources of heat. Exercise due caution to prevent damage to or leakage from the container.

### Maximum storage temperature

not determined



## TMAL SSG (TRIMETHYLALUMINUM)

### General comments

Under inert conditions the product is not corrosive to metals commonly used in construction. Some plastics and elastomers may be attacked. Contact Akzo Nobel Polymer Chemicals LLC for specific recommendations regarding suitable materials for use with this product.

## 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### Respiratory protection

This material is normally handled under nitrogen and closed process conditions. In an emergency where adequate ventilation is not available and conditions could generate mist or aerosol, inhalation must be prevented through the use of NIOSH-approved organic vapor/ acid gas respirators with dust, mist and fume filters to reduce potential for exposure. Where exposure potential necessitates a higher level of protection, use a NIOSH-approved, positive-pressure/ pressure-demand, air-supplied respirator.

When using respirator cartridges or canisters, they must be changed frequently (following each use or at the end of the workshift) to assure breakthrough exposure does not occur.

### Skin protection

Skin contact must be prevented through the use of fire-retardant clothing. During sampling, disconnecting lines or opening connections, additional protective outerwear including full-face shield, impervious gloves, aluminized suit, a hard hat, steel toed safety shoes that cover the ankles and chemical safety goggles should also be worn.

### Eye protection

Because eye contact with this product may cause severe and possibly permanent damage, chemical goggles and/or a full face shield must be worn whenever handling this product.

### Ventilation protection

This material is normally handled under closed process conditions.

### Other information

This product should not be used until all personnel handling it have been thoroughly trained. Contact Akzo Nobel Polymer Chemicals LLC, Chicago, IL. Additional information on safety and handling of organometallics is available in the Akzo Nobel Polymer Chemicals LLC brochure on metal alkyls.

During the development of safe handling procedures, consideration should be given to the need for cleaning of equipment and piping systems to render them nonhazardous before maintenance and repair activities are performed. Waste resulting from these procedures should be handled in an environmentally safe manner.

All food and smoking materials should be kept in a separate area away from the storage/use location. Eating, drinking and smoking should be prohibited in areas where there is a potential for exposure to this material.

Before eating, hands and face should be thoroughly washed.

Safety showers, with quick opening valves which stay open, and eye wash fountains, or other means of washing the eyes with a gentle flow of cool to tepid tap water, should be readily available in all areas where this material is handled or stored. Water should be supplied through insulated and heat-traced lines to prevent freezeups in cold weather.

### Applicable exposure limits

Other than any exposure limits which may be displayed below, there are no other exposure limits applicable for this product or its components. The exposure limits for the aluminum alkyl shown in Section 8 refers to the "Aluminum, Alkyls, not otherwise classified, as Al" value.

Agency	Value/Unit of measurement
<b>Trimethylaluminum</b>	
ACGIH TLV/TWA	2.000 mg/m <sup>3</sup>
NIOSH REL/TWA	2.000 mg/m <sup>3</sup>
PEL = Permissible Exposure Limit TLV = Threshold Limit Value TWA = Time Weighted Average STEL = Short Term Exposure Limit CEIL = Ceiling Exposure Limit REL = Recommended Exposure Limit WEEL = Workplace Environmental Exposure Limit IDLH = Immediate Dangerous to Life and Health	



## TMAL SSG (TRIMETHYLALUMINUM)

### 9. PHYSICAL AND CHEMICAL PROPERTIES

<b>Appearance and Odor</b> Clear, colorless liquid	<b>pH value</b> not determined
<b>Odor threshold (ppm)</b> not determined	<b>Relative vapor density (air=1)</b> N/D
<b>Volatile %</b> N/D	<b>Vapor pressure (mm Hg)</b> 11 mm Hg @ 68 F (20 C)
<b>Boiling point/range</b> 261.00 °F 127.22 °C @ 760 mm Hg	<b>Evaporation rate</b> not determined
<b>Melting point/range</b> 59.00 °F 15.00 °C	
<b>Cloud point</b> N/D	<b>Pour point</b> not determined
<b>Flash point</b> PYROPHORIC! (ignites in air)	<b>Solubility in water</b> Reacts violently
<b>Flash method</b> Not Applicable	<b>Solubility in other solvents</b> Miscible with hydrocarbons
<b>Autoignition temperature</b> Ignites spontaneously in air.	
<b>Specific Gravity/Density</b> 0.74 @ 86 F (30 C)	<b>Partition coefficient n-octanol/water</b> not determined
<b>Bulk density</b> Not Applicable	
<b>Other information</b> Viscosity @ 86 F (30 C) = 0.9 cp.      Density @ 77 F (25 C) = 0.748 g/ml.	<b>Explosion limits</b> lower: Not applicable upper: Not applicable

### 10. STABILITY AND REACTIVITY

<b>Stability</b> This product is stable when stored under dry, inert atmosphere and away from heat. Dry nitrogen containing less than 5 ppm oxygen and less than 5 ppm of moisture is recommended. This product is not sensitive to physical impact.
<b>Incompatibilities</b> This product may react violently with air, water, and compounds containing active hydrogen such as alcohols and acids. Compounds containing oxygen or organic halide may react vigorously upon contact with the product.
<b>Polymerization</b> Hazardous polymerization is not expected to occur.
<b>Decomposition</b> Product may undergo exothermic decomposition with gas (methane) evolution at temperatures above 120 C (248 F).
<b>Conditions to avoid</b> Avoid contact with incompatible material, excessive heat and flames.



## TMAL SSG (TRIMETHYLALUMINUM)

### 11. TOXICOLOGICAL INFORMATION

<b>Oral LD50</b>	Ingestion toxicity data are not available for this product.
<b>Dermal LD50</b>	Dermal toxicity data are not available for this product.
<b>Inhalation LC50</b>	Inhalation toxicity data are not available for this product.
<b>Skin</b>	Chronic dermal exposure effects for this product are not known. Skin contact with this product will cause severe chemical burns.
<b>Eye</b>	The acute eye effects of this product have not been determined.
<b>Chronic toxicity/carcinogenicity</b>	<p>Chronic ingestion effects of this product are not known. Ingestion will result in burns of the mouth, throat, esophagus and digestive tract.</p> <p>Chronic inhalation exposure effects for this product are not known.</p> <p>The carcinogenic/mutagenic properties of this product are not known.</p> <p>The reproductive toxicity of this product is not known.</p> <p>The neurotoxic effects of this product are not known.</p> <p>Overexposure to this product may affect the skin and eyes.</p>
<b>Other toxicological information</b>	No other toxic effects for this product are known.

### 12. ECOLOGICAL INFORMATION

<b>Ecotoxicological information</b>	The ecological toxicity of this product is not known.
<b>Bioaccumulation</b>	This product decomposes to hydrogen, hydrocarbons and elemental aluminum.
<b>Other information</b>	Other ecological information on this product is not known.

### 13. DISPOSAL CONSIDERATIONS

<p><b>Waste disposal in accordance with regulations</b></p> <p>Incineration by controlled feed of air and product is a suitable disposal procedure. Alternately, deactivation can be achieved by diluting the product with hydrocarbon (heptane, etc.) to less than 5 weight percent metal alkyl concentration and treating the hydrocarbon solution with water under a nitrogen atmosphere in a vented and agitated container. Always add the diluted metal alkyl solution to a large excess of water. Allow for the generation of heat and flammable hydrocarbons when treating with water. Conduct water treatment in the absence of oxygen gas to avoid possible ignition of flammable material. The products from hydrolysis are ethane and aluminum oxide(hydrated).</p> <p>Consult RCRA hazardous waste regulations prior to deactivation for potential treatment permitting considerations.</p> <p>Should the unused product become a waste material, it would meet the characteristics of an ignitable (D001) and reactive (D003) waste per 40 CFR, 261, Subpart C. It is the responsibility of the waste generator to evaluate whether his wastes are hazardous by characteristics or listing.</p> <p>Note: A technical bulletin (No. 95-90) is available from Akzo Nobel Polymer Chemicals LLC describing details of disposal of laboratory quantities of metal alkyls.</p>
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## TMAL SSG (TRIMETHYLALUMINUM)

### Container disposal

Containers with residual semiconductor grade metal alkyls may be returned to : Akzo Nobel Polymer Chemicals LLC, 730 Battleground Road, Deer Park, Texas 77536. Return shipments of containers are to be in compliance with DOT regulations.

## 14. TRANSPORT INFORMATION

<b>Shipping description</b>	ALUMINUM ALKYLs 4.2, UN3051, PG I NORTH AMERICAN EMERGENCY RESPONSE GUIDE NO. 135 ICAO: FORBIDDEN IMO: UN3051
<b>Required labels</b>	Primary Label: SPONTANEOUSLY COMBUSTIBLE Subsidiary Label: DANGEROUS WHEN WET
<b>Environmentally hazardous substance</b>	This product does not contain an environmentally hazardous substance per 49 CFR 172.101, Appendix A.

## 15. REGULATORY INFORMATION

Products and/or components listed below are subject to the following:

### Trimethylaluminum

Massachusetts Substance List	yes
New Jersey R-T-K Hazard. Sub.	yes
Penn. Hazardous Substance list	yes
Toxic Subst. Cont. Act -listed	yes
Domestic Substance List-Canada	yes

### Hazard classes

Description	Applicable
HMIS Hazard Rating Source	HMIS
HMIS Health	3
HMIS Flammability	4
HMIS Reactivity	3
WHMIS Hazard Class	B-6, D-2B, E, F

### Other regulatory information

No other regulatory information is available on this product.

## 16. OTHER INFORMATION

### Other information

No other information is available.

### Created by

PRODUCT SAFETY 914-674-5000

The information in this material safety data sheet should be provided to all who will use, handle, store, transport or otherwise be exposed to this product. All information concerning this product and/or suggestions for handling and use contained herein are offered in good faith and are believed to be reliable as of the date of publication. However, no warranty is made as to the accuracy of and/or sufficiency of such information and/or suggestions as to the merchantability or fitness of the product for any particular purpose, or that any suggested use will not infringe any patent. Nothing in here shall be construed as granting or extending any license under any patent. Buyer must determine for himself, by preliminary tests or otherwise, the suitability of this product for his purposes, including mixing with other products. The information contained herein supersedes all previously issued bulletins on the subject matter covered. If the date on this document is more than three years old, call to make certain that this sheet is current.



# MATERIAL SAFETY DATA SHEET

Date of Issue: 13 March 2000  
Revision: 5  
ID: tmga

## TRIMETHYLGALLIUM

### 1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND COMPANY.

**Product Name**  
Trimethylgallium  
**Formula**  
(CH<sub>3</sub>)<sub>3</sub>Ga  
**Company Identification**  
See footer.

### 2. COMPOSITION/INFORMATION ON INGREDIENTS

**Substance/Preparation**  
Trimethylgallium  
**Components/Impurities**  
None  
**EC No.**  
215-897-6  
**CAS No.**  
1445-79-0

### 3. HAZARDS IDENTIFICATION

Pyrophoric liquid, decomposes violently in water. Skin contact can cause severe burns. Fumes may cause skin and eye irritation. Avoid inhalation of fumes.

### 4. FIRST AID MEASURES

Prompt medical attention is required in all cases of exposure to Trimethylgallium and its by-products. Rescue personnel should be equipped with appropriate protective equipment (e.g. Self-contained breathing apparatus) to avoid unnecessary exposure and must be aware of the fire and explosion potential of Trimethylgallium.

#### Skin

Contact may cause severe burns. Fumes may cause irritation. Immediately flush affected areas with large quantities of water. Remove affected clothing as rapidly as possible only if not stuck to skin.

#### Eyes

Contact may cause severe burns. Fumes may cause irritation. Persons with potential exposure to Trimethylgallium should not wear contact lenses. Flush contaminated eyes with large quantities of water for at least 15 minutes. Hold eyelids open to ensure complete flushing.

#### Inhalation

May cause irritation. Move exposed personnel to an uncontaminated area quickly using self-contained breathing apparatus. If breathing is difficult, give oxygen. If breathing has stopped, apply artificial respiration. Medical assistance should be sought immediately. Keep victim warm and quiet.

### 5. FIRE-FIGHTING MEASURES

#### Extinguishing Media

Always use dry powder, soda ash or lime. Never use water, foam or halogenated compounds to fight fires involving organometallic materials. Without risk, stop flow of this compound to the fire. Without risk, and if safe to do so, move container(s) away from fire area.

#### Exposure Hazards

In a controlled fire any unreacted Trimethylgallium may re-ignite when contact with air or water is renewed.

#### Special Protective Equipment for Fire-Fighters

Fire resistant clothing, self-contained breathing apparatus, face shield and safety goggles, safety shoes and fire resistant gloves.

### 6. ACCIDENTAL RELEASE MEASURES

#### Personal Precautions

Evacuate area. Use appropriate protective equipment. Purge equipment with inert gas before attempting repairs. Ensure adequate ventilation. If leak is in container call one of the emergency numbers as appropriate. (See footer).

#### Environmental Precautions

Try to stop release, if safe to do so. For fire-fighting measures see Section 5.

#### Clean up methods

Contact Epichem for specific advice.

### 7. HANDLING AND STORAGE

#### Handling

Valve outlet seals must remain in place unless container is secured and valve outlet piped to use point. Use a check valve or trap to prevent hazardous back flow into the container. Any equipment used for Trimethylgallium service must be thoroughly cleaned and prepared to eliminate contamination and must be maintained in a leak-free state. All air and moisture in the system must be eliminated before use.

#### Storage

Protect containers from physical damage. Do not allow temperatures to exceed (125F)51C. Store away from flammable material.

### 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

#### Exposure Controls

**OSHA or ACGIH:** None established.

**OES and MEL:** None established.

Ensure adequate ventilation.

#### Personal Protection

Self-contained breathing apparatus, fire resistant gloves, face shield and safety goggles, safety shoes, fire-resistant garments. Safety shower and eyewash.



## 9. PHYSICAL AND CHEMICAL PROPERTIES

Boiling Point: (131.5F) 55.7C  
Vapor Pressure:  $\log_{10} P(\text{mmHg}) = 8.07-1703/T(K)$   
Gas Density (at (70F)21C, 1 atm): Liquid  
Freezing Point: (3.5F) -15.8C  
Liquid Density: 1.151g/ml @ 15C  
Molecular Weight: 114.82 grams  
Solubility in water: Reacts violently.  
Appearance: Colorless liquid which is pyrophoric.

## 10. STABILITY AND REACTIVITY

### Conditions to avoid

Reacts pyrophorically in air.

**Note:** Trimethylgallium is stable indefinitely in an inert atmosphere at room temperature.

### Materials to avoid

Avoid water, air or other oxidizers.

### Hazardous Decomposition Products

Gallium Oxide dust, CO, CO<sub>2</sub>

## 11. TOXICOLOGICAL INFORMATION

Gallium Oxide dust formed when this compound is oxidized has caused toxic effects to the liver and kidneys in test animals.

Trimethylgallium is not listed in the IARC, NTP or OSHA Subpart Z as a carcinogen or potential carcinogen.

Trimethylgallium is listed on the TSCA inventory.

## 12. ECOLOGICAL INFORMATION

This product does not contain any Class I or Class II ozone depleting chemicals.

## 13. DISPOSAL CONSIDERATIONS

Regional and National regulations should be followed during waste disposal. Contact an Epichem representative for disposal of container and any unused quantities.

## 14. TRANSPORT INFORMATION

UN No: 2003  
CLASS: 4.2 (4.3)  
PG I  
ECCN#: 3C003  
IMDG Code: 4243  
Shipping Name: Metal alkyls, water-reactive, n.o.s.  
(Trimethylgallium)

## 15. REGULATORY INFORMATION

### Classification

Highly Flammable

### Risk and Safety Phrases

R14: Reacts violently with water.

R17: Spontaneously flammable in air.

S6: Keep under inert atmosphere.

S8: Keep container dry.

S43a: In case of fire use dry powder or lime - Never use water.

## 16. OTHER INFORMATION

Ensure operators understand the pyrophoric nature of the product. DSC data is available on request. Before using this product, it is recommended that a risk assessment and safety study be carried out. Further information on the use of this product can be obtained from the Technical Product Manager at the nearest Epichem facility.

*SAFETY NOTICE: In Order to provide our customers with the highest quality material and maintain our high standards of safety, the surface temperature of the bubbler will be monitored during the transportation of our products. We would like to monitor the surface temperature of the bubbler using a tempilabel. Tempilabel is a temperature-monitoring strip ranging from 120F to 150F (49C to 66C) which will indicate the temperature during shipment. The strip will turn black at one of the four ratings shown if the temperature is reached (normally a silver centre). If the temperature monitor is changed, please notify an Epichem representative immediately and we will assist you in the proper measures to be taken. We ask for your co-operation in our efforts of quality assurance and safety. If you have any questions or comments, please contact an Epichem representative. We thank you for your co-operation. Your assistance is greatly appreciated.*

*Information contained in this material safety data sheet is offered without charge for use by technically qualified personnel at their discretion and risk. All statements, technical information and recommendations contained herein are based on tests and data which we believe to be reliable, but the accuracy or completeness thereof is not guaranteed no warranty of any kind is made with respect thereto. This information is not intended as a license to operate under or a recommendation to practice or infringe any patent of this Company or others covering any process, composition of matter or use.*

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### 24 Hour Emergency Contact Numbers:

Europe: 44 151 334 2774      United States: Chemtrec: (800) 424 9300  
Other International Countries: Chemtrec (703) 527 3887

# Center for Nanophotonics, TTU

## SOP for Lithography Chemicals

- (1) Make sure you are wearing lab **coat, goggles, respirator, and hand globes** while working with chemicals.
- (2) Pay attention to photo-resists and developers, they are **toxic** and they **evaporate**.
- (3) Follow the guidelines while pouring from delivered container to the bottles for daily use.
- (4) Apply chemicals with droppers whenever possible
- (5) Do not forget to put the chemicals back to their designated storage areas after each use.
- (6) After use, dump your waste chemical into a specified container of corresponding used chemical, level it clearly (if not already), and inform the group member responsible for waste chemical management.
- (7) Follow the guidelines if you spill any chemical.

# MATERIAL SAFETY DATA SHEET

## SECTION 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

**MANUFACTURER/SUPPLIER NAME:** Clariant Corporation, AZ Electronic Materials

PO Box 3700,  
70 Meister  
Avenue

Somerville, NJ  
08876-1258

**TELEPHONE NUMBERS:** Emergency-CHEMTREC: (800) 424-9300

Product Safety  
Information:  
(908) 429-3593

Customer  
Service: (800)  
515-4164

**PRODUCT NAME:** **AZ(R) 400T PHOTORESIST STRIPPER**

**SYNONYMS:** None

**MSDS NO.** 70Q6

**REVISION DATE:** 10/16/2000

**DATE PRINTED:** 11/01/2000

## SECTION 2. COMPOSITION/INFORMATION ON INGREDIENTS

<u>Chemical Name &amp; CAS Number</u>	<u>Weight Percent</u>	<u>Hazardous?</u>	<u>NJ Trade Secret #</u>	<u>Ingredient Synonyms</u>	<u>Other Information:</u>
1-Methyl-2-pyrrolidinone 000872-50-4	74	Yes	N/A	1-Methyl-2-pyrrolidone, N-methylpyrrolidone, NMP	PA RTK List.
1,2-Propanediol 000057-55-6	24	Yes	NA	Propylene glycol	PA RTK List.
Tetramethylammonium hydroxide 000075-59-2	2	Yes	No	TMAH	None

## **SECTION 3. HAZARDS IDENTIFICATION**

### **EMERGENCY OVERVIEW:**

Clear, colorless liquid. Characteristic odor. Water soluble. Causes skin and eye irritation. May produce systemic or organ effects with repeated or excessive exposure. Contains an ingredient that is highly toxic by ingestion and skin absorption.

### **POTENTIAL HEALTH EFFECTS:**

#### **Relevant Routes of Exposure:**

Skin absorption. Eye contact with liquid and vapors. Inhalation of mist.

#### **Medical Conditions Aggravated:**

Preexisting skin, eye, and respiratory conditions may be aggravated.

**1-Methyl-2-pyrrolidinone, NMP** is an eye irritant. It is fetotoxic and produces fetal skeletal abnormalities at high doses. Skin contact can lead to dermatitis. NMP has shown nervous system depression, bone marrow and lymph tissue effects. Some tests in rats have shown testicular effects. It was positive in chromosome aberration testing.

**1,2-Propanediol** is a skin and eye irritant. It has been reported to cause central nervous system depression when administered orally and has been reported to be an in-vitro mutagen. Most mutagenicity tests with propylene glycol have indicated that it is not mutagenic. However, in one in vitro test, it was found to be mutagenic, at one dose level.

**Tetramethylammonium hydroxide** May cause severe irritation or caustic burns to eyes and mucous membranes. TMAH is caustic and corrosive to skin and eyes in concentrated form. Pure TMAH is highly toxic in animal tests by the oral and dermal routes of exposure.

DOT four hour rabbit skin test of the highest commercial concentration of this product was negative for corrosion.

## **SECTION 4. FIRST AID MEASURES**

### **FIRST AID PROCEDURES:**

#### **Inhalation:**

Remove victim to fresh air. Consult physician if irritation occurs.

#### **Eye Contact:**

Flush thoroughly with water for 15 minutes. Get immediate medical help.

#### **Skin Contact:**

Immediately remove contaminated clothing and wash affected area thoroughly with water until greasy feel is gone. Consult physician if exposure is extensive or if irritation occurs.

#### **Ingestion:**

If person is conscious, give water or milk to dilute stomach contents. Never give anything by mouth to an unconscious person. Consult physician. Do not induce vomiting.

**NOTE TO PHYSICIANS:**

A component of this material causes severe acute toxicity in experimental animals by the oral or dermal route of exposure. Exposed individuals should be carefully observed and treated according to symptoms.

**SECTION 5. FIRE FIGHTING MEASURES****Flash point:**

> 200 deg F, Closed Cup

**Extinguishing Media:**

Carbon dioxide, water, alcohol foam, dry chemical.

**Special Procedures:**

Use self-contained breathing apparatus and full protective clothing. Use water spray to cool drums in fire area.

**Unusual hazards:**

Solvent vapors. Emits toxic and corrosive fumes under fire conditions.

**SECTION 6. ACCIDENTAL RELEASE MEASURES****Spill or Leak Procedures:**

Wearing appropriate personal protective equipment, contain spill, collect onto inert absorbent, and place in a suitable container. Rinse residual with water.

**SECTION 7. HANDLING AND STORAGE****Handling:**

Wash thoroughly after handling. Keep container closed. Avoid breathing vapors and contact with skin, eyes, and clothing. Use only with adequate ventilation and proper protective eyewear, gloves, and clothing.

**Storage:**

Store at appropriate temperature. See label for details. Store in original container. Transport and store under dry conditions tightly closed.

**SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION****Engineering Controls:**

Where mist is present, provide local exhaust ventilation or a respirator certified for mist by NIOSH.

**Personal Protective Equipment (PPE):**

Clothing suitable to prevent skin contact. Rubber gloves. Chemical cartridge respirator recommended for exposures exceeding TLV. Safety eyewear to protect against splashes.

### Exposure Guidelines:

<u>Chemical Name &amp; CAS Number</u>	<u>Weight Percent</u>	<u>Manufacturer's TWA TLV*</u>	<u>ACGIH TWA TLV*</u>	<u>OSHA PEL*</u>	<u>NIOSH REL*</u>	<u>AIHA WEEL*</u>
1-Methyl-2-pyrrolidinone 000872-50-4	74	5 ppm ***				
1,2-Propanediol 000057-55-6	24					
Tetramethylammonium hydroxide 000075-59-2	2					

\*TWA TLV = Time Weighted Average Threshold Limit Value

ACGIH = American Conference of Governmental Industrial Hygienists

OSHA PEL = Occupational Safety and Health Administration Permissible Exposure Limit

NIOSH REL = National Institute of Occupational Safety and Health Recommended Exposure Limit

AIHA WEEL = American Industrial Hygiene Association Workplace Environmental Exposure Level

\*\*Skin Notation

\*\*\*Hoechst Celanese Workplace Exposure Level (HCC WEL); included is a "no contact" recommendation for NMP due to its skin absorption properties.

## **SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES**

**Appearance:** Clear, colorless liquid.

**Odor:** Characteristic odor.

**Physical State:** Liquid

**Vapor Pressure** 0.2 torr (calculated)

**Vapor Density:** >1

**Solubility in water:** Soluble.

**Specific gravity:** 1.035

**VOC:** 1000 g/L calculated

**Evaporation rate**

**(butyl acetate=1):** < butyl acetate

**% Volatile:** 98%

## **SECTION 10. STABILITY AND REACTIVITY**

**Chemical Stability:**

Stable.

**Hazardous Polymerization:**

Will not occur.

**Conditions to Avoid:**

Avoid contact with oxidizing agents. Avoid contact with strong acids.

**Hazardous Decomposition Products:**

Thermal decomposition may generate carbon dioxide, carbon monoxide, and oxides of nitrogen. If heated to dryness, TMAH may decompose to trimethylamine and methanol. TMAH reportedly decomposes in boiling water, rate unknown.

**SECTION 11. TOXICOLOGICAL INFORMATION**

**Carcinogen:**

IARC: NO NTP: NO OSHA: NO

**Ingredient Toxicity Data:**

<u>Chemical Name &amp; CAS Number</u>	<u>Weight Percent</u>	<u>oral rat LD50</u>	<u>skin rbt LD50</u>	<u>inh rat LC50</u>
1-Methyl-2-pyrrolidinone 000872-50-4	74	3.9 g/kg	8.0 g/kg	>370 ppm/6hr
1,2-Propanediol 000057-55-6	24			
Tetramethylammonium hydroxide 000075-59-2	2	50 mg/kg as TMAH chloride salt	25 mg/kg (g pig)	

**TOXICITY HAZARD STATEMENTS FOR PRODUCT:**

**Eye Effects:**

Testing in rabbits of a more concentrated form of this product showed it was a moderate eye irritant.

**Skin Effects:**

Testing in rabbits of a more concentrated form of this product showed it was a mild skin irritant. D.O.T. four hour rabbit skin test of the highest commercial concentration of this product was negative for skin corrosion.

**SECTION 12. ECOLOGICAL INFORMATION**

**Ingredient Ecological Toxicity Data:**

<u>Weight Percent</u>	<u>Fish LC50</u>	<u>Daphnia EC50</u>	<u>Algae IC50</u>
-----------------------	------------------	---------------------	-------------------

**Chemical Name & CAS Number**

1-Methyl-2-pyrrolidinone 74

000872-50-4

1,2-Propanediol 24

000057-55-6

Tetramethylammonium hydroxide 2 35.1 mg/l (as chloride) 0.21 mg/l (as chloride)

000075-59-2

**Environmental hazard information statements (using EU classification criteria):**

**Toxicity to fish:**

A more concentrated form of this product was non-toxic to fathead minnow at up to 1.017 grams per liter.

**Environmental Fate:**

The ingredients of this product are known to be biodegradable.

**SECTION 13. DISPOSAL CONSIDERATIONS**

**Disposal:**

Dispose of or incinerate in accordance with regulations. Product would be considered a hazardous waste under RCRA due to high pH unless neutralized prior to disposal. See special precautions.

**SECTION 14. TRANSPORT INFORMATION**

**DOT/IATA Shipper Entry:**

Corrosive liquid, basic, organic, n.o.s. (tetramethylammonium hydroxide), 8, UN3267, III.

**SECTION 15. REGULATORY INFORMATION**

**TSCA Inventory Status:**

All components of this product are listed on the TSCA Inventory.

**SARA Title III section 313:**

This product contains the chemical or chemicals listed below which are subject to the supplier notification requirements of Section 313 of the Superfund Amendments and Reauthorization Act of 1986 ("SARA") and the requirements of 40 CFR Part 372:

SARA Ingredient: 1-Methyl-2-pyrrolidone; CAS# 872-50-4; 41%.

**OSHA Health Hazards:**

Eye Hazard. Irritant. Skin Hazard. Nervous System Toxin. Reproductive Toxin. Blood Toxin. Highly Toxic.

**SARA (311, 312) Hazard Class(es):**

Acute health hazard. Fire hazard. Chronic health hazard.

**Other Federal Regulations:**

Toxic Substance Control Act (TSCA) Section 12(B) Export Notification Requirement for 1-Methyl-2-Pyrrolidinone.

**SECTION 16. OTHER INFORMATION****HMIS Ratings:**

Health = 2; Flammability = 1; Reactivity = 0; PPE=X \*

**NFPA Ratings:**

Health = 2; Flammability = 1; Reactivity = 0; Special Hazard = None.

**Special Precautions:**

The tetramethylammonium ion (TMA), as TMAH, in this developer is toxic at low levels to the water flea ceriodaphnia dubia (CD) used in the whole effluent toxicity (WET) biomonitoring test. Data from the supplier suggests that continuous input of 60-100 ppm TMA to a small POTW should not cause WET toxicity. It is expected that discharges to a sizable POTW will not affect the ability to pass the WET tests. However, discharges to a small POTW or direct discharges to surface waters should be carefully reviewed. Contact AZ Electronic Materials Product Safety for additional information (908-429-3593 or 908-429-3562).

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1254 Chestnut Street  
Newton, MA 02464-1418  
Tel: (617) 965-5511  
Fax: (617) 965-5818

## MATERIAL SAFETY DATA SHEET

PAGE 1  
03 March 2005

### SECTION 1. CHEMICAL IDENTIFICATION -----

CHEMICAL NAME: Organic Polymer Solution  
TRADE NAME: 950 PMMA Series Resists in Anisole  
Positive Radiation Sensitive Resists  
PRODUCT #: See Table 1 – Section 9

### SECTION 2. COMPOSITION-----

HAZARDOUS  
INGREDIENTS: Anisole (CAS: 100-66-3); 85-99% (See Table 1 – Section 9)  
OTHER  
INGREDIENTS: Poly(methylmethacrylate) (CAS: 9011-14-7)

### SECTION 3. HAZARD DATA-----

INFLAMMABILITY: Flammable liquid.  
SKIN CONTACT: May cause skin irritation.  
EYE CONTACT: Vapor or mist is irritating to the eyes.  
INHALATION: Vapor or mist is irritating to mucous membranes and upper  
respiratory tract.  
MUTAGENICITY: Not known to be mutagenic.  
CARCINOGENICITY: Not known to be carcinogenic.  
TARGET ORGANS: Eyes, Skin, Respiratory System, and Nervous System.

### SECTION 4. FIRST AID MEASURES-----

INHALATION: Move the affected person away from the contaminated area and into  
the fresh air. If necessary seek medical advice.  
INGESTION: Rinse mouth out with water. Consult a doctor if necessary.  
SKIN CONTACT: Rinse with plenty of water.  
EYE CONTACT: Rinse with water while keeping the eyes wide open.

### SECTION 5. FIRE FIGHTING MEASURES-----

EXTINGUISHING MEDIA: Dry chemical, carbon dioxide.  
SPECIAL FIRE FIGHTING  
PRECAUTIONS: Wear self-contained breathing apparatus (SCBA) and  
personal protective equipment to prevent contact with skin  
and eyes.  
UNUSUAL FIRE OR  
EXPLOSION HAZARDS: Heat will build pressure and may rupture closed containers.  
Keep containers cool with water spray.

**MATERIAL SAFETY DATA SHEET**

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03 March 2005

CHEMICAL NAME: Organic Polymer Solution  
TRADE NAME: 950PMMA Series Resists in Anisole  
Positive Radiation Sensitive Resists  
PRODUCT #: See Table 1 – Section 9

---

**SECTION 6. ACCIDENTAL RELEASE PROCEDURES**

---

**EVACUATION**

**PROCEDURES & SAFETY:** Wear appropriate protective gear for the situation. See Personal Protection information in Section 8. Eliminate all sources of ignition. Do not breathe vapors or dust.

**CLEANUP & DISPOSAL  
OF SPILL:**

Absorb with an inert absorbent. Sweep up and place in an appropriate closed container. Use clean, non-sparking tools to collect absorbed material.

**ENVIRONMENTAL &**

**REGULATORY REPORTING:** Do not flush to drain. If required proper authorities should be notified.

**SECTION 7. STORAGE AND HANDLING PRECAUTIONS**

---

**STORAGE:** Store in tightly closed container in a cool, dry, well-ventilated environment away from ignition sources.

**HANDLING:** Use only under yellow light.  
Keep away from heat, sparks, and flames.  
Use only with mechanical exhaust.  
Do not contact with skin, eyes, and clothing.  
Avoid prolonged or repeated contact with skin.  
Do not breathe vapors or mist.  
Wash with soap and water after handling.  
Have safety shower and eye wash available.  
Store and transfer under a blanket of dry inert gas.

**SECTION 8. EXPOSURE CONTROLS AND PERSONAL PROTECTION**

---

**RESPIRATORY  
PROTECTION:**

Under normal conditions, use of air-purifying (half-mask/full-face) respirator with cartridges/canisters approved for use against organic vapors, dust, mists and fumes is recommended.

**VENTILATION:**

General area dilution/exhaust ventilation.

**SKIN PROTECTION:**

PVC protective gloves are highly recommended.

**EYE PROTECTION:**

Safety goggles are highly recommended.

**MATERIAL SAFETY DATA SHEET**PAGE 3  
03 March 2005

CHEMICAL NAME: Organic Polymer Solution  
TRADE NAME: 950PMMA Series Resists in Anisole  
Positive Radiation Sensitive Resists  
PRODUCT #: See Table 1 – Section 9

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**SECTION 9. PHYSICAL AND CHEMICAL DATA**

---

APPEARANCE: Clear to straw colored liquid  
ODOR: Strong  
BOILING POINT: 154 °C (309 °F)  
SPECIFIC GRAVITY: See Table 1 below  
VAPOR PRESSURE: 13 mm @ 42 °C (108 °F)  
VAPOR DENSITY: 3.7 (air=1)  
H<sub>2</sub>O SOLUBILITY: Slightly soluble.  
% VOLATILES: See Table 1 below  
EVAPORATION RATE: 0.1 (BuAc=1)  
FLASH POINT: 44 °C (111 °F) CC  
AUTOIGNITION TEMP: 475 °C (887 °F)  
EXPLOSION LIMITS: unk. Lower  
unk. Upper

**Table 1**

Name	Product #	Specific Gravity	Volatiles (% by wt.)	VOC (g/L)
950A1	M230001	0.994	99	985
950A2	M230002	0.996	98	975
950A3	M230003	0.998	97	970
950A4	M230004	1.000	96	960
950A4.5	M230504	1.001	95.5	958
950A5	M230005	1.004	95	955
950A5.5	M230505	1.004	94.5	950
950A6	M230006	1.005	94	945
950A7	M230007	1.007	93	935
950A8	M230008	1.009	92	930
950A9	M230009	1.010	91	920
950A10	M230010	1.012	90	910
950A11	M230011	1.014	89	900
950A12	M230012	1.016	88	895
950A13	M230013	1.018	87	885
950A15	M230015	1.022	85	870

**SECTION 10. REACTIVITY DATA**

---

STABILITY: Stable  
INCOMPATIBILITY: Strong Oxidizing Agents, Strong Acids, Strong Bases  
HAZARDOUS COMBUSTION OR  
DECOMPOSITION PRODUCTS: Carbon Monoxide, Carbon Dioxide, Phenol

**MATERIAL SAFETY DATA SHEET**

CHEMICAL NAME: Organic Polymer Solution  
TRADE NAME: 950PMMA Series Resists in Anisole  
Positive Radiation Sensitive Resists  
PRODUCT #: See Table 1 – Section 9

---

**SECTION 11. TOXICITY HAZARDS**

---

**ACUTE TOXICITY:**

As Anisole:

ORAL: LD50 (rat): 3700 mg/kg

SKIN: LD50 (rat): >5000 mg/kg

LOCAL EFFECTS: Slightly irritating to the skin. Not irritating to rabbits on ocular application. No sensitizing reaction was observed for guinea pigs.

**SECTION 12. ECOLOGICAL DATA**

---

BIODEGRADABILITY: Readily biodegradable.  
BIOACCUMULATION: Not potentially bioaccumulable.  
ECOTOXICITY: EC50 (Daphnia/24 hr): 40 mg/l

**SECTION 13. DISPOSAL CONSIDERATIONS**

---

Comply with applicable local, state or international regulations regarding the proper disposal of this material and/or containers.

**SECTION 14. TRANSPORTATION INFORMATION**

---

HAZARD CLASSIFICATION: Flammable Liquid  
SHIPPING NAME: Resin Solution  
UN NUMBER: UN 1866  
PACKING GROUP III

**SECTION 15. REGULATORY INFORMATION**

---

**EUROPEAN INFORMATION**

**EINECS LISTED**

EC Nos: Anisole 202-876-1

**RISK & SAFETY PHRASES**

R10 Flammable

S16 Keep away from sources of ignition. No smoking.

S24 Avoid contact with skin.

**INDICATIONS OF DANGER**

None

**MATERIAL SAFETY DATA SHEET**

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03 March 2005

CHEMICAL NAME: Organic Polymer Solution  
TRADE NAME: 950PMMA Series Resists in Anisole  
Positive Radiation Sensitive Resists  
PRODUCT #: See Table 1 – Section 9

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**US AND INTERNATIONAL INFORMATION**

HAZARDOUS LISTINGS: All ingredients appear on the TSCA Inventory of Chemical Substances, EINECS, Canadian DSL and the Japan ENCS Listing.  
SARA Title III: This product IS NOT subject to SARA Title III, Section 313 Reporting Requirements.

Calif. SCAQMD Rule 443.1 VOC's: See Table 1 – Section 9

**SECTION 16. ADDITIONAL PRECAUTIONS AND COMMENTS**

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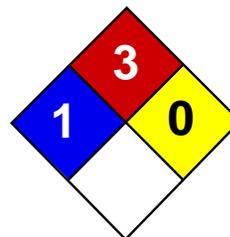
National Fire Protection Association Hazard Ratings – NFPA:

- 1 Health Hazard Rating
- 2 Flammability Rating
- 0 Reactivity Rating

To the best of our knowledge, the above information is believed to be accurate but does not claim to be all-inclusive and is intended to be used only as a guide. The supplier makes no warranty of any kind, expressed or implied, concerning the use of this product and shall not be held liable for any damage resulting from handling or from contact with the above product. User assumes all risks incident to its use.

MSDS Revision Information:

- A) Removed “NANO” name from trade name.
- B) General update of MSDS. Added European Risk and Safety phrases to Section 15.



Health	2
Fire	3
Reactivity	0
Personal Protection	H

## Material Safety Data Sheet Acetone MSDS

### Section 1: Chemical Product and Company Identification

**Product Name:** Acetone

**Catalog Codes:** SLA3502, SLA1645, SLA3151, SLA3808

**CAS#:** 67-64-1

**RTECS:** AL3150000

**TSCA:** TSCA 8(b) inventory: Acetone

**CI#:** Not applicable.

**Synonym:** 2-propanone; Dimethyl Ketone; Dimethylformaldehyde; Pyroacetic Acid

**Chemical Name:** Acetone

**Chemical Formula:** C3-H6-O

**Contact Information:**

**Sciencelab.com, Inc.**

14025 Smith Rd.

Houston, Texas 77396

US Sales: **1-800-901-7247**

International Sales: **1-281-441-4400**

Order Online: [ScienceLab.com](http://ScienceLab.com)

**CHEMTREC (24HR Emergency Telephone), call:**

1-800-424-9300

**International CHEMTREC, call:** 1-703-527-3887

**For non-emergency assistance, call:** 1-281-441-4400

### Section 2: Composition and Information on Ingredients

**Composition:**

Name	CAS #	% by Weight
Acetone	67-64-1	100

**Toxicological Data on Ingredients:** Acetone: ORAL (LD50): Acute: 5800 mg/kg [Rat]. 3000 mg/kg [Mouse]. 5340 mg/kg [Rabbit]. VAPOR (LC50): Acute: 50100 mg/m 8 hours [Rat]. 44000 mg/m 4 hours [Mouse].

### Section 3: Hazards Identification

**Potential Acute Health Effects:**

Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

**Potential Chronic Health Effects:**

CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female, Reproductive system/toxin/male [SUSPECTED]. The substance is toxic to central nervous system (CNS). The substance may be toxic to kidneys, the reproductive system, liver, skin. Repeated or prolonged exposure to the substance can produce target organs damage.

### Section 4: First Aid Measures

**Eye Contact:**

Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Get medical attention.

**Skin Contact:**

In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Cold water may be used. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

**Serious Skin Contact:**

Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

**Inhalation:**

If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention if symptoms appear.

**Serious Inhalation:**

Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

**Ingestion:**

Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Loosen tight clothing such as a collar, tie, belt or waistband. Get medical attention if symptoms appear.

**Serious Ingestion:** Not available.

## Section 5: Fire and Explosion Data

**Flammability of the Product:** Flammable.

**Auto-Ignition Temperature:** 465°C (869°F)

**Flash Points:** CLOSED CUP: -20°C (-4°F). OPEN CUP: -9°C (15.8°F) (Cleveland).

**Flammable Limits:** LOWER: 2.6% UPPER: 12.8%

**Products of Combustion:** These products are carbon oxides (CO, CO<sub>2</sub>).

**Fire Hazards in Presence of Various Substances:** Highly flammable in presence of open flames and sparks, of heat.

**Explosion Hazards in Presence of Various Substances:**

Risks of explosion of the product in presence of mechanical impact: Not available. Slightly explosive in presence of open flames and sparks, of oxidizing materials, of acids.

**Fire Fighting Media and Instructions:**

Flammable liquid, soluble or dispersed in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use alcohol foam, water spray or fog.

**Special Remarks on Fire Hazards:** Vapor may travel considerable distance to source of ignition and flash back.

**Special Remarks on Explosion Hazards:**

Forms explosive mixtures with hydrogen peroxide, acetic acid, nitric acid, nitric acid + sulfuric acid, chromic anhydride, chromyl chloride, nitrosyl chloride, hexachloromelamine, nitrosyl perchlorate, nitryl perchlorate, permonosulfuric acid, thiodiglycol + hydrogen peroxide, potassium ter-butoxide, sulfur dichloride, 1-methyl-1,3-butadiene, bromoform, carbon, air, chloroform, thitriazylperchlorate.

## Section 6: Accidental Release Measures

**Small Spill:**

Dilute with water and mop up, or absorb with an inert dry material and place in an appropriate waste disposal container.

**Large Spill:**

Flammable liquid. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

**Section 7: Handling and Storage****Precautions:**

Keep locked up.. Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/ vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents, reducing agents, acids, alkalis.

**Storage:**

Store in a segregated and approved area (flammables area) . Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Keep away from direct sunlight and heat and avoid all possible sources of ignition (spark or flame).

**Section 8: Exposure Controls/Personal Protection****Engineering Controls:**

Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

**Personal Protection:**

Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

**Personal Protection in Case of a Large Spill:**

Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

**Exposure Limits:**

TWA: 500 STEL: 750 (ppm) from ACGIH (TLV) [United States] TWA: 750 STEL: 1000 (ppm) from OSHA (PEL) [United States] TWA: 500 STEL: 1000 [Australia] TWA: 1185 STEL: 2375 (mg/m3) [Australia] TWA: 750 STEL: 1500 (ppm) [United Kingdom (UK)] TWA: 1810 STEL: 3620 (mg/m3) [United Kingdom (UK)] TWA: 1800 STEL: 2400 from OSHA (PEL) [United States] Consult local authorities for acceptable exposure limits.

**Section 9: Physical and Chemical Properties**

**Physical state and appearance:** Liquid.

**Odor:** Fruity. Mint-like. Fragrant. Ethereal

**Taste:** Pungent, Sweetish

**Molecular Weight:** 58.08 g/mole

**Color:** Colorless. Clear

**pH (1% soln/water):** Not available.

**Boiling Point:** 56.2°C (133.2°F)

**Melting Point:** -95.35 (-139.6°F)

**Critical Temperature:** 235°C (455°F)

**Specific Gravity:** 0.79 (Water = 1)

**Vapor Pressure:** 24 kPa (@ 20°C)

**Vapor Density:** 2 (Air = 1)

**Volatility:** Not available.

**Odor Threshold:** 62 ppm

**Water/Oil Dist. Coeff.:** The product is more soluble in water;  $\log(\text{oil/water}) = -0.2$

**Ionicity (in Water):** Not available.

**Dispersion Properties:** See solubility in water.

**Solubility:** Easily soluble in cold water, hot water.

## Section 10: Stability and Reactivity Data

**Stability:** The product is stable.

**Instability Temperature:** Not available.

**Conditions of Instability:** Excess heat, ignition sources, exposure to moisture, air, or water, incompatible materials.

**Incompatibility with various substances:** Reactive with oxidizing agents, reducing agents, acids, alkalis.

**Corrosivity:** Non-corrosive in presence of glass.

**Special Remarks on Reactivity:** Not available.

**Special Remarks on Corrosivity:** Not available.

**Polymerization:** Will not occur.

## Section 11: Toxicological Information

**Routes of Entry:** Absorbed through skin. Dermal contact. Eye contact. Inhalation.

### Toxicity to Animals:

WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 3000 mg/kg [Mouse]. Acute toxicity of the vapor (LC50): 44000 mg/m<sup>3</sup> 4 hours [Mouse].

### Chronic Effects on Humans:

CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH. DEVELOPMENTAL TOXICITY: Classified Reproductive system/toxin/female, Reproductive system/toxin/male [SUSPECTED]. Causes damage to the following organs: central nervous system (CNS). May cause damage to the following organs: kidneys, the reproductive system, liver, skin.

### Other Toxic Effects on Humans:

Hazardous in case of skin contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

**Special Remarks on Toxicity to Animals:** Not available.

### Special Remarks on Chronic Effects on Humans:

May affect genetic material (mutagenicity) based on studies with yeast (*S. cerevisiae*), bacteria, and hamster fibroblast cells. May cause reproductive effects (fertility) based upon animal studies. May contain trace amounts of benzene and formaldehyde which may cancer and birth defects. Human: passes the placental barrier.

### Special Remarks on other Toxic Effects on Humans:

Acute Potential Health Effects: Skin: May cause skin irritation. May be harmful if absorbed through the skin. Eyes: Causes eye irritation, characterized by a burning sensation, redness, tearing, inflammation, and possible corneal injury. Inhalation: Inhalation at high concentrations affects the sense organs, brain and causes respiratory tract irritation. It also may affect the Central Nervous System (behavior) characterized by dizziness, drowsiness, confusion, headache, muscle weakness, and possibly motor incoordination, speech abnormalities, narcotic effects and coma. Inhalation may also affect the gastrointestinal tract (nausea, vomiting). Ingestion: May cause irritation of the digestive (gastrointestinal) tract (nausea, vomiting). It may also

affect the Central Nervous System (behavior), characterized by depression, fatigue, excitement, stupor, coma, headache, altered sleep time, ataxia, tremors as well as the blood, liver, and urinary system (kidney, bladder, ureter) and endocrine system. May also have musculoskeletal effects. Chronic Potential Health Effects: Skin: May cause dermatitis. Eyes: Eye irritation.

## Section 12: Ecological Information

### Ecotoxicity:

Ecotoxicity in water (LC50): 5540 mg/l 96 hours [Trout]. 8300 mg/l 96 hours [Bluegill]. 7500 mg/l 96 hours [Fathead Minnow]. 0.1 ppm any hours [Water flea].

**BOD5 and COD:** Not available.

### Products of Biodegradation:

Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

**Toxicity of the Products of Biodegradation:** The product itself and its products of degradation are not toxic.

**Special Remarks on the Products of Biodegradation:** Not available.

## Section 13: Disposal Considerations

### Waste Disposal:

Waste must be disposed of in accordance with federal, state and local environmental control regulations.

## Section 14: Transport Information

**DOT Classification:** CLASS 3: Flammable liquid.

**Identification:** : Acetone UNNA: 1090 PG: II

**Special Provisions for Transport:** Not available.

## Section 15: Other Regulatory Information

### Federal and State Regulations:

California prop. 65: This product contains the following ingredients for which the State of California has found to cause reproductive harm (male) which would require a warning under the statute: Benzene California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: Benzene California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Benzene, Formaldehyde Connecticut hazardous material survey.: Acetone Illinois toxic substances disclosure to employee act: Acetone Illinois chemical safety act: Acetone New York release reporting list: Acetone Rhode Island RTK hazardous substances: Acetone Pennsylvania RTK: Acetone Florida: Acetone Minnesota: Acetone Massachusetts RTK: Acetone Massachusetts spill list: Acetone New Jersey: Acetone New Jersey spill list: Acetone Louisiana spill reporting: Acetone California List of Hazardous Substances (8 CCR 339): Acetone TSCA 8(b) inventory: Acetone TSCA 4(a) final test rules: Acetone TSCA 8(a) IUR: Acetone

### Other Regulations:

OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200). EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

### Other Classifications:

### WHMIS (Canada):

CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2B: Material causing other toxic effects (TOXIC).

**DSCL (EEC):**

R11- Highly flammable. R36- Irritating to eyes. S9- Keep container in a well-ventilated place. S16- Keep away from sources of ignition - No smoking. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

**HMIS (U.S.A.):**

**Health Hazard:** 2

**Fire Hazard:** 3

**Reactivity:** 0

**Personal Protection:** h

**National Fire Protection Association (U.S.A.):**

**Health:** 1

**Flammability:** 3

**Reactivity:** 0

**Specific hazard:**

**Protective Equipment:**

Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

**Section 16: Other Information****References:**

-Material safety data sheet issued by: la Commission de la Santé et de la Sécurité du Travail du Québec. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. LOLI, RTECS, HSDB databases. Other MSDSs

**Other Special Considerations:** Not available.

**Created:** 10/10/2005 08:13 PM

**Last Updated:** 11/06/2008 12:00 PM

*The information above is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular purposes. In no event shall ScienceLab.com be liable for any claims, losses, or damages of any third party or for lost profits or any special, indirect, incidental, consequential or exemplary damages, howsoever arising, even if ScienceLab.com has been advised of the possibility of such damages.*

## Material Safety Data Sheet

### 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

**PRODUCT NAME:** 100:1 BOE  
**OTHER/GENERIC NAMES:** 100:1 BOE  
**PRODUCT USE:** Semiconductor Manufacturing

**MANUFACTURER:** Honeywell/GEM3  
101 Columbia Road  
Morristown, New Jersey 07962-1053

**FOR MORE INFORMATION CALL:**  
(Monday-Friday, 8:00am-5:00pm)  
1-800-279-9998

**IN CASE OF EMERGENCY CALL:**  
(24 Hours/Day, 7 Days/Week)  
1-800-707-4555 or Chemtrec 1-800-424-9300  
International: 1-703-527-3887

### 2. COMPOSITION/INFORMATION ON INGREDIENTS

<u>INGREDIENT NAME</u>	<u>CAS NUMBER</u>	<u>WEIGHT %</u>
Ammonium Fluoride	12125-01-8	< 40%
Hydrofluoric Acid	7664-39-3	< 02%

Trace impurities and additional material names not listed above may also appear in Section 15 toward the end of the MSDS. These materials may be listed for local "Right-To-Know" compliance and for other reasons.

### 3. HAZARDS IDENTIFICATION

#### **EMERGENCY OVERVIEW:**

Extremely hazardous liquid and vapor. Causes severe burns that may not be immediately painful or visible. May be fatal if inhaled or swallowed. May cause damage to bones.

#### **POTENTIAL HEALTH HAZARDS**

**SKIN:** Liquid causes severe irritation and burns of eyes and skin

**EYES:** Both liquid and vapor can cause irritation or corneal burns.

**INHALATION:** May cause irritation to mucous membranes. Inhalation causes acute systematic poisoning which must receive immediate medical attention.

**INGESTION:** Ingestion causes vomiting and severe burns of mouth and stomach.

## MATERIAL SAFETY DATA SHEET

**DELAYED EFFECTS:** The effects of contact with dilute solutions of hydrofluoric acid or its vapors may be delayed. The potential delay in clinical signs or symptoms for dilute solutions is given below. Symptoms might include pain, redness and possible tissue destruction.

<u>HF Concentration</u>	<u>Delay in Symptoms</u>
>50%	Immediately Apparent
20%-50%	1-8 Hours
0%-20%	Up to 24 hours

Can also cause bone and joint changes in humans (Fluorosis)

**Ingredients found on one of the OSHA designated carcinogen lists are listed below.**

<u>INGREDIENT NAME</u>	<u>NTP STATUS</u>	<u>IARC STATUS</u>	<u>OSHA LIST</u>
------------------------	-------------------	--------------------	------------------

No ingredients listed in this section.

### 4. FIRST AID MEASURES

**SKIN:** Do not scrub. Remove the victim from the contaminated area and immediately wash the burned area with plenty of water for a minimum of 15 minutes. Limit washing to 5 minutes if treatment specific for HF exposure is available. Remove all contaminated clothing while washing continuously. After thorough washing for at least 5 minutes, the burned area should be immersed in a solution of 0.13% iced aqueous Zephiran® Chloride until pain is relieved. As an alternate first aid treatment, 2.5% calcium gluconate gel may be continuously massaged into the burn area until the pain is relieved. For larger burns or burns treated with calcium gluconate gel (in which pain is present longer than 30 minutes), a physician should inject 5% aqueous calcium gluconate beneath, around and in the burned area. Use of local anesthetics is not recommended, as a reduction in pain is an indicator of effectiveness of treatment.

**EYES:** Irrigate eyes for at least 15 minutes with copious quantities of water, keeping eyelids apart and away from eyeballs during irrigation. Get competent medical attention immediately, preferably an eye specialist. If a physician is not immediately available, apply one or two drops of 0.5% tetracaine hydrochloride solution, or other aqueous topical ophthalmic anesthetic and continue irrigation. DO NOT use the solution described for skin treatment. Use no oils or greases unless instructed to do so by a physician. Irrigate with 1% calcium gluconate in normal saline for 1 to 2 hours to prevent or lessen corneal damage.

**INHALATION:** Move to fresh air. Keep the victim lying down, quiet and warm. Get competent medical attention immediately. If breathing has stopped, start artificial respiration at once. An authorized person should administer oxygen to a victim who is having difficulty breathing, until the victim is able to breathe easily by himself. Calcium gluconate, 2.5% in normal saline may be given by nebulizer with oxygen. DO NOT give stimulants unless instructed to do so by a physician. Victim should be examined by a physician and held under observation for at least 24 hours.

**INGESTION:** Drink large amounts of water to dilute. DO NOT induce vomiting. Several glasses of milk or several ounces of milk of magnesia may be given for their soothing effect. Take the victim to a doctor.

**ADVICE TO PHYSICIAN:** Treat symptomatically.

For Hydrofluoric Acid:

For burns of large skin areas (greater than 25 square inches), for ingestion and for significant inhalation exposure, severe systemic effects may occur. Monitor and correct for hypocalcemia, cardiac arrhythmias, hypomagnesemia and hyperkalemia. In some cases hemodialysis may be indicated. For certain burns, especially of the digits, use of intra-arterial calcium gluconate may be indicated. For inhalation exposures, treat as chemical pneumonia. Monitor for hypocalcemia. 2.5% calcium gluconate in normal saline by nebulizer or by IPPB with 100% oxygen may decrease pulmonary damage. Bronchodilators may also be administered.

A booklet titled "Recommended Medical Treatment for Hydrofluoric Acid Exposure" is available from the Honeywell HF website: <http://www.HFacid.com>

## MATERIAL SAFETY DATA SHEET

### 5. FIRE FIGHTING MEASURES

#### FLAMMABLE PROPERTIES

FLASH POINT:	Not flammable
FLASH POINT METHOD:	Closed cup
AUTOIGNITION TEMPERATURE:	N/A
UPPER FLAME LIMIT (volume % in air):	N/A
LOWER FLAME LIMIT (volume % in air):	N/A
FLAME PROPAGATION RATE (solids):	N/A
OSHA FLAMMABILITY CLASS:	N/A

#### EXTINGUISHING MEDIA:

Use water or suitable agent for fires adjacent to non-leaking tanks or containers of HF. This substance is not combustible. Use water fog or carbon dioxide. DO NOT use solid water streams near ruptured tanks or spills of HF. Acid reacts with water and can splatter acid onto personnel.

#### UNUSUAL FIRE AND EXPLOSION HAZARDS:

The product is not flammable. Emits toxic fumes.

#### SPECIAL FIRE FIGHTING PRECAUTIONS/INSTRUCTIONS:

Use spray to cool exposed containers. Block sewers in the path of spreading spill to prevent entry. Remove containers of this material to cool areas. Prevent the boiling of this formulation. Wear self-contained breathing apparatus approved by NIOSH and full chemical protective clothing. Use water spray to keep containers cool.

### 6. ACCIDENTAL RELEASE MEASURES

#### IN CASE OF SPILL OR OTHER RELEASE: (Always wear recommended personal protective equipment.)

Good ventilation is necessary. Discharge will ordinarily be a vapor or a liquid that gives off fumes of HF gas. Those treating spills or repairing leaks must use full protective equipment. Take actions to minimize environmental impact. Try to contain spillage and avoid drainage to areas, which cannot be treated. Rapid dilution of the spill with water will reduce the amount of fumes given off.

Carefully neutralize the dilute liquid with lime slurry, soda ash, limestone, caustic soda or other alkaline material.

(See sections 10 and 13 for more information.)

**Spills and releases may have to be reported to Federal and/or local authorities. See Section 15 regarding reporting requirements.**

### 7. HANDLING AND STORAGE

#### NORMAL HANDLING: (Always wear recommended personal protective equipment.)

DO NOT breathe vapor or mist. Use only adequate ventilation. Avoid all contact with skin, eyes and clothing, even dilute solutions. DO NOT add water to acid.

#### STORAGE RECOMMENDATIONS:

Store in approved containers only. Store in cool, well-ventilated area. Flammable hydrogen gas can be generated in contact with metals. Diking of storage tanks is recommended.

## MATERIAL SAFETY DATA SHEET

### 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

**ENGINEERING CONTROLS:**

Material must be handled or transferred in an approved fume hood or with equivalent ventilation sufficient to reduce vapor and acid mists below permissible TLV levels. Packaging and unloading areas and open processing equipment may require mechanical exhaust systems.

**PERSONAL PROTECTIVE EQUIPMENT**

**SKIN PROTECTION:**

For routine product use, wear acid-resistant jacket, trousers, boots and gauntlet gloves. For increased protection, use air-supplied totally encapsulating HF resistant protective suit.

**EYE PROTECTION:**

As a minimum, wear hardhat, chemical safety goggles (plastic lenses), and full-face plastic shield. For increased protection, use air-supplied hydrofluoric acid resistant hood.

**RESPIRATORY PROTECTION:**

Where required, use a respirator approved by NIOSH for HF gas or mists, as applicable. Some exposures may require a NIOSH-approved, self-contained breathing apparatus or air supplied respirator.

**ADDITIONAL RECOMMENDATIONS:**

Eyewash and quick-drench shower facilities, protected from freezing, should be available where HF is stored or handled.

**EXPOSURE GUIDELINES**

<u>INGREDIENT NAME</u>	<u>ACGIH TLV</u>	<u>OSHA PEL</u>	<u>OTHER LIMIT</u>
Hydrofluoric Acid	3ppm-Ceiling	3ppm (TWA)	3mg(F)/g creatinine in urine pre-shift 10mg(F)/g creatinine post-shift***
		<u>OSHA STEL</u>	<u>IDLH</u>
		6ppm (15min.)	30ppm
Ammonium Fluoride	2.5 mg/m <sup>3</sup>	None	
	<u>AIHA Emergency Response Planning Guideline</u>		
	<u>ERPG-1</u>	<u>ERPG-2</u>	<u>ERPG-3</u>
	2ppm (60mins)	20ppm (60mins)	50ppm (60mins)
	2ppm (10mins)	20ppm (10mins)	50ppm (10mins)

- \* = Limit established by Honeywell International, Inc.
- \*\* = Workplace Environmental Exposure Level (AIHA).
- \*\*\* = Biological Exposure Index (ACGIH).

**OTHER EXPOSURE LIMITS FOR POTENTIAL DECOMPOSITION PRODUCTS:** None

### 9. PHYSICAL AND CHEMICAL PROPERTIES

**APPEARANCE:** Colorless liquid  
**PHYSICAL STATE:** Liquid  
**MOLECULAR WEIGHT:** Mixture

## MATERIAL SAFETY DATA SHEET

<b>CHEMICAL FORMULA:</b>	NH <sub>4</sub> F + HF
<b>ODOR:</b>	Slight pungent odor
<b>SPECIFIC GRAVITY (water = 1.0):</b>	1.108
<b>SOLUBILITY IN WATER (weight %):</b>	Miscible
<b>pH:</b>	~4
<b>BOILING POINT:</b>	Unknown
<b>MELTING POINT:</b>	N/A
<b>VAPOR PRESSURE:</b>	N/A
<b>VAPOR DENSITY (air = 1.0):</b>	N/A
<b>EVAPORATION RATE:</b>	N/A
<b>% VOLATILES:</b>	99+%
<b>FLASH POINT:</b>	N/A

(Flash point method and additional flammability data are found in Section 5.)

### 10. STABILITY AND REACTIVITY

**NORMALLY STABLE? (CONDITIONS TO AVOID):** Yes;

**INCOMPATIBILITIES:**

Chemical is very reactive. Store away from other chemicals

**HAZARDOUS DECOMPOSITION PRODUCTS:**

Releases highly corrosive forms of fluorides when heated; oxides of C

**HAZARDOUS POLYMERIZATION:**

Does not occur

### 11. TOXICOLOGICAL INFORMATION

**IMMEDIATE (ACUTE) EFFECTS:**

Hydrofluoric Acid:

ihl-hmn LCLo: 50 ppm/30M

ihl-rat LC50: 1300 ppm/60M

ihl-man TCLo: 100 mg/m<sup>3</sup>/IM

Ammonium Fluoride:

oral-rat LD50:200 mg/kg

**DELAYED (SUBCHRONIC AND CHRONIC) EFFECTS:**

Prolonged exposure can cause bone and joint changes in humans. (Fluorosis- increased bone density and mottling of teeth)

**OTHER DATA:** Tests on laboratory animals indicate HF in concentrate form may produce adverse mutagenic and reproductive effects. Cited in Registry of Toxic Effects of Substances (RTECS).

### 12. ECOLOGICAL INFORMATION

N/A

## MATERIAL SAFETY DATA SHEET

### 13. DISPOSAL CONSIDERATIONS

#### RCRA

Is the unused product a RCRA hazardous waste if discarded? Yes (Hydrofluoric Acid)

If yes, the RCRA ID number is: U134 D002

**OTHER DISPOSAL CONSIDERATIONS:** Observe all Federal, State, and Local Environmental regulations.

The information offered here is for the product as shipped. Use and/or alterations to the product such as mixing with other materials may significantly change the characteristics of the material and alter the RCRA classification and the proper disposal method.

### 14. TRANSPORT INFORMATION

**US DOT PROPER SHIPPING NAME:** Corrosive liquid, Toxic, N.O.S. (Ammonium Fluoride, Hydrofluoric Acid)

**US DOT HAZARD CLASS:** 8, 6.1

**US DOT ID NUMBER:** UN 2922

For additional information on shipping regulations affecting this material, contact the information number found in Section 1.

### 15. REGULATORY INFORMATION

#### TOXIC SUBSTANCES CONTROL ACT (TSCA)

**TSCA INVENTORY STATUS:** Hydrofluoric Acid, Aqueous is listed

**OTHER TSCA ISSUES:** None

#### SARA TITLE III/CERCLA

"Reportable Quantities" (RQs) and/or "Threshold Planning Quantities" (TPQs) exist for the following ingredients.

<u>INGREDIENT NAME</u>	<u>SARA/CERCLA RQ (lb)</u>	<u>SARA EHS TPQ (lb)</u>
Hydrofluoric Acid	250 lb (as 100:1 BOE)	
Ammonium Fluoride	5,000 lb (as 100:1 BOE)	

**Spills or releases resulting in the loss of any ingredient at or above its RQ requires immediate notification to the National Response Center [(800) 424-8802] and to your Local Emergency Planning Committee.**

**SECTION 311 HAZARD CLASS:**

**SARA 313 TOXIC CHEMICALS:**

The following ingredients are SARA 313 "Toxic Chemicals". CAS numbers and weight percents are found in Section 2.

<u>INGREDIENT NAME</u>	<u>COMMENT</u>
Hydrofluoric Acid	De Minimis Concentration 1.0

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## MATERIAL SAFETY DATA SHEET

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### STATE RIGHT-TO-KNOW

In addition to the ingredients found in Section 2, the following are listed for state right-to-know purposes.

<u>INGREDIENT NAME</u>	<u>WEIGHT %</u>	<u>COMMENT</u>
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No ingredients listed in this section.

**ADDITIONAL REGULATORY INFORMATION:** None

**WHMIS CLASSIFICATION (CANADA):** N/A

**FOREIGN INVENTORY STATUS:** N/A

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### 16. OTHER INFORMATION

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**CURRENT ISSUE DATE:** October 9, 2003

**PREVIOUS ISSUE DATE:** July 17, 2000

**CHANGES TO MSDS FROM PREVIOUS ISSUE DATE ARE DUE TO THE FOLLOWING:**

Converted to ANSI 16-section format.

**OTHER INFORMATION:** Honeywell MAKES NO WARRANTY, EXPRESSED OR IMPLIED, CONCERNING THIS MATERIAL OR THE USE OF THIS PRODUCT OTHER THAN INDICATED ON THE LABEL. BUYER ASSUMES ALL RISK OF USE AND/OR HANDLING OF THIS MATERIAL WHEN SUCH USE AND/OR HANDLING IS CONTRARY TO LABEL INSTRUCTIONS

NFPA Hazard Ratings:

Health: 3  
Flammability: 0  
Reactivity: 1  
Special Hazards:



# Material Safety Data Sheet

## 1. Product and Company Identification

Product name : **Boron Trichloride**

Chemical formula : BCl<sub>3</sub>

Synonyms : Trichloroborane; Chlorure De Bore; Trichloroborane; Trichloroboron; Borane; Trichloro-; Boron Chloride (BCL3); UN 1741; BCL3

Company : Specialty Gases of America, Inc  
6055 Brent Dr.  
Toledo, OH 43611

Telephone : 419-729-7732

Emergency : 800-424-9300

## 2. Composition/Information on Ingredients

Components	CAS Number	% Volume
Boron Trichloride	10294-34-5	100%

## 3. Hazards Identification

### Emergency Overview

May cause respiratory tract burns, skin burns, eye burns, mucous membrane burns.  
Containers may rupture or explode if exposed to heat. May react on contact with water.  
Releases toxic, corrosive, flammable or explosive gas.

### Potential Health Effects

Inhalation : Burns.  
Eye contact : Burns.  
Skin contact : Burns.  
Ingestion : Burns.  
Chronic Health Hazard : None.

## 4. First Aid Measures

General advice : None.

Eye contact : Immediately flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

Skin contact : Wash skin with soap and water for at least 15 minutes while removing contaminated clothes and shoes. Get immediate medical attention. Thoroughly clean and dry clothing before reuse. Destroy contaminated shoes.

Ingestion : If swallowed, drink plenty of water for at least 15 minutes. Then get immediate medical attention.

Inhalation : If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

Note to physicians: For inhalation, consider oxygen. Avoid gastric lavage or emesis.

## 5. Fire-Fighting Measures

Suitable extinguishing media	: Carbon dioxide regular dry chemical. Large fires: Use regular foam or flood with fine water spray.
Specific hazards	: Negligible fire hazard. Containers may rupture or explode if exposed to heat.
Fire fighting	: Wear full protective fire fighting gear including self contained breathing apparatus (SCBA) for protection against possible exposure. Do not get water inside container. Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. Keep unnecessary people away, isolate hazard area and deny entry.
Thermal decomposition products	: Combustion: chlorine Water or Moisture: boron compounds, hydrochloric acid

## 6. Accidental Release Measures

Occupational spill/release	: Stop leak if possible without personal risk. Reduce vapors with water spray. Do not get water directly on material. Do not get water inside container. Keep unnecessary people away, isolate hazard area and deny entry. Small spills: Flood with water. Large spills: Dike for later disposal. Stay upwind and keep out of low areas. Ventilate closed spaces before entering. Evacuation radius: 150 feet. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).
Additional advice	: None.

## 7. Handling and Storage

### Handling

Do not breathe gas, fumes, vapor or spray. When using, do not eat, drink or smoke. Wash thoroughly after handling.

### Storage

Store in accordance with all current regulations and standards. Notify Emergency Response Commission for storage or use at amounts greater than or equal to the TPQ (U.S. EPA SARA Section 302). SARA Section 303 requires facilities storing a material with a TPQ to participate in local emergency response planning (U.S. EPA 40 CFR 355 Part B). Subject to storage regulation: U.S. OSHA 29 CFR 1910.101. Keep separated from incompatible substances. Store in a well-ventilated area. Store below 52°C. Store in a cool, dry place. Protect from sunlight.

## 8. Exposure Controls / Personal Protection

### Engineering measures / Ventilation

Provide local exhaust or process enclosure ventilation system. Ensure compliance with applicable exposure limits.

### Personal protective equipment

Respiratory protection : Under conditions of frequent use or heavy exposure, respiratory protection may be needed. Respiratory protection is ranked in order from minimum to maximum. Consider warning properties before use.

Any chemical cartridge respirator with acid gas cartridge(s).  
 Any chemical cartridge respirator with a full facepiece and acid gas cartridge(s).  
 Any air-purifying respirator with a full facepiece and an acid gas canister.  
 For unknown concentrations or immediately dangerous to life or health –  
 Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.  
 Any self-contained breathing apparatus that has a full facepiece and is operated in pressure-demand or other positive-pressure mode.

- Hand protection : Wear appropriate chemical-resistant gloves.  
 Eye protection : Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick shower drench in the immediate work area.  
 Skin and body protection : Wear appropriate protective and chemical-resistant clothing.  
 Protective materials: Butyl rubber, neoprene, polyvinyl chloride (PVC), polyethylene.

## 9. Physical and Chemical Properties

- Form : Gas.  
 Color : Colorless.  
 Odor : Pungent odor.  
 Molecular weight : 117.16  
 Vapor pressure : 131.7 kPa @ 21.1°C  
 Vapor density : 4.03 (air = 1)  
 Specific gravity : 1.349 @ 11°C (water = 1)  
 Boiling point : -54.5 F (12.5°C)  
 Melting point : -161 F (-107°C)  
 Water solubility : Decomposes/reacts

## 10. Stability and Reactivity

- Stability : May react with evolution of heat on contact with water. Releases corrosive gases.  
 Conditions to avoid : Minimize contact with material. Avoid inhalation of material or combustion by-products. Containers may rupture or explode if exposed to heat.  
 Materials to avoid : Combustible materials, amines.  
 Water or Moisture: boron compounds, hydrochloric acid  
 Combustion: Chlorine  
 Hazardous reactions : Will not polymerize.

## 11. Toxicological Information

The components of this material have been reviewed in various sources and the following selected endpoints are published:

- BORON TRICHLORIDE (10294-34-5) : Inhalation LC50 Rat: 2541 ppm/1H

### Acute Toxicity Level

- BORON TRICHLORIDE (10294-34-5) : Moderately toxic: inhalation.

### Component Carcinogenicity

None of this product's components are listed by ACGIH, IARC, NTP, OSHA or DFG.

Irritation

No animal testing data available for skins or eyes.

Local Effects

BORON : Corrosive: inhalation, skin, eye, ingestion.  
TRICHLORIDE  
(10294-34-5)

Medical Conditions Aggravated by Exposure

Respiratory disorders.

**12. Ecological Information**

No LOEL ecotoxicity data are available for this product's components.

**13. Disposal Considerations**

Waste from residues : Dispose in accordance with all applicable regulations. Subject to disposal  
/ unused products regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): D003.  
Contaminated : Return cylinder to supplier.  
packaging

**14. Transport Information**

DOT (US only)

Proper shipping name : Boron Trichloride  
Class : 2.3  
UN/ID No. : UN1741  
Labeling : Poison Gas, Corrosive  
Additional Info : Toxic-Inhalation Hazard Zone C

Further information

Cylinders should be transported in a secure upright position in a well ventilated truck.

**15. Regulatory Information**

U.S. Federal Regulations

This material contains one or more of the following chemicals required to be identified under SARA Section 302/304 (40 CFR 355 Appendix A), SARA Section 313 (40 CFR 372.65), CERCLA (40 CFR 302.4), TSCA 12(b), and/or require an OSHA process safety plan.

BORON TRICHLORIDE (10294-34-5) – SARA 302: 500 lb TPQ  
SARA 313: 1.0% de minimis concentration  
OSHA (Safety): 2500 lb TQ

SARA 311/312

Acute: Yes  
Chronic: No  
Fire: Yes  
Reactive: Yes  
Pressure: Yes

U.S. State Regulations

The following components appear on one or more of the following state hazardous substances lists:

Component	CAS	CA	MA	MN	NJ	PA	RI
BORON TRICHLORIDE	10294-34-5	No	Yes	No	Yes	Yes	No

Not regulated under California Proposition 65

## 16. Other Information

Prepared by : Specialty Gases of America, Inc.

For additional information, please visit our website at [www.americangasgroup.com](http://www.americangasgroup.com).

## 1. PRODUCT AND COMPANY IDENTIFICATION

**PRODUCT NAME:** Carbon tetrafluoride      **CHEMICAL FORMULA:** CF<sub>4</sub>      **PRODUCT CODE:**

**COMPANY NAME:**

**PELICHEM:** The Chemical Division of NECSA

P O Box 582, Pretoria, 0001, South Africa

**Tel:** 27 12 305-3396 / **Fax:** 27 12 305-3728

**E-mail:** [cheminfo@pelchem.necsa.co.za](mailto:cheminfo@pelchem.necsa.co.za) / **Cell:** +27 83 628 0831

**Emergency tel:** +27 12 305-3333/4

## 2. COMPOSITION/INFORMATION ON INGREDIENTS

**CHEMICAL NAME OF SUBSTANCE:**

Carbon tetrafluoride

**SYNONYMS:**

Tetrafluorure de carbone, Perfluoromethane  
Tetrafluoromethane, Fluorocarbon 14  
FC 14, Carbon Fluoride, R 14, Methane,  
tetrafluoro, Freon 14, Tetrafluorocarbon, CF<sub>4</sub>

**UN No:**  
1982

**CAS-No:**  
75-73-0

## 3. HAZARDS IDENTIFICATION

<b>EMERGENCY OVERVIEW</b>
---------------------------

## 4. FIRST AID MEASURES

**Inhalation:** Remove to fresh air. Assist in breathing if necessary. Keep affected person warm and at rest. treat symptomatically and supportively. Get medical attention immediately.

**Ingestion:** It is unlikely that emergency treatment will be required. If adverse affects occur, treat symptomatically and supportively and get medical attention.

**Skin:** If adverse affects occur get medical attention. In case of frostbite, warm affected skin in warm water at a temp. of 107°F. If warm water is not available gently wrap affected part in blankets. Encourage victim to exercise affected part while it is being warmed. Allow circulation to return naturally. Get medical attention immediately.

**Eyes:** Immediately wash eye out with large amounts of water, occasionally lifting upper and lower lids, until no evidence of chemical remains. If frostbite is present, warm water may be preferred. Get medical attention immediately.

## 5. FIRE FIGHTING MEASURES

### FIRE AND EXPLOSION HAZARDS:

Non-flammable gas

### COMBUSTION AND THERMAL DECOMPOSITION PRODUCTS:

Carbon monoxide, carbon dioxide, hydrogen fluoride gas

### EXTINGUISHING MEDIA:

Dry chemical, carbon dioxide, or Halon. For larger fires use water spray, fog, or standard foam.

### SPECIAL FIRE-FIGHTING PROCEDURES:

Move containers from fire area if possible. Cool fire-exposed containers with water from the side until well after the fire is out. Withdraw immediately if rising sound venting or discoloration of tanks due to fire. Do not use water directly on materials, use fog to absorb vapors.

## 6. ACCIDENTAL RELEASE MEASURES

Wear self-contained breathing apparatus and protective clothing. Stop leak if you can do so without risk. Keep unnecessary people away; isolate hazard area and deny entry

## 7. HANDLING AND STORAGE

### INCOMPATIBLES:

Aluminum: (exothermic reaction)

## 8. EXPOSURE CONTROLS, PERSONAL PROTECTION

Measure oxygen content of the workplace air, especially in confined spaces, because displacement of oxygen by high concentrations of carbon tetrafluoride is possible.

### EYES:

Gas form: none required but recommended.

Liquid form: splash proof goggles and faceshield are required.

### SKIN:

**Gas form:** protective clothing is not required. Wear full protective cold insulating gloves.

**Liquid form:** If contact with the liquid form is possible, employee must wear appropriate protective clothing and equipment to prevent skin from freezing.

### INHALATION:

Chemical cartridge respirator with an organic vapor cartridge with an acid gas cartridge and full facepiece.

**SPECIAL PRECAUTIONS:**

**Ventilation:** Provide general dilution ventilation.

Emergency eyewash should be provided.

Quick drench shower should be provided.

**9. PHYSICAL AND CHEMICAL PROPERTIES**

**MOLECULAR WEIGHT:** 88.01

**APPEARANCE AND ODOUR:** Colourless, odourless gas

**CONVERSION FACTOR:** 1 ppm = 3.59 mg/m<sup>3</sup>; 1 mg/m<sup>3</sup> = 0.278 ppm at 25° (calculated)

**MELTING POINT:** -304°F (-187°C)

**FREEZING POINT:** -184°C (-299.2°F) (2)

**BOILING POINT:** -198 °F (-128°C)

**RELATIVE DENSITY (SPECIFIC GRAVITY):** (Liquid) 1.89 at -183°C (water =1) (1)

**SOLUBILITY IN WATER:** 0.0015 % (at 25°C)

**SOLUBILITY IN OTHER LIQUIDS:** Soluble in benzene, chloroform (3)

**VAPOUR DENSITY:** 3.04 (air=1) (3)

**VAPOUR PRESSURE:** 799 mmHg (at -127°C)

**SATURATION VAPOUR CONCENTRATION:** Not applicable

**VISCOSITY:** 0.170 CP (at-60°C)

**SPECIFIC GRAVITY:** 1.89 (at-183°C)

**LATENT HEAT OF VAPORIZATION:** 135.95 kJ/kg (at-128°C)

**pH Value:** Not available

**CRITICAL TEMPERATURE:** -45.6°C (-50.08°F) (5)

**CRITICAL PRESSURE:** 3.74Mpa (5)

**10. STABILITY AND REACTIVITY**

**STABILITY:**

Thermally stable, chemically very inert (1).

**INCOMPATIBLE MATERIALS:**

Not available.

**HAZARDOUS POLYMERISATION:**

Will not occur.

**HAZARDOUS DECOMPOSITION PRODUCTS:**

Toxic and Corrosive fumes of Fluorides.

## 11. TOXICOLOGICAL INFORMATION

ORAL-RAT LCLO 895,000 ppm/15 minutes.

**INHALATION:**

May cause hypoxia with dizziness, disorientation, incoordination, narcosis, nausea, and vomiting.

**SKIN:**

Skin contact with the liquid may cause irritation or frostbite

**EYE:**

Liquid splashed in the eye may cause freezing resulting in frostbite, temporary irritation or serious damage.

**INGESTION:**

Ingestion of a gas is unlikely.

## 12. ECOLOGICAL INFORMATION

## 13. DISPOSAL CONSIDERATIONS

Comply with all federal, state, and local regulations.

## 14. TRANSPORT INFORMATION

<b>UN No:</b> 1982		
<b>ADR/RID:</b>	<b>Class:</b> 2.2 <b>Label:</b> Non-flammable gas	<b>Proper shipping name:</b> Tetrafluoromethane (R14)
<b>IMDG:</b>	<b>Class:</b> 2.2 <b>Label:</b> Non-flammable gas	<b>Proper shipping name:</b> Tetrafluoromethane (R14)
<b>IATA:</b>	<b>Class:</b> 2.2 <b>Label:</b> Non-flammable gas	<b>Proper shipping name:</b> Tetrafluoromethane (R14)



## 15. REGULATORY INFORMATION

### APPLICABLE REGULATIONS:

Refer to country of destination.

### SAFETY AND RISK PHRASES:

Refer to country of destination.

## 16. OTHER INFORMATION

### SELECTED BIBLIOGRAPHY:

1. The Merck Index: an encyclopedia of chemicals, drugs, and biologicals, 11<sup>th</sup> ed. Merck, 1989 p.276.
2. Hawley's condensed chemical dictionary, 12<sup>th</sup> ed. Van Nostrand Reinhold, 1993. p. 1130.
3. HSDB record for carbon tetrafluoride. Last updated 9412.
4. The Sigma Aldrich library of chemical safety data. Edition II. Sigma Aldrich, 1988 p. 686C.
5. Kirk-Othmer encyclopedia of chemical technology. Vol 103, 4<sup>th</sup> ed. John Wiley & Sons, 1980 p. 957.

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# MATERIAL SAFETY DATA SHEET

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## SECTION 1 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

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**MATHESON TRI-GAS, INC.**  
**959 ROUTE 46 EAST**  
**PARSIPPANY, NEW JERSEY 07054-0624**

**EMERGENCY CONTACT:**  
**CHEMTREC 1-800-424-9300**  
**INFORMATION CONTACT:**  
**973-257-1100**

**SUBSTANCE: CHLORINE**

**TRADE NAMES/SYNONYMS:**

MTG MSDS 22; CHLORINE MOLECULAR; DIATOMIC CHLORINE; DICHLORINE; MOLECULAR CHLORINE; UN 1017; Cl<sub>2</sub>; MAT04600; RTECS FO2100000

**CHEMICAL FAMILY:** halogens, gas

**CREATION DATE:** Jan 24 1989

**REVISION DATE:** Dec 16 2002

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## SECTION 2 COMPOSITION, INFORMATION ON INGREDIENTS

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**COMPONENT:** CHLORINE

**CAS NUMBER:** 7782-50-5

**PERCENTAGE:** 100.0

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## SECTION 3 HAZARDS IDENTIFICATION

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**NFPA RATINGS (SCALE 0-4):** HEALTH=4 FIRE=0 REACTIVITY=0



**EMERGENCY OVERVIEW:**

**COLOR:** yellow or green

**PHYSICAL FORM:** gas

**ODOR:** distinct odor, irritating odor

**MAJOR HEALTH HAZARDS:** harmful if inhaled, respiratory tract burns, skin burns, eye burns

**PHYSICAL HAZARDS:** Containers may rupture or explode if exposed to heat. May ignite combustibles.

**POTENTIAL HEALTH EFFECTS:**

**INHALATION:**

**SHORT TERM EXPOSURE:** burns, chest pain, difficulty breathing, headache, dizziness, hyperactivity, emotional disturbances, bluish skin color, lung damage, death

**LONG TERM EXPOSURE:** burns, skin disorders, lack of sense of smell, lung damage

**SKIN CONTACT:**

**SHORT TERM EXPOSURE:** burns

**LONG TERM EXPOSURE:** burns

**EYE CONTACT:**

**SHORT TERM EXPOSURE:** burns

**LONG TERM EXPOSURE:** burns

**INGESTION:**

**SHORT TERM EXPOSURE:** ingestion of harmful amounts is unlikely

**LONG TERM EXPOSURE:** ingestion of harmful amounts is unlikely

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## SECTION 4 FIRST AID MEASURES

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**INHALATION:** If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. If breathing is difficult, oxygen should be administered by qualified personnel. Get immediate medical attention.

**SKIN CONTACT:** Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get immediate medical attention. Thoroughly clean and dry contaminated clothing and shoes before reuse. Destroy contaminated shoes.

**EYE CONTACT:** Immediately flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.

**INGESTION:** Contact local poison control center or physician immediately. Never make an unconscious person vomit or drink fluids. Give large amounts of water or milk. Allow vomiting to occur. When vomiting occurs, keep head lower than hips to help prevent aspiration. If person is unconscious, turn head to side. Get medical attention immediately.

**NOTE TO PHYSICIAN:** For inhalation, consider oxygen. Avoid gastric lavage or emesis.

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## SECTION 5 FIRE FIGHTING MEASURES

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**FIRE AND EXPLOSION HAZARDS:** Negligible fire hazard. Oxidizer. May ignite or explode on contact with combustible materials.

**EXTINGUISHING MEDIA:** water

Do not use dry chemicals, carbon dioxide or halogenated extinguishing agents. Large fires: Flood with fine water spray.

**FIRE FIGHTING:** Move container from fire area if it can be done without risk. Cool containers with water spray until well after the fire is out. Stay away from the ends of tanks. For fires in cargo or storage area: If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. For small fires, contain and let burn. Use extinguishing agents appropriate for surrounding fire. Cool containers with water spray until well after the fire is out. Apply water from a protected location or from a safe distance. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas. Evacuation radius: 800 meters (1/2 mile).

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## SECTION 6 ACCIDENTAL RELEASE MEASURES

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**AIR RELEASE:**

Reduce vapors with water spray. Collect runoff for disposal as potential hazardous waste.

**SOIL RELEASE:**

Dig holding area such as lagoon, pond or pit for containment. Dike for later disposal. Trap spilled material at bottom in deep water pockets, excavated holding areas or within sand bag barriers. Absorb with sand or other non-combustible material. Add an alkaline material (lime, crushed limestone, sodium bicarbonate, or soda ash).

**WATER RELEASE:**

Add an alkaline material (lime, crushed limestone, sodium bicarbonate, or soda ash). Absorb with activated carbon. Collect spilled material using mechanical equipment.

**OCCUPATIONAL RELEASE:**

Stop leak if possible without personal risk. Avoid contact with combustible materials. Keep unnecessary people away, isolate hazard area and deny entry. Ventilate closed spaces before entering. Notify Local Emergency Planning Committee and State Emergency Response Commission for release greater than or equal to RQ (U.S. SARA Section 304). If release occurs in the U.S. and is reportable under CERCLA Section 103, notify the National Response Center at (800)424-8802 (USA) or (202)426-2675 (USA).

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**SECTION 7 HANDLING AND STORAGE**

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**STORAGE:** Store and handle in accordance with all current regulations and standards. Protect from physical damage. Keep separated from incompatible substances. Store outside or in a detached building. Notify State Emergency Response Commission for storage or use at amounts greater than or equal to the TPQ (U.S. EPA SARA Section 302). SARA Section 303 requires facilities storing a material with a TPQ to participate in local emergency response planning (U.S. EPA 40 CFR 355.30).

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**SECTION 8 EXPOSURE CONTROLS, PERSONAL PROTECTION**

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**EXPOSURE LIMITS:****CHLORINE:**

1 ppm (3 mg/m<sup>3</sup>) OSHA ceiling

0.5 ppm (1.5 mg/m<sup>3</sup>) OSHA TWA (vacated by 58 FR 35338, June 30, 1993)

1 ppm (3 mg/m<sup>3</sup>) OSHA STEL (vacated by 58 FR 35338, June 30, 1993)

0.5 ppm ACGIH TWA

1 ppm ACGIH STEL

0.5 ppm (1.45 mg/m<sup>3</sup>) NIOSH recommended ceiling 15 minute(s)

**VENTILATION:** Provide local exhaust or process enclosure ventilation system. Ensure compliance with applicable exposure limits.

**EYE PROTECTION:** Wear splash resistant safety goggles with a faceshield. Provide an emergency eye wash fountain and quick drench shower in the immediate work area.

**CLOTHING:** Wear appropriate chemical resistant clothing.

**GLOVES:** Wear appropriate chemical resistant gloves.

**RESPIRATOR:** The following respirators and maximum use concentrations are drawn from NIOSH and/or OSHA.

**5 ppm**

Any chemical cartridge respirator with cartridge(s) providing protection against this substance.

Any supplied-air respirator.

**10 ppm**

Any supplied-air respirator operated in a continuous-flow mode.

Any powered, air-purifying respirator with cartridge(s) providing protection against this substance.

Any chemical cartridge respirator with a full facepiece and cartridge(s) providing protection against this substance.

Any air-purifying respirator with a full facepiece and a canister providing protection against this substance.

Any self-contained breathing apparatus with a full facepiece.

Any supplied-air respirator with a full facepiece.

**Escape -**

Any air-purifying respirator with a full facepiece and a canister providing protection against this substance.

Any appropriate escape-type, self-contained breathing apparatus.

**For Unknown Concentrations or Immediately Dangerous to Life or Health -**

Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.

Any self-contained breathing apparatus with a full facepiece.

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**SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES**

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**PHYSICAL STATE:** gas

**COLOR:** yellow or green

**ODOR:** distinct odor, irritating odor

**MOLECULAR WEIGHT:** 70.906

**MOLECULAR FORMULA:** Cl<sub>2</sub>

**BOILING POINT:** -31 F (-35 C)

**FREEZING POINT:** -150 F (-101 C)

**VAPOR PRESSURE:** 5168 mmHg @ 21 C

**VAPOR DENSITY (air=1):** 2.49

**SPECIFIC GRAVITY:** Not applicable

**DENSITY:** 3.214 g/L @ 0 C

**WATER SOLUBILITY:** 1.46% @ 0 C

**PH:** Not applicable

**VOLATILITY:** Not applicable

**ODOR THRESHOLD:** 0.01 ppm

**EVAPORATION RATE:** Not applicable

**VISCOSITY:** 0.01327 cP @ 20 C

**COEFFICIENT OF WATER/OIL DISTRIBUTION:** Not applicable

**SOLVENT SOLUBILITY:**

**Soluble:** alkali

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**SECTION 10 STABILITY AND REACTIVITY**

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**REACTIVITY:** Stable at normal temperatures and pressure.

**CONDITIONS TO AVOID:** Avoid contact with combustible materials. Minimize contact with material. Avoid inhalation of material or combustion by-products. Keep out of water supplies and sewers.

**INCOMPATIBILITIES:** combustible materials, bases, metals, halogens, metal salts, reducing agents, amines, metal carbide, metal oxides, oxidizing materials, halo carbons, acids

**HAZARDOUS DECOMPOSITION:**

Thermal decomposition products: chlorine

**POLYMERIZATION:** Will not polymerize.

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## SECTION 11 TOXICOLOGICAL INFORMATION

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**CHLORINE:**

**TOXICITY DATA:**

293 ppm/1 hour(s) inhalation-rat LC50

**CARCINOGEN STATUS:** ACGIH: A4 -Not Classifiable as a Human Carcinogen

**LOCAL EFFECTS:**

Corrosive: inhalation, skin, eye

**ACUTE TOXICITY LEVEL:**

Toxic: inhalation

**MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:** heart problems

**TUMORIGENIC DATA:** Available.

**MUTAGENIC DATA:** Available.

**REPRODUCTIVE EFFECTS DATA:** Available.

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## SECTION 12 ECOLOGICAL INFORMATION

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**ECOTOXICITY DATA:**

**FISH TOXICITY:** 390 ug/L 96 hour(s) LC50 (Mortality) Orangethroat darter (*Etheostoma spectabile*)

**INVERTEBRATE TOXICITY:** 637.5 ug/L 1 hour(s) LC50 (Mortality) Pacific oyster (*Crassostrea gigas*)

**ALGAL TOXICITY:** 50-1000 ug/L 23 hour(s) (Population) Algae, phytoplankton, algal mat (Algae)

**PHYTOTOXICITY:** 20 ug/L 96 day(s) (Growth) Water-milfoil (*Myriophyllum spicatum*)

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## SECTION 13 DISPOSAL CONSIDERATIONS

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Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): D001. Dispose in accordance with all applicable regulations.

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## SECTION 14 TRANSPORT INFORMATION

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**U.S. DOT 49 CFR 172.101:**

**PROPER SHIPPING NAME:** Chlorine

**ID NUMBER:** UN1017

**HAZARD CLASS OR DIVISION:** 2.3

**LABELING REQUIREMENTS:** 2.3; 8

**ADDITIONAL SHIPPING DESCRIPTION:** Toxic-Inhalation Hazard Zone B



**CANADIAN TRANSPORTATION OF DANGEROUS GOODS:**

**SHIPPING NAME:** Chlorine

**ID NUMBER:** UN1017

**CLASSIFICATION:** 2.3, 8

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**SECTION 15 REGULATORY INFORMATION**

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**U.S. REGULATIONS:**

**CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4):**

**CHLORINE:** 10 LBS RQ

**SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30):**

**CHLORINE:** 100 LBS TPQ

**SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40):**

**CHLORINE:** 10 LBS RQ

**SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):**

ACUTE: Yes

CHRONIC: No

FIRE: No

REACTIVE: No

SUDDEN RELEASE: Yes

**SARA TITLE III SECTION 313 (40 CFR 372.65):**

**CHLORINE**

**OSHA PROCESS SAFETY (29CFR1910.119):**

**CHLORINE:** 1500 LBS TQ

**STATE REGULATIONS:**

**California Proposition 65:** Not regulated.

**CANADIAN REGULATIONS:**

**WHMIS CLASSIFICATION:** ACD1E

**NATIONAL INVENTORY STATUS:**

**U.S. INVENTORY (TSCA):** Listed on inventory.

**TSCA 12(b) EXPORT NOTIFICATION:** Not listed.

**CANADA INVENTORY (DSL/NDSL):** Not determined.

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**SECTION 16 OTHER INFORMATION**

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**MSDS SUMMARY OF CHANGES**

SECTION 15 REGULATORY INFORMATION

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# Material Safety Data Sheet

## HYDROFLUORIC ACID, ANHYDROUS

### 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

**PRODUCT NAME:** Hydrofluoric Acid, Anhydrous

**OTHER/GENERIC NAMES:** HF, Anhydrous HF, AHF, Hydrogen Fluoride, HF Acid

**PRODUCT USE:** Chemical Derivatives, Alkylation Catalyst

**MANUFACTURER:** Honeywell International  
Industrial Products  
101 Columbia Road  
Box 1053  
Morristown, New Jersey 07962-1053

**FOR MORE INFORMATION CALL:**

(Monday-Friday, 8:00am-4:30pm EST)  
HF Technical Service Department  
800-622-5002  
Or visit the Honeywell HF website:  
<http://www.HFacid.com>

**IN CASE OF EMERGENCY CALL:**

(24 Hours/Day, 7 Days/Week)  
800-707-4555 or 602-365-4980  
For Transportation Emergencies  
800-424-9300 (CHEMTREC for US)  
613-996-6666 (CANUTEC for Canada)

### 2. COMPOSITION/INFORMATION ON INGREDIENTS

<u>INGREDIENT NAME</u>	<u>CAS NUMBER</u>	<u>WEIGHT %</u>
Hydrofluoric Acid	7664-39-3	100

Trace impurities and additional material names not listed above may also appear in the Regulatory Information Section 15 towards the end of the MSDS. These materials may be listed for local "Right-To-Know" compliance and for other reasons.

### 3. HAZARDS IDENTIFICATION

**EMERGENCY OVERVIEW:** Clear, colorless, corrosive fuming liquid with an extremely acid odor. Forms dense white vapor clouds if released. Both liquid and vapor can cause severe burns to all parts of the body. Specialized medical treatment is required for all exposures.

## MATERIAL SAFETY DATA SHEET

Hydrofluoric Acid, Anhydrous

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### POTENTIAL HEALTH HAZARDS

**SKIN:** Both liquid and vapor can cause severe burns, which may not be immediately painful or visible. HF will penetrate skin and attack underlying tissues. Large or multiple burns totaling over 25 square inches of body surface area may also cause hypocalcemia (depletion of calcium in the body) and other toxic effects which may be fatal. Prolonged contact with very dilute HF solutions will cause burns

**EYES:** Both liquid and vapor can cause irritation or corneal burns.

**INHALATION:** **Mild exposure:** Can irritate nose, throat and respiratory system. Onset of symptoms may be delayed for several hours.

**Severe exposure:** Can cause nose and throat burns, lung inflammation and pulmonary edema (fluid in the lungs). Also results in other toxic effects including hypocalcemia (depletion of calcium in the body) which if not properly treated can result in death.

**INGESTION:** Can cause severe mouth, throat and stomach burns and may be fatal if swallowed. Even with small amounts of dilute solutions, profound and possibly fatal hypocalcemia (depletion of calcium in body) and systematic toxicity is likely to occur unless medical treatment is promptly initiated.

**DELAYED EFFECTS:** The effects of contact with dilute solutions of hydrofluoric acid or its vapors may be delayed. The potential delay in clinical signs or symptoms for dilute solutions is given below. Symptoms might include pain, redness of the skin and possible tissue destruction.

<u>HF Concentration</u>	<u>Delay in Symptoms</u>
>50%	Immediately Apparent
20%-50%	1-8 hours
0%-20%	Up to 24 hours

Can also cause bone and joint changes in humans (Fluorosis).

Carcinogenicity: Hydrofluoric Acid is not listed by NTP, IARC, OSHA, US EPA, ACGIH, or Health Canada as a carcinogen.

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### 4. FIRST AID MEASURES

**SKIN:** Remove the victim from the contaminated area and immediately wash the burned area with plenty of water for a minimum of 15 minutes. Limit washing to 5 minutes if treatment specific for HF exposure is available. Remove all contaminated clothing while washing continuously. After thorough washing for at least 5 minutes, the burned area should be immersed in a solution of 0.13% iced aqueous Zephiran® Chloride until pain is relieved. As an alternate first aid treatment, 2.5% calcium gluconate gel may be continuously massaged into the burn area until the pain is relieved. For larger burns or burns treated with calcium gluconate gel (in which pain is present longer than 30 minutes), a physician should inject 5% aqueous calcium gluconate beneath, around and in the burned area. Use of local anesthetics is not recommended, as reduction in pain is an indicator of effectiveness of treatment.

## MATERIAL SAFETY DATA SHEET

### Hydrofluoric Acid, Anhydrous

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**EYES:** Irrigate eyes for at least 15 minutes with copious quantities of water, keeping eyelids apart and away from eyeballs during irrigation. Get competent medical attention immediately, preferably an eye specialist. If a physician is not immediately available, apply one or two drops of 0.5% tetracaine hydrochloride solution, or other aqueous, topical ophthalmic anesthetic and continue irrigation. Do not use the solution described for skin treatment. Use no other medications unless instructed to do so by a physician. Rubbing of the eyes is to be avoided. Irrigate with 1% calcium gluconate in normal saline for 1 to 2 hours to prevent or lessen corneal damage.

**INHALATION:** Move to fresh air. Keep the victim lying down, quiet and warm. Get competent medical attention immediately. If breathing has stopped, start artificial respiration at once. An authorized person should administer oxygen to a victim who is having difficulty breathing, until the victim is able to breathe easily by himself. Calcium Gluconate, 2.5% in normal saline may be given by nebulizer with oxygen. Do not give stimulants unless instructed to do so by a physician. Victim should be examined by a physician and held under observation for at least 24 hours.

**INGESTION:** Drink large amounts of water to dilute. Do not induce vomiting. Several glasses of milk or several ounces of milk of magnesia may be given for their soothing effect. Take victim to a doctor.

**ADVICE TO PHYSICIAN:** For large skin area burns (totaling greater than 25 square inches), for ingestion and for significant inhalation exposure, severe systemic effects may occur. Monitor and correct for hypocalcemia, cardiac arrhythmias, hypomagnesemia and hyperkalemia. In some cases hemodialysis may be indicated. For certain burns, especially of the digits, use of intra-arterial calcium gluconate may be indicated. For inhalation exposures, treat as chemical pneumonia. Monitor for hypocalcemia. 2.5% calcium gluconate in normal saline by nebulizer or by IPPB with 100% oxygen may decrease pulmonary damage. Bronchodilators may also be administered. A booklet titled "Recommended Medical Treatment for Hydrofluoric Acid Exposure" is available from the Honeywell HF website: <http://www.HFacid.com>

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## 5. FIRE FIGHTING MEASURES

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### FLAMMABLE PROPERTIES

<b>FLASH POINT:</b>	Not flammable
<b>FLASH POINT METHOD:</b>	Closed cup
<b>AUTOIGNITION TEMPERATURE:</b>	Not applicable
<b>UPPER FLAME LIMIT (volume % in air):</b>	Not applicable
<b>LOWER FLAME LIMIT (volume % in air):</b>	Not applicable
<b>FLAME PROPAGATION RATE (solids):</b>	Not applicable
<b>OSHA FLAMMABILITY CLASS:</b>	Not applicable

### **EXTINGUISHING MEDIA:**

Use water or suitable agent for fires adjacent to non-leaking tanks or containers of HF. Do not use solid water streams near ruptured tanks or spills of HF. Acid reacts with water and can splatter acid onto personnel.

### **UNUSUAL FIRE AND EXPLOSION HAZARDS:**

Reaction with certain metals generates flammable and potentially explosive hydrogen gas. Considerable heat is evolved when contacted with many substances. Heat increases pressure and may explode container. Will react violently with water.

### **SPECIAL FIRE FIGHTING PRECAUTIONS/INSTRUCTIONS:**

Wear self-contained breathing apparatus approved by NIOSH and full chemical protective clothing. Use water spray to keep containers cool.

## MATERIAL SAFETY DATA SHEET

Hydrofluoric Acid, Anhydrous

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### **6. ACCIDENTAL RELEASE MEASURES**

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**IN CASE OF SPILL OR OTHER RELEASE:** (Always wear recommended personal protective equipment )

Good ventilation is necessary. Discharge will ordinarily be a vapor or a liquid that gives off fumes of HF gas. Those treating spills or repairing leaks must use full protective equipment. Take actions to minimize environmental impact. Try to contain spillage and avoid drainage to areas which cannot be treated. Rapid dilution of the spill with water to <50% will reduce the amount of fumes given off. Carefully neutralize the dilute liquid with lime slurry, soda ash, limestone, caustic soda or other alkaline material. (See Sections 10 and 13 for more information.)

**Spills and releases may have to be reported to Federal and/or local authorities. See Section 15 regarding reporting requirements.**

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### **7. HANDLING AND STORAGE**

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**NORMAL HANDLING:** (Always wear recommended personal protective equipment.)

Do not breathe vapor or mist. Use only with adequate ventilation. Avoid all contact with skin, eyes and clothing, even dilute solutions. Do not add water to acid.

**STORAGE RECOMMENDATIONS:**

Store in approved containers only. Store in cool, well-ventilated area. Flammable hydrogen gas can be generated in metal storage containers. Diking of storage tanks is recommended. Carbon steel in HF service may be subject to indiscriminate hydrogen blistering and possibly other hydrogen related damage and should, therefore, be routinely inspected and repaired if needed. Non-destructive tank thickness testing (NDT), and other techniques should be utilized for periodic checks of tank wall thickness and to assure equipment integrity.

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### **8. EXPOSURE CONTROLS/PERSONAL PROTECTION**

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**ENGINEERING CONTROLS:**

Sufficient to reduce vapor and acid mists below permissible TLV levels. Packaging and unloading areas and open processing equipment may require mechanical exhaust systems.

**PERSONAL PROTECTIVE EQUIPMENT**

**SKIN PROTECTION:**

For routine product use, wear hydrofluoric acid-resistant jacket, trousers, boots and gauntlet gloves. For increased protection, use air-supplied totally encapsulating HF resistant protective suit.

**EYE PROTECTION:**

As a minimum, wear hard hat, chemical safety goggles (plastic lenses), and full face plastic shield. For increased protection, use air supplied hydrofluoric acid resistant hood.

**RESPIRATORY PROTECTION:**

Where required, use a respirator approved by NIOSH for HF gas or mists, as applicable. Some exposures may require a NIOSH-approved, self-contained breathing apparatus or air supplied respirator.

**ADDITIONAL RECOMMENDATIONS:**

Eyewash and quick-drench shower facilities, protected from freezing, should be available where HF is stored or handled.

## MATERIAL SAFETY DATA SHEET

Hydrofluoric Acid, Anhydrous

### EXPOSURE GUIDELINES (Guidelines exist for the following ingredients)

<u>INGREDIENT NAME</u>	<u>ACGIH TLV</u>	<u>OSHA PEL</u>	<u>OTHER LIMITS</u>
Hydrogen Fluoride/Hydrofluoric acid	3 ppm – CEILING	3 ppm (TWA)	3 mg(F)/g creatinine in urine pre-shift 10 mg(F)/g creatinine post-shift***

<u>OSHA STEL</u>	<u>NIOSH IDLH</u>
6 ppm (15 min.)	30 ppm (30 mins)

### AIHA Emergency Response Planning Guideline

<u>ERPG-1</u>	<u>ERPG-2</u>	<u>ERPG-3</u>
2 ppm (60 mins)	20 ppm (60 mins)	50 ppm (60 mins)
2 ppm (10 mins)	50 ppm(10 mins)	170 ppm (10 mins)

\*\*\* = Biological Exposure Index

**OTHER EXPOSURE LIMITS FOR POTENTIAL DECOMPOSITION PRODUCTS:** None

## 9. PHYSICAL AND CHEMICAL PROPERTIES

<b>APPEARANCE:</b>	Colorless liquid, fumes in air
<b>PHYSICAL STATE:</b>	Liquid
<b>MOLECULAR WEIGHT:</b>	20.01
<b>CHEMICAL FORMULA:</b>	HF
<b>ODOR:</b>	Sharp pungent odor
<b>SPECIFIC GRAVITY:</b>	(Water = 1.0) 0.97 at 70°F (21.1°C)
<b>SOLUBILITY IN WATER:</b>	(Weight %) 100% by weight
<b>pH:</b>	Not applicable
<b>BOILING POINT:</b>	67.2°F (19.55°C)
<b>MELTING POINT:</b>	-118°F (-84°C)
<b>VAPOR PRESSURE:</b>	776 mm Hg at 70°F (21.1°C)
<b>VAPOR DENSITY (Air = 1.0):</b>	2.21 at 70°F, (21.1°C), 1.76 at 80°F (26.7°C)
<b>EVAPORATION RATE:</b>	Not applicable
<b>% VOLATILES:</b>	100%
<b>IONIZATION POTENTIAL:</b>	15.98 eV
<b>FLASH POINT:</b>	Not flammable.
	(Flash point method and additional flammability data are found in section 5.)

## 10. STABILITY AND REACTIVITY

**NORMALLY STABLE? (CONDITIONS TO AVOID):** Stable under normal conditions.

### **INCOMPATIBILITIES:**

Glass, concrete and other silicon bearing materials: yield silicon tetrafluoride gas. Pressure buildup from this process has been known to rupture glass containers. Carbonates, sulfides and cyanides: yield toxic gases: carbon dioxide, hydrogen sulfide and hydrogen cyanide. Alkalis, some oxides: cause strong violent exothermic reactions. Common metals: yield hydrogen gas, a fire and explosive reactive hazard. Corrosive to many materials including leather, natural rubber and many organics. Considerable heat is evolved and a violent reaction can occur when water is added to HF.

## MATERIAL SAFETY DATA SHEET

Hydrofluoric Acid, Anhydrous

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**HAZARDOUS DECOMPOSITION PRODUCTS:** Not applicable; boils away unchanged.

**HAZARDOUS POLYMERIZATION:** Will not occur.

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### **11. TOXICOLOGICAL INFORMATION**

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**IMMEDIATE (ACUTE) EFFECTS:**

Inhalation: LC <sub>50</sub> (Rat)	=	5,100 ppm/5 min
LC <sub>50</sub> (Rat)	=	1,300 ppm/60 min
LC <sub>50</sub> (Mouse)	=	6,247 ppm/5 min

Skin: 2% solution of HF was corrosive to rabbit skin with 1 hour exposure, but not with 1 minute exposure.

**DELAYED (SUBCHRONIC AND CHRONIC) EFFECTS:**

Prolonged exposure can cause bone and joint changes in humans. (Fluorosis – Increased bone density and mottling of teeth.)

**OTHER DATA:** None

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### **12. ECOLOGICAL INFORMATION**

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Aquatic toxicity: 60 ppm\*/fish/lethal/fresh water. (\*time period not specified).

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### **13. DISPOSAL CONSIDERATIONS**

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**RCRA**

**Is the unused product a RCRA hazardous waste if discarded?** Yes

**If yes, the RCRA ID number is:** U134 (hydrofluoric acid) and D002 (Corrosive)

**OTHER DISPOSAL CONSIDERATIONS:** As waste disposal methods may vary, contact the supplier for specific recommendations. Treat small amounts by adding to an excess of water and neutralize with a lime slurry, soda ash, limestone, caustic soda or other alkali. Add to water and neutralize cautiously as reaction is immediate and can be violent. Considerable amounts of harmful vapors may be released. Good ventilation is required. Dispose of residue (or slurry) by removal to an approved chemical waste landfill or by an approved waste contractor.

The information offered here is for the product as shipped. Use and/or alterations to the product such as mixing with other materials may significantly change the characteristics of the material and alter the RCRA classification and the proper disposal method.

## MATERIAL SAFETY DATA SHEET

Hydrofluoric Acid, Anhydrous

### 14. TRANSPORT INFORMATION

**PROPER DOT SHIPPING DESCRIPTION:**

(FOR QUANTITIES WITH >100 LBS IN A SINGLE CONTAINER)

RQ Hydrogen Fluoride, Anhydrous, 8, UN1052, PG I, (6.1)

Poison Inhalation Hazard, Hazard Zone C

**PLACARDS REQUIRED:**

Primary – Class 8 – Corrosive

Subsidiary – Class 6 – Poison Inhalation Hazard

**EMERGENCY RESPONSE GUIDEBOOK (2000 EDITION):** Guide No. 125

For additional information on shipping regulations affecting this material, contact the information number found in Section 1.

### 15. REGULATORY INFORMATION

**TOXIC SUBSTANCES CONTROL ACT (TSCA)**

**TSCA INVENTORY STATUS:** Hydrofluoric Acid, Anhydrous is listed.

**OTHER TSCA ISSUES:** None

**SARA TITLE III/CERCLA:**

**RQs and TPQs:**

"Reportable Quantities" (RQs) and/or "Threshold Planning Quantities" (TPQs) exist for the following ingredients.

<u>INGREDIENT NAME</u>	<u>SARA/CERCLA RQ (lbs)</u>	<u>SARA EHS TPQ (lbs)</u>
Hydrogen Fluoride	100	100

Spills or releases resulting in the loss of any ingredient at or above its RQ requires immediate notification to the National Response Center (800-424-8802) and to your Local Emergency Planning Committee.

**SECTION 311 HAZARD CLASS:** Immediate. Delayed

**SARA 313 TOXIC CHEMICALS:**

The following ingredients are SARA 313 "Toxic Chemicals". CAS numbers and weight percents are found in Section 2.

<u>INGREDIENT NAME</u>	<u>COMMENT</u>
Hydrogen Fluoride	None

**STATE RIGHT-TO-KNOW**

In addition to the ingredients found in Section 2, the following are listed for state right-to-know purposes.

<u>INGREDIENT NAME</u>	<u>WEIGHT %</u>	<u>COMMENT</u>
No ingredients in this section		

## MATERIAL SAFETY DATA SHEET

Hydrofluoric Acid, Anhydrous

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### **ADDITIONAL REGULATORY INFORMATION:**

Storage or in process use greater than the specified threshold quantity of 1000 lbs. is subject to OSHA 29 CFR Part 1910.119, Process Safety Management of Highly Hazardous Chemicals.

Stationary sources (fixed facilities) with more than the specified threshold quantity of 1000 lbs. of Hydrogen Fluoride/Hydrofluoric Acid (concentration 50% or greater) are subject to EPA 40 CFR Part 68, Section 112(r)7

Accidental Release Prevention Requirements: Risk Management Programs.

### **WHMIS CLASSIFICATION (CANADA):**

Class D, Division 1, Subdivision A and

Class E

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.

### **FOREIGN INVENTORY STATUS:**

Canadian DSL (Domestic Substances List)

EINECS (European Inventory of Existing Chemical Substances) (EINECS #:231-634-8)

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## **16. OTHER INFORMATION**

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**CURRENT ISSUE DATE:** January, 2004

**PREVIOUS ISSUE DATE:** January, 2003

### **CHANGES TO MSDS FROM PREVIOUS ISSUE DATE ARE DUE TO THE FOLLOWING:**

Minor wording changes for clarification made in Sections 1,8,14,15,16

**OTHER INFORMATION:** National Fire Prevention Association (NFPA) Rating  
Health 4, Flammability 0, Reactivity 1, Special Instructions – None

## Material Safety Data Sheet Isopropyl Alcohol

### PRODUCT & COMPANY IDENTIFICATION

In case of Emergency call CHEMTREC 1-800-424-9300

<b>Supplier</b>	Simchem Corporation, 311 Sarasota Center Blvd., P.O. Box 697, Osprey, Florida, 34229-0697 (941) 377-9935 Fax (941) 377-9539
<b>CAS Number</b>	67-63-0
<b>Synonyms</b>	Isopropanol; sec-propyl alcohol; sec-propanol; dimethylcarbinol
<b>Formula</b>	(CH <sub>3</sub> ) <sub>2</sub> CHOH

### TRANSPORTATION DATA

<b>US Department of Transportation – 49 CFR</b>	
<b>Proper Shipping Name</b>	Isopropanol
<b>UN Number</b>	UN1219
<b>Hazard Class</b>	3
<b>Packing Group</b>	II
<b>Labels</b>	Flammable Liquid

### PHYSICAL/CHEMICAL DATA

<b>Appearance</b>	Clear, colorless liquid
<b>Odor</b>	Rubbing alcohol
<b>Boiling Point</b>	82° C
<b>Melting Point</b>	-89° C
<b>Vapor Pressure</b>	44 @ 25° C (mm Hg)
<b>Vapor Density (Air = 1)</b>	2.1
<b>Specific Gravity</b>	0.79 @ 20° C / 4° C
<b>Solubility in Water</b>	Miscible in water
<b>Volatile by Volume</b>	100% @ 21° C
<b>Evaporation Rate</b>	2.83 (BuAc = 1)

### REACTIVITY DATA

<b>Stability</b>	Stable
<b>Incompatibility</b>	Heat, flame, strong oxidizers, acetaldehyde, acids, chlorine, ethylene oxide, isocyanates.
<b>Hazardous Decomposition Products</b>	Carbon dioxide and carbon monoxide may form when heated to decomposition.
<b>Conditions to Avoid</b>	Heat, flame, ignition sources and incompatibles.
<b>Hazardous Polymerization</b>	Will not occur.

## FIRE AND EXPLOSION HAZARD DATA

<b>Flash Point</b>	12° C
<b>Auto Ignition Temperature</b>	399° C
<b>Flammable Limits</b>	LEL: 2.0 UEL: 12.7
<b>Fire Extinguishing Spray</b>	Water spray, dry chemical, alcohol foam, or carbon dioxide. Water spray may be used to keep fire exposed containers cool, dilute spills and nonflammable mixtures, protect personnel attempting to stop leak and disperse vapors.
<b>Explosion</b>	Above flash point, vapor air mixtures are explosive within flammable limits noted above. Contact with strong oxidizers may cause fire or explosion. Vapors can flow along surfaces to distant ignition source and flash back. Sensitive to static discharge.
<b>Special Information</b>	In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full face piece operated in the pressure demand for other positive pressure mode.

## PRECAUTIONS FOR SAFE HANDLING & USE

<b>to be Taken in Case Material is Spilled or Released</b>	Ventilate area of leak or spill. Remove all sources of ignition. Wear appropriate personal protective equipment as specified on section 5. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! If a leak or spill has not ignited, use water spray to disperse the vapors, to protect personnel attempting to stop leak, and to flush spills away from exposures.
<b>Disposal Method</b>	Whatever cannot be saved for recovery or recycling should be handled as hazardous waste and sent to a RCRA approved incinerator or disposed in a RCRA approved waste facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.
<b>Handling and Storage</b>	Protect against physical damage. Store in a cool, dry well-ventilated location, away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from incompatibles. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment, including explosion proof ventilation. Containers of this material may be hazardous when empty since they retain product residues.

## HEALTH HAZARD DATA

### Potential Health Effects:

<b>Inhalation</b>	Inhalation of vapors irritates the respiratory tract. Exposure to high concentrations has a narcotic effect, producing symptoms of dizziness, drowsiness, headache, staggering, unconsciousness and possibly death.
<b>Ingestion</b>	Ingestion can cause drowsiness, unconsciousness, and death. Gastrointestinal pain, cramps, nausea, vomiting, and diarrhea may also result. The single lethal dose for a human adult = about 250 mls (8 ounces).
<b>Skin Contact</b>	May cause skin irritation with redness and pain. May be absorbed through the skin with possible systemic effects.
<b>Eye Contact</b>	Vapors cause eye irritation. Splashes caused severe irritation, possible corneal burns and eye damage.

### First Aid Measures:

<b>Inhalation</b>	In case of Inhalation, remove to fresh air. In not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.
<b>Ingestion</b>	Give large amounts of water to drink. Never give anything by mouth to an unconscious person. Get medical attention.
<b>Skin Contact</b>	Immediately flush skin with plenty of water for at least 15 minutes. Call a physician if irritation develops.
<b>Eye Contact</b>	Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

### Personal Protective Equipment:

<b>Skin Protection</b>	Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact. Neoprene and nitrile rubber are recommended materials.
<b>Eye Protection</b>	Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

## ADDITIONAL INFORMATION

Always comply with all applicable international, federal, state and local regulations regarding the transportation, storage, use and disposal of this chemical.

Due to the changing nature of regulatory requirements, the regulatory information listed in Section X this document should not be considered all-inclusive or authoritative. International, Federal, State Local regulations should be consulted to determine with all required reporting requirements.

The information in this MSDS was obtained from sources, which we believe are reliable. However, the information is provided without any warranty, express or implied, regarding its correctness. The conditions or methods of handling, storage, use, and disposal of the product are beyond our control and may be beyond our knowledge. For this and other reasons, we do not assume responsibility and expressly disclaim liability for loss, damage or expense arising out of or in any way connected with the handling, storage, use or disposal of the product. This MSDS was prepared and is to be used only for this product. If the product is used as a component in another product, MSDS information may not be applicable.

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**1. PRODUCT AND COMPANY IDENTIFICATION**

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**MICROPOSIT(TM) MF(TM) -319 Developer****Supplier**Rohm and Haas Electronic Materials LLC  
455 Forest Street  
Marlborough, MA 01752 United States of America

Revision date: 01/01/2004

For non-emergency information contact: 508-481-7950

**Emergency telephone number**Chemtrec 800-424-9300  
Rohm and Haas Emergency 215-592-3000

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**2. COMPOSITION/INFORMATION ON INGREDIENTS**

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Component	CAS-No.	Concentration
Water	7732-18-5	> 95.0 %
Surfactant		< 1.0 %
Tetramethylammonium hydroxide	75-59-2	2.2 %

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**3. HAZARDS IDENTIFICATION**

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**Emergency Overview****Appearance**

Form liquid

Colour colourless

**Odour** amines**Hazard Summary****WARNING!**Alkaline liquid and vapor. Causes skin, eye, and respiratory tract irritation. Onset of symptoms may be delayed.  
Prolonged, repeated contact, inhalation, ingestion, or absorption through the skin, may cause toxic effects to internal organ systems (liver, kidney, central nervous system).**Potential Health Effects**

**Primary Routes of Entry:** Inhalation, ingestion, eye and skin contact, absorption.

**Eyes:** May cause pain, transient irritation and superficial corneal effects.

**Skin:** Material may cause irritation.

Prolonged or repeated exposure may have the following effects:

central nervous system depression

drowsiness

defatting of skin leading to irritation and dermatitis

**Ingestion:** Swallowing may have the following effects:

irritation of mouth, throat and digestive tract

Repeated doses may have the following effects:

central nervous system depression

drowsiness

**Inhalation:** Inhalation may have the following effects:

irritation of nose, throat and respiratory tract

Higher concentrations may have the following effects:

systemic effects similar to those resulting from ingestion

**Target Organs:** Eye

Respiratory System

Skin

nervous system

### **Carcinogenicity**

Not considered carcinogenic by NTP, IARC, and OSHA

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## **4. FIRST AID MEASURES**

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**Inhalation:** Remove from exposure. If there is difficulty in breathing, give oxygen. Seek medical attention if symptoms persist.

**Skin contact:** Wash skin with water. Continue washing for at least 15 minutes. Obtain medical attention if blistering occurs or redness persists.

**Eye contact:** Immediately flush the eye with plenty of water for at least 15 minutes, holding the eye open. Obtain medical attention if soreness or redness persists.

**Ingestion:** Wash out mouth with water. Have victim drink 1-3 glasses of water to dilute stomach contents. Immediate medical attention is required. Never administer anything by mouth if a victim is losing consciousness, is unconscious or is convulsing.

### **Notes to physician**

Treat symptomatically.

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## **5. FIRE-FIGHTING MEASURES**

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**Flash point** Nonflammable

**Suitable extinguishing media:** Not readily combustible.  
Select extinguishing agent appropriate to other materials involved.

**Specific hazards during fire fighting:** No specific measures necessary.

**Special protective equipment for fire-fighters:** Wear full protective clothing and self-contained breathing apparatus.

**Further information:** This product may give rise to hazardous vapors in a fire.

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## 6. ACCIDENTAL RELEASE MEASURES

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### Personal precautions

Wear suitable protective clothing.

### Environmental precautions

Prevent the material from entering drains or water courses.

Do not discharge directly to a water source.

Advise Authorities if spillage has entered watercourse or sewer or has contaminated soil or vegetation.

### Methods for cleaning up

Cover with absorbent or contain. Collect and dispose.

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## 7. HANDLING AND STORAGE

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### Handling

Use only in well-ventilated areas. Avoid breathing vapor. Avoid contact with eyes, skin and clothing.

Keep container tightly closed.

**Further information on storage conditions:** No special precautions necessary.

### Storage

**Storage conditions:** Store in original container. Storage area should be: cool dry well ventilated out of direct sunlight away from incompatible materials

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## 8. EXPOSURE CONTROLS / PERSONAL PROTECTION

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### Exposure limit(s)

Exposure limits are listed below, if they exist.

**Eye protection:** goggles

**Hand protection:** Butyl rubber gloves. Other chemical resistant gloves may be recommended by your safety professional.

**Skin and body protection:** Normal work wear.

**Respiratory protection:** Respiratory protection if there is a risk of exposure to high vapor concentrations. The specific respirator selected must be based on the airborne concentration found in the workplace and must not exceed the working limits of the respirator.

**Engineering measures:** Engineering methods to prevent or control exposure are preferred. Methods include process or personnel enclosure, mechanical ventilation (local exhaust), and control of process conditions.

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## 9. PHYSICAL AND CHEMICAL PROPERTIES

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### Appearance

<b>Form</b>	liquid
<b>Colour</b>	colourless
<b>Odour</b>	amines
<b>pH</b>	13
<b>Boiling point/range</b>	100 °C (212 °F)
<b>Flash point</b>	Nonflammable

Component: **Tetramethylammonium hydroxide**

<b>Vapour pressure</b>	17.5 mmHg at 20 °C
<b>Relative vapour density</b>	no data available
<b>Water solubility</b>	completely soluble
<b>Relative density</b>	1.00
<b>Evaporation rate</b>	Slower than ether
<b>VOC's</b>	not applicable

NOTE: The physical data presented above are typical values and should not be construed as a specification.

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## 10. STABILITY AND REACTIVITY

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<b>Hazardous reactions</b>	Stable under normal conditions.
<b>Conditions to avoid</b>	contact with incompatible materials
<b>Materials to avoid</b>	Acids. Oxidizers
<b>Hazardous decomposition products</b>	Methanol, oxides of carbon., nitrogen oxides (NOx),
<b>polymerization</b>	Will not occur.

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## 11. TOXICOLOGICAL INFORMATION

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*Toxicological information on this product or its components appear in this section when such data is available.*

Component: **Tetramethylammonium hydroxide**

**Acute dermal toxicity** 2.1 %(m)  
A single 4h semi-occlusive application to intact rabbit skin produced no signs of dermal irritation.  
No clinical signs of toxicity were observed.  
Testing complied with OECD 404 and EPA TSCA 40 CFR Part 798 standard protocols.  
DOT Corrosivity testing conducted on stainless steel and laboratory animals determined that this product is not corrosive.

Component: **Tetramethylammonium hydroxide**

**Acute dermal toxicity** 3.5 %(m)  
A single 4h semi-occlusive application to intact rabbit skin produced minimal signs of irritation ( mean scores for erythema or edema less than 2).  
No clinical signs of toxicity were observed.  
Testing complied with OECD 404 and EPA TSCA 40 CFR Part 798 standard protocols.

Component: **Tetramethylammonium hydroxide**

**Acute dermal toxicity** 5 %(m)  
A single 4h semi-occlusive application to intact rabbit skin produced burns (full thickness destruction of skin).  
This material is corrosive.  
No clinical signs of toxicity were observed.  
Testing complied with OECD 404 and EPA TSCA 40 CFR Part 798 standard protocols.  
Corrosive to aluminum per DOT corrosivity testing.

Component: **Tetramethylammonium hydroxide**

**Acute dermal toxicity** 7 %(m)  
A single 4h semi-occlusive application to intact rabbit skin produced burns (full thickness destruction of skin).  
This material is corrosive.  
No clinical signs of toxicity were observed.  
Testing complied with OECD 404 and EPA TSCA 40 CFR Part 798 standard protocols.  
Corrosive to aluminum per DOT corrosivity testing.

Component: **Tetramethylammonium hydroxide**

**Acute dermal toxicity** <5% (w/v):  
Repeated application to rat skin for 6 h/d, 5 d/wk for 4 weeks did not produce systemic toxicity.  
Test material was applied continuously through a reservoir affixed to shaved animal backs.

Component: **Tetramethylammonium hydroxide**

**Acute dermal toxicity** >=5% (w/v):  
Repeated application to rat skin for 6h/d, 5d/wk for 4 weeks produced rapid toxicity and following effects:  
convulsions  
death  
Effects were noted after 2 hours of initial application.  
Test material was applied continuously through a reservoir affixed to shaved animal backs.

Component: **Tetramethylammonium hydroxide**  
**Acute dermal toxicity** LD50 guinea pig 25 mg/kg  
100% (by weight).

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## 12. ECOLOGICAL INFORMATION

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*Ecotoxicological information on this product or its components appear in this section when such data is available.*

### **Tetramethylammonium hydroxide**

#### **Ecotoxicity effects**

#### **Toxicity to aquatic invertebrates**

LC50 ceriodaphnia dubia (water flea) 96 h

0.07 - 1.2 mg/l

A pH neutralized solution has been shown to be toxic to aquatic organisms.

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## 13. DISPOSAL CONSIDERATIONS

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**Environmental precautions:** Prevent the material from entering drains or water courses. Do not discharge directly to a water source. Advise Authorities if spillage has entered watercourse or sewer or has contaminated soil or vegetation.

#### **Disposal**

Dispose in accordance with all local, state (provincial), and federal regulations. Under RCRA, it is the responsibility of the product's user to determine at the time of disposal, whether the product meets RCRA criteria for hazardous waste. This is because the product uses, transformations, mixtures, processes, etc. may render the resulting materials hazardous.

Do not remove label until container is thoroughly cleaned. Empty containers may contain hazardous residues. This material and its container must be disposed of in a safe way.

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## 14. TRANSPORT INFORMATION

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#### **DOT**

Not regulated for transport

#### **IMO/IMDG**

Not regulated (Not dangerous for transport)

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## 15. REGULATORY INFORMATION

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**SARA TITLE III: Section 311/312 Categorizations (40CFR370):** Immediate health hazard

#### **SARA TITLE III: Section 313 Information (40CFR372)**

This product does not contain a chemical which is listed in Section 313 at or above de minimis concentrations.

**U.S. Toxic Substances Control Act (TSCA) Section 12(b) Export Notification (40 CFR 707, Subpt D):**

U.S. Toxic Substances Control Act (TSCA) Section 12(b) Export Notification (40 CFR 707, Subpt D)  
This product does not contain any substances subject to Section 12(b) export notification.

**US. Toxic Substances Control Act (TSCA)** All components of this product are in compliance with the inventory listing requirements of the U.S. Toxic Substances Control Act (TSCA) Chemical Substance Inventory.

**California (Proposition 65)**

This product does not contain materials which the State of California has found to cause cancer, birth defects or other reproductive harm.

**16. OTHER INFORMATION****Hazard Rating**

	<b>Health</b>	<b>Fire</b>	<b>Reactivity</b>
<b>NFPA</b>	3	0	0

**Legend**

ACGIH	American Conference of Governmental Industrial Hygienists
BAC	Butyl acetate
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
STEL	Short Term Exposure Limit (STEL):
TLV	Threshold Limit Value
TWA	Time Weighted Average (TWA):
	Bar denotes a revision from prior MSDS.

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

Print Date: 11/23/2005  
Version: 2.0  
Layout 354439



**MATERIAL SAFETY DATA SHEET**  
**MICROPOSIT S1813 PHOTO RESIST**  
41280 4.00 US US 11.06.1998 MSDS\_US

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**1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION**

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**Product Code** 41280  
**Trade Name** MICROPOSIT S1813 PHOTO RESIST  
**Manufacturer/Supplier** Shipley Company  
**Address** 455 Forest St.  
Marlborough, Massachusetts 01752

**Phone Number** (508) 481-7950  
**Emergency Phone Number** (508) 481-7950  
**Chemtrec #** (800) 424-9300  
**MSDS first issued** 2 July 1996  
**MSDS data revised** 11 June 1998  
**Prepared By:** Amy C. Nichols  
**Local Sales Company** Shipley Company, 455 Forest Street, Marlboro, MA 01752  
(508-481-7950)

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**2. COMPOSITION/INFORMATION ON THE INGREDIENTS**

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**Components in Product**

<b>Component Name</b>	<b>CAS# / Codes</b>	<b>Concentration</b>
Electronic grade propylene glycol monomethyl ether acetate	108-65-6	71.00 - 76.00
Mixed cresol novolak resin		10.00 - 20.00
Fluoroaliphatic Polymer Esters		0.01 - 1.00
Diazo Photoactive Compound		1.00 - 10.00
cresol	1319-77-3	0.01 - 0.99

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**3. HAZARD IDENTIFICATION**

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**Main Hazards** - Irritant - Combustible - Nervous System - Skin - Eye - Kidney - Liver

**Routes of Entry** Inhalation, ingestion, eye and skin contact, absorption.

**Carcinogenic Status** Not considered carcinogenic by NTP, IARC and OSHA

**Target Organs** - Nervous System - Skin - Eye - Liver - Kidney

**Health Effects - Eyes** Liquid or vapor may cause pain, transient irritation and superficial corneal effects.

**Health Effects - Skin** Material may cause slight irritation on prolonged or repeated contact. Repeated and/or prolonged contact may lead to: -

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### 3. HAZARD IDENTIFICATION

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	drowsiness - liver damage - kidney damage
<b>Health Effects - Ingestion</b>	A large dose may have the following effects: - drowsiness - liver damage - kidney damage
<b>Health Effects - Inhalation</b>	Exposure to vapor at high concentrations may have the following effects: - irritation of nose, throat and respiratory tract - liver damage - kidney damage

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### 4. FIRST AID MEASURES

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<b>First Aid - Eyes</b>	Immediately flush the eye with plenty of water for at least 15 minutes, holding the eye open. Obtain medical attention if soreness or redness persists.
<b>First Aid - Skin</b>	Wash skin with water. Obtain medical attention if blistering occurs or redness persists.
<b>First Aid - Ingestion</b>	Wash out mouth with water. Obtain medical attention.
<b>First Aid - Inhalation</b>	Remove from exposure. If there is difficulty in breathing, give oxygen. Seek medical attention if symptoms persist.
<b>Advice to Physicians</b>	Treat symptomatically.

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### 5. FIRE FIGHTING MEASURES

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<b>Extinguishing Media</b>	Use water spray, foam, dry chemical or carbon dioxide. Keep containers and surroundings cool with water spray.
<b>Special Fire-Fighting Procedures</b>	This product may give rise to hazardous vapors in a fire. Vapors can travel a considerable distance to a source of ignition and result in flashback.
<b>Unusual Fire &amp; Explosion Hazards</b>	Pressure may build up in closed containers with possible liberation of combustible vapors.
<b>Protective Equipment for Fire-Fighting</b>	Wear full protective clothing and self-contained breathing apparatus.

---

**6. ACCIDENTAL RELEASE MEASURES**

---

<b>Spill Procedures</b>	Contain and absorb using earth, sand or other inert material. Transfer into suitable containers for recovery or disposal. Finally flush area with plenty of water.
<b>Personal Precautions</b>	Wear appropriate protective clothing. Wear respiratory protection. Eliminate all sources of ignition.
<b>Environmental Precautions</b>	Prevent the material from entering drains or water courses.

---

**7. HANDLING AND STORAGE**

---

**Handling** Use local exhaust ventilation. Avoid contact with eyes, skin and clothing. Keep container tightly closed when not in use.

**Storage** Store in original containers. Store away from sources of heat or ignition. Storage area should be:  
- cool - dry - well ventilated - out of direct sunlight

**Other**  
Proprietary photoresist film contains approximately 2-4% of 2,3,4-trihydroxybenzophenone (THBP), which may sublime during soft-bake or hard-bake processing. THBP has low acute toxicity (LD50 > 5g/kg). Contact with eyes, skin or mucous membranes cause irritation.

To prevent accumulation of THBP on equipment surfaces and ventilation ducts, preventative maintenance program including regular cleaning should be implemented. Wipe surfaces using an appropriate cleaning solvent when possible. Provide adequate general or local exhaust ventilation during the cleaning process. In situations where this is not possible or where solvent or dust concentrations become excessive, use an air purifying respirator with an organic vapor/toxic particulate cartridge. When cleaning residual THBP, wear protective gloves and adequate protective clothing to prevent skin contact. Practice good personal hygiene to prevent accidental exposure. Clean all protective clothing and equipment thoroughly after each use.

---

**8. EXPOSURE CONTROLS/PERSONAL PROTECTION**

---

<b>Occupational Exposure Standards</b>	
<b>Electronic grade propylene glycol monomethyl ether acetate</b>	Manufacturer recommends 30ppm 8h TWA and 90ppm 15 min STEL.
<b>cresol</b>	ACGIH: TLV 5ppm (22mg/m <sup>3</sup> ) 8h TWA. OSHA: PEL 5ppm (22mg/m <sup>3</sup> ) 8h TWA. UK EH40: OES 5ppm (22mg/m <sup>3</sup> ) 8h TWA. Can be absorbed through skin.

**Engineering Control Measures** Engineering methods to prevent or control exposure are preferred. Methods include process or personnel enclosure, mechanical ventilation (local exhaust), and control of process conditions.

---

**8. EXPOSURE CONTROLS/PERSONAL PROTECTION**

---

<b>Respiratory Protection</b>	Respiratory protection if there is a risk of exposure to high vapor concentrations. The specific respirator selected must be based on the airborne concentration found in the workplace and must not exceed the working limits of the respirator.
<b>Hand Protection</b>	Butyl rubber gloves.
<b>Eye Protection</b>	Chemical goggles.
<b>Body Protection</b>	Normal work wear.

---

**9. PHYSICAL AND CHEMICAL PROPERTIES**

---

<b>Physical State</b>	Viscous liquid
<b>Color</b>	Red
<b>Odor</b>	Sweet
<b>VOC (g/l)</b>	764.7
<b>Specific Gravity</b>	1.04
<b>pH</b>	Neutral
<b>Boiling Range/Point (°C/F)</b>	145.8/295
<b>Flash Point (PMCC) (°C/F)</b>	40.5-46.1 / 105-115
<b>Explosion Limits (%)</b>	Lower limit 1.5 at 20 °C. Upper limit 7.0 at 20 C..
<b>Solubility in Water</b>	Insoluble.
<b>Vapor Density (Air = 1)</b>	Heavier than air.
<b>Evaporation Rate</b>	Slower than ether
<b>Vapor Pressure</b>	Propylene Glycol Monomethyl Ether Acetate: 3.7 mmHg at 20 °C.

---

**10. STABILITY AND REACTIVITY**

---

<b>Stability</b>	Stable under normal conditions.
<b>Conditions to Avoid</b>	- High temperatures - Static discharge
<b>Incompatibilities</b>	- Oxidizing agents
<b>Hazardous Polymerization</b>	Will not occur.
<b>Hazardous Decomposition Products</b>	- oxides of carbon - oxides of nitrogen - acrid smoke and irritating fumes - phenols - carbon monoxide - toxic fluorine compounds

---

**10. STABILITY AND REACTIVITY**

---

---

**11. TOXICOLOGICAL INFORMATION**

---

<b>Acute Data</b>	Propylene Glycol Monomethyl Ether Acetate: Oral LD50 (rat) 8532mg/kg. Dermal LD50 (rabbit) 5000mg/kg.
<b>Chronic/Subchronic Data</b>	No data.
<b>Genotoxicity</b>	It was not mutagenic when tested in bacterial or mammalian systems.
<b>Reproductive/Developmental Toxicity</b>	Developmental effects were seen in laboratory animals only at dose levels that were maternally toxic.
<b>Additional Data</b>	None known.

---

**12. ECOLOGICAL INFORMATION**

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<b>Mobility</b>	Propylene Glycol Monomethyl Ether Acetate: Koc is 0 - 50.
<b>Persistence/Degradability</b>	The product is partially or slowly biodegradable. BOD20 greater than 40%
<b>Bio-accumulation</b>	No data.
<b>Ecotoxicity</b>	The product is rated as practically non-toxic to aquatic species. Tests on the following species gave a LC50 of 161mg/litre: - fathead minnows Tests on the following species gave a LC50 of 408mg/litre: - daphnia

---

**13. DISPOSAL CONSIDERATIONS**

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<b>Product Disposal</b>	Incineration is the recommended method of disposal. Dispose of in accordance with all applicable local and national regulations.
<b>Container Disposal</b>	Labels should not be removed from containers until they have been cleaned. Empty containers may contain hazardous residues. Dispose of containers with care.

---

**14. TRANSPORT INFORMATION**

---

DOT Ground:	Not Regulated per 49 CFR 173.150(f)(2)
UN Proper Shipping Name	Flammable liquid, n.o.s.
UN Class	(3) Flammable Liquid
UN Number	UN1993
UN Packaging Group	III
N.O.S. 1:	Propylene Glycol Monomethyl Ether Acetate
N.O.S. 2:	
Subsidiary Risks	None.
ADR/RID Substance Identification Number	CLASS 3 - 31(c)
CERCLA RQ	Cresol (100#)
Marine Pollutant	No.

---

**15. REGULATORY INFORMATION**

---

TSCA Listed	Yes
TSCA Exemptions	
WHMIS Classification	D.2.B B.3
MA Right To Know Law	All components have been checked for inclusion on the Massachusetts Substance List (MSL). Those components present at the de minimus concentration have been identified in the hazardous ingredients section of the MSDS.
California Proposition 65	This product does not contain materials which the State of California has found to cause cancer, birth defects or other reproductive harm.
SARA TITLE III-Section 311/312 Categorization (40 CFR 370)	Immediate, delayed, flammability hazard
SARA TITLE III-Section 313 (40 CFR 372)	This product does not contain a chemical which is listed in Section 313 at or above de minimis concentrations.

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**16. OTHER INFORMATION**

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NFPA Rating- FIRE	2
NFPA Rating- HEALTH	2
NFPA Rating- REACTIVITY	0
NFPA Rating- SPECIAL	None.
Revisions Highlighted	Flash Point (PMCC) (°C/F)

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## 16. OTHER INFORMATION

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### Abbreviations

CAS#: Chemical Abstract Services Number  
ACGIH: American Conference of Governmental Industrial Hygienists  
OSHA: Occupational Safety and Health Administration  
TLV: Threshold Limit Value  
PEL: Permissible Exposure Limit  
STEL: Short Term Exposure Limit  
NTP: National Toxicology Program  
IARC: International Agency for Research on Cancer  
R: Risk  
S: Safety  
LD50: Lethal Dose 50%  
LC50: Lethal Concentration 50%  
BOD: Biological Oxygen Demand  
Koc: Soil Organic Carbon Partition Coefficient.  
TLm: Median Tolerance Limit

### Disclaimer

The data contained herein is based on information that Shipley Company believes to be reliable, but no expressed or implied warranty is made with regard to the accuracy of such data or its suitability for a given situation. Such data relates only to the specific product described and not to such products in combination with any other product and no agent of Shipley Company is authorized to vary any of such data. Shipley Company and its agents disclaim all liability for any action taken or foregone on reliance upon such data.

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# MATERIAL SAFETY DATA SHEET

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## SECTION 1 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

---

**MATHESON TRI-GAS, INC.**  
**959 ROUTE 46 EAST**  
**PARSIPPANY, NEW JERSEY 07054-0624**

**EMERGENCY CONTACT:**  
**CHEMTREC 1-800-424-9300**  
**INFORMATION CONTACT:**  
**973-257-1100**

**SUBSTANCE: SILANE**

**TRADE NAMES/SYNONYMS:**

MTG MSDS 78; MONOSILANE (SIH4); SILICANE; SILICON HYDRIDE (SIH4); SILICON TETRAHYDRIDE; SILICON HYDRIDE; MONOSILANE; STCC 4920168; UN 2203; H4Si; MAT20590; RTECS VV1400000

**CHEMICAL FAMILY:** hydrides

**CREATION DATE:** Jan 24 1989

**REVISION DATE:** Dec 16 2002

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## SECTION 2 COMPOSITION, INFORMATION ON INGREDIENTS

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**COMPONENT:** SILANE  
**CAS NUMBER:** 7803-62-5  
**PERCENTAGE:** 100.0

---

## SECTION 3 HAZARDS IDENTIFICATION

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**NFPA RATINGS (SCALE 0-4):** HEALTH=2 FIRE=4 REACTIVITY=3



**EMERGENCY OVERVIEW:**

**COLOR:** colorless

**PHYSICAL FORM:** gas

**ODOR:** unpleasant odor

**MAJOR HEALTH HAZARDS:** respiratory tract irritation, skin irritation, eye irritation

**PHYSICAL HAZARDS:** May explode on contact with water. Flammable gas. May cause flash fire. Extremely flammable. May ignite spontaneously on exposure to air.

**POTENTIAL HEALTH EFFECTS:**

**INHALATION:**

**SHORT TERM EXPOSURE:** irritation, nausea, headache

**LONG TERM EXPOSURE:** no information is available

**SKIN CONTACT:**

**SHORT TERM EXPOSURE:** irritation, blisters

**LONG TERM EXPOSURE:** same as effects reported in short term exposure

**EYE CONTACT:****SHORT TERM EXPOSURE:** irritation, blurred vision**LONG TERM EXPOSURE:** same as effects reported in short term exposure**INGESTION:****SHORT TERM EXPOSURE:** frostbite**LONG TERM EXPOSURE:** no information is available

---

**SECTION 4 FIRST AID MEASURES**

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**INHALATION:** If adverse effects occur, remove to uncontaminated area. Give artificial respiration if not breathing. Get immediate medical attention.**SKIN CONTACT:** Wash skin with soap and water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention, if needed. Thoroughly clean and dry contaminated clothing and shoes before reuse.**EYE CONTACT:** Flush eyes with plenty of water for at least 15 minutes. Then get immediate medical attention.**INGESTION:** If a large amount is swallowed, get medical attention.

---

**SECTION 5 FIRE FIGHTING MEASURES**

---

**FIRE AND EXPLOSION HAZARDS:** Severe fire hazard. May ignite on exposure to air. The vapor is heavier than air. Vapors or gases may ignite at distant ignition sources and flash back.**EXTINGUISHING MEDIA:** carbon dioxide, regular dry chemical

Large fires: Use regular foam or flood with fine water spray.

**FIRE FIGHTING:** Move container from fire area if it can be done without risk. For fires in cargo or storage area: Cool containers with water from unmanned hose holder or monitor nozzles until well after fire is out. If this is impossible then take the following precautions: Keep unnecessary people away, isolate hazard area and deny entry. Let the fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tanks due to fire. For tank, rail car or tank truck: Stop leak if possible without personal risk. Let burn unless leak can be stopped immediately. For smaller tanks or cylinders, extinguish and isolate from other flammables. Evacuation radius: 800 meters (1/2 mile). Do not attempt to extinguish fire unless flow of material can be stopped first. Flood with fine water spray. Cool containers with water spray until well after the fire is out. Apply water from a protected location or from a safe distance. Avoid inhalation of material or combustion by-products. Stay upwind and keep out of low areas. Evacuate if fire gets out of control or containers are directly exposed to fire. Evacuation radius: 500 meters (1/3 mile). Consider downwind evacuation if material is leaking.**LOWER FLAMMABLE LIMIT:** 1%**UPPER FLAMMABLE LIMIT:** 100%

---

**SECTION 6 ACCIDENTAL RELEASE MEASURES**

---

**OCCUPATIONAL RELEASE:**

Avoid heat, flames, sparks and other sources of ignition. Stop leak if possible without personal risk. Reduce vapors with water spray. Keep unnecessary people away, isolate hazard area and deny entry. Remove sources of ignition. Ventilate closed spaces before entering.

---

**SECTION 7 HANDLING AND STORAGE**

---

**STORAGE:** Store and handle in accordance with all current regulations and standards. Subject to storage regulations: U.S. OSHA 29 CFR 1910.101. Keep separated from incompatible substances. Store above -110 C. Store in a tightly closed container. May ignite on exposure to air.

---

**SECTION 8 EXPOSURE CONTROLS, PERSONAL PROTECTION**

---

**EXPOSURE LIMITS:****SILANE:**

5 ppm (7 mg/m<sup>3</sup>) OSHA TWA (vacated by 58 FR 35338, June 30, 1993)

5 ppm ACGIH TWA

5 ppm (7 mg/m<sup>3</sup>) NIOSH recommended TWA 10 hour(s)

**VENTILATION:** Provide local exhaust ventilation system. Ventilation equipment should be explosion-resistant if explosive concentrations of material are present. Ensure compliance with applicable exposure limits.

**EYE PROTECTION:** Wear helmet with full face shield and fire-proof hood to prevent any possibility of burns if in contact with this substance.

**CLOTHING:** Wear appropriate chemical resistant clothing.

**GLOVES:** Wear fire-resistant gloves.

**RESPIRATOR:** Under conditions of frequent use or heavy exposure, respiratory protection may be needed. Respiratory protection is ranked in order from minimum to maximum. Consider warning properties before use.

Any supplied-air respirator with a full facepiece that is operated in a pressure-demand or other positive-pressure mode.

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

**For Unknown Concentrations or Immediately Dangerous to Life or Health -**

Any supplied-air respirator with full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with a separate escape supply.

Any self-contained breathing apparatus with a full facepiece.

---

**SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES**

---

**PHYSICAL STATE:** gas

**COLOR:** colorless

**ODOR:** unpleasant odor

**MOLECULAR WEIGHT:** 32.12

**MOLECULAR FORMULA:** Si-H4  
**BOILING POINT:** -170 F (-112 C)  
**FREEZING POINT:** -301 F (-185 C)  
**VAPOR PRESSURE:** Not available  
**VAPOR DENSITY (air=1):** 1.3  
**SPECIFIC GRAVITY:** Not applicable  
**DENSITY:** 1.342 g/L @ 20 C  
**WATER SOLUBILITY:** insoluble  
**PH:** Not applicable  
**VOLATILITY:** 100%  
**ODOR THRESHOLD:** Not available  
**EVAPORATION RATE:** Not applicable  
**VISCOSITY:** 0.01092 cP @ 25 C  
**COEFFICIENT OF WATER/OIL DISTRIBUTION:** Not applicable  
**SOLVENT SOLUBILITY:**  
**Insoluble:** ethanol, benzene, ether, chloroform, silicochloroform, silicon tetrachloride

---

## SECTION 10 STABILITY AND REACTIVITY

---

**REACTIVITY:** May ignite on exposure to air.

**CONDITIONS TO AVOID:** Avoid heat, flames, sparks and other sources of ignition. Containers may rupture or explode if exposed to heat.

**INCOMPATIBILITIES:** metal salts, bases, halogens, oxidizing materials

**HAZARDOUS DECOMPOSITION:**  
Thermal decomposition products: silicon, hydrogen

**POLYMERIZATION:** Will not polymerize.

---

## SECTION 11 TOXICOLOGICAL INFORMATION

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**SILANE:**

**TOXICITY DATA:**  
9600 ppm/4 hour(s) inhalation-rat LC50

**LOCAL EFFECTS:**  
Irritant: inhalation, skin, eye

**ACUTE TOXICITY LEVEL:**  
Slightly Toxic: inhalation

**MUTAGENIC DATA:** Available.

---

## SECTION 12 ECOLOGICAL INFORMATION

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Not available

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## SECTION 13 DISPOSAL CONSIDERATIONS

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Subject to disposal regulations: U.S. EPA 40 CFR 262. Hazardous Waste Number(s): D001. Dispose in accordance with all applicable regulations.

---

## SECTION 14 TRANSPORT INFORMATION

---

**U.S. DOT 49 CFR 172.101:**  
**PROPER SHIPPING NAME:** Silane, compressed  
**ID NUMBER:** UN2203  
**HAZARD CLASS OR DIVISION:** 2.1  
**LABELING REQUIREMENTS:** 2.1



**CANADIAN TRANSPORTATION OF DANGEROUS GOODS:**  
**SHIPPING NAME:** Silane, compressed  
**ID NUMBER:** UN2203  
**CLASSIFICATION:** 2.1

---

## SECTION 15 REGULATORY INFORMATION

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**U.S. REGULATIONS:**  
**CERCLA SECTIONS 102a/103 HAZARDOUS SUBSTANCES (40 CFR 302.4):** Not regulated.

**SARA TITLE III SECTION 302 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.30):** Not regulated.

**SARA TITLE III SECTION 304 EXTREMELY HAZARDOUS SUBSTANCES (40 CFR 355.40):** Not regulated.

**SARA TITLE III SARA SECTIONS 311/312 HAZARDOUS CATEGORIES (40 CFR 370.21):**  
ACUTE: Yes  
CHRONIC: No  
FIRE: Yes  
REACTIVE: Yes  
SUDDEN RELEASE: Yes

**SARA TITLE III SECTION 313 (40 CFR 372.65):** Not regulated.

**OSHA PROCESS SAFETY (29CFR1910.119):** Not regulated.

**STATE REGULATIONS:**  
**California Proposition 65:** Not regulated.

**CANADIAN REGULATIONS:**  
**WHMIS CLASSIFICATION:** AB

**NATIONAL INVENTORY STATUS:**  
**U.S. INVENTORY (TSCA):** Listed on inventory.

**TSCA 12(b) EXPORT NOTIFICATION:** Not listed.

CANADA INVENTORY (DSL/NDSL): Not determined.

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## SECTION 16 OTHER INFORMATION

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### MSDS SUMMARY OF CHANGES

#### SECTION 15 REGULATORY INFORMATION

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# MATERIAL SAFETY DATA SHEET

Date of Issue: 13 March 2000  
Revision: 4  
ID: tmin

## TRIMETHYLINDIUM

### 1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND COMPANY.

**Product Name**  
Trimethylindium  
**Formula**  
(CH<sub>3</sub>)<sub>3</sub>In  
**Company Identification**  
See footer.

### 2. COMPOSITION/INFORMATION ON INGREDIENTS

**Substance/Preparation**  
Trimethylindium  
**Components/Impurities**  
None  
**EC No.**  
222-200-9  
**CAS No.**  
3385-78-2

### 3. HAZARDS IDENTIFICATION

Pyrophoric solid, decomposes violently in water. Skin contact can cause severe burns. Fumes may cause skin and eye irritation. Avoid inhalation of fumes. Trimethylindium is thermally unstable above 140°C – **DO NOT HEAT ABOVE 80°C**

### 4. FIRST AID MEASURES

Prompt medical attention is required in all cases of exposure to Trimethylindium and its by-products. Rescue personnel should be equipped with appropriate protective equipment (e.g. Self-contained breathing apparatus) to prevent unnecessary exposure and must be aware of the fire and explosion potential of Trimethylindium.

#### Skin

Contact may cause severe burns. Fumes may cause irritation. Immediately flush affected areas with large quantities of water. Remove affected clothing as rapidly as possible only if not stuck to skin.

#### Eyes

Contact may cause severe burns. Fumes may cause irritation. Persons with potential exposure to Trimethylindium should not wear contact lenses. Flush contaminated eyes with large quantities of water for at least 15 minutes. Hold eyelids open to ensure complete flushing.

#### Inhalation

May cause irritation. Move exposed personnel to an uncontaminated area quickly using self-contained breathing apparatus. If breathing is difficult, give oxygen. If breathing has stopped, apply artificial respiration. Medical assistance should be sought immediately. Keep victim warm and quiet.

### 5. FIRE-FIGHTING MEASURES

#### Extinguishing Media

Always use dry powder, soda ash or lime. Never use water, foam or halogenated compounds to fight fires involving organometallic materials. Without risk, stop flow of this compound to the fire. Without risk, and if safe to do so, move container(s) away from fire area.

#### Exposure Hazards

In a controlled fire any unreacted Trimethylindium may re-ignite when contact with air or water is renewed.

#### Special Protective Equipment for Fire-Fighters

Fire resistant clothing, self-contained breathing apparatus, face shield and safety goggles, safety shoes and fire resistant gloves.

### 6. ACCIDENTAL RELEASE MEASURES

#### Personal Precautions

Evacuate area. Use appropriate protective equipment. Purge equipment with inert gas before attempting repairs. Ensure adequate ventilation. If leak is in container call one of the emergency numbers as appropriate (See footer).

#### Environmental Precautions

Try to stop release, if safe to do so. For fire-fighting measures see Section 5.

#### Clean up methods

Contact Epichem for specific advice.

### 7. HANDLING AND STORAGE

#### Handling

Valve outlet seals must remain in place unless container is secured and valve outlet piped to use point. Use a check valve or trap to prevent hazardous back flow into the container. Any equipment used for Trimethylindium service must be thoroughly cleaned and prepared to eliminate contamination and must be maintained in a leak-free state. All air and moisture in the system must be eliminated before use.

#### Storage

Protect containers from physical damage. Do not allow temperatures to exceed (125F)51C. Store away from flammable material.

### 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

#### Exposure Controls

##### OSHA or ACGIH:

TLV(TWA)= 0.1 mg/m<sup>3</sup> (In and compounds)

**OEL and MEL:** Long term exposure limit for Indium and compounds: 0.1mg/m<sup>3</sup> (as In) (8-Hour TWA reference period)  
Short term exposure limit: 0.3 mg/m<sup>3</sup> (15-Minute reference period)  
Ensure adequate ventilation.

#### Personal Protection

Self-contained breathing apparatus, fire resistant gloves, face shield and safety goggles, safety shoes, fire-resistant garments. Safety shower and eyewash.



## 9. PHYSICAL AND CHEMICAL PROPERTIES

Boiling Point: (272.8F)133.8C  
Vapor Pressure:  $\log_{10} P(\text{mmHg}) = 10.52 - 3014/T(K)$   
Melting Point: (191F) 88C  
Molecular Weight: 159.93 grams  
Density: Crystal density= 1.568 (literature)  
Powder density= 1.3 (experimental)  
Solubility in water: Reacts violently.  
Appearance: White solid which is pyrophoric.

## 10. STABILITY AND REACTIVITY

### Conditions to avoid

Reacts pyrophorically in air.

**Note:** Trimethylindium is stable indefinitely in an inert atmosphere at room temperature.

**THERMALLY UNSTABLE ABOVE 140°C. DO NOT HEAT ABOVE 80°C.**

### Materials to avoid

Avoid water, air or other oxidizers.

### Hazardous Decomposition Products

Indium Oxide dust, CO, CO<sub>2</sub>

## 11. TOXICOLOGICAL INFORMATION

Indium Oxide dust formed when this compound is oxidized is an irritant to skin, eyes and by inhalation.

Trimethylindium is not listed in the IARC, NTP or OSHA Subpart Z as a carcinogen or potential carcinogen.

Trimethylindium is listed on the TSCA inventory.

## 12. ECOLOGICAL INFORMATION

This product does not contain any Class I or Class II ozone depleting chemicals.

## 13. DISPOSAL CONSIDERATIONS

Regional and National regulations should be followed during waste disposal. Contact an Epichem representative for disposal of container and any unused quantities.

## 14. TRANSPORT INFORMATION

UN No: 2846  
CLASS: 4.2  
PG I  
ECCN#: 3C003  
IMDG Code: 4255  
Shipping Name: Pyrophoric solid, organic, n.o.s.  
(Trimethylindium)

## 15. REGULATORY INFORMATION

### Classification

Highly Flammable

### Risk and Safety Phrases

R14: Reacts violently with water.

R17: Spontaneously flammable in air.

S6: Keep under inert atmosphere.

S8: Keep container dry.

S43a: In case of fire use dry powder or lime - Never use water.

## 16. OTHER INFORMATION

Ensure operators understand the pyrophoric and potentially thermally unstable nature of the product. DSC data available on request. Before using this product, it is recommended that a risk assessment and safety study be carried out. Further information on the use of this product can be obtained from the Technical Product Manager at the nearest Epichem facility.

*SAFETY NOTICE: In Order to provide our customers with the highest quality material and maintain our high standards of safety, the surface temperature of the bubbler will be monitored during the transportation of our products. We would like to monitor the surface temperature of the bubbler using a tempilabel. Tempilabel is a temperature-monitoring strip ranging from 120F to 150F (49C to 66C) which will indicate the temperature during shipment. The strip will turn black at one of the four ratings shown if the temperature is reached (normally a silver centre). If the temperature monitor is changed, please notify an Epichem representative immediately and we will assist you in the proper measures to be taken. We ask for your co-operation in our efforts of quality assurance and safety. If you have any questions or comments, please contact an Epichem representative. We thank you for your co-operation. Your assistance is greatly appreciated.*

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Fax: 1 508 374 6474

### 24 Hour Emergency Contact Numbers:

Europe: 44 151 334 2774 United States: Chemtrec: (800) 424 9300  
Other International Countries: Chemtrec (703) 527 3887

## Chemical safety



### Precautions:

- Always wear protective clothing, including a face mask, goggles, rubber gloves, and apron when handling corrosive chemicals.
- Use the chemicals only in the designated area;
- Do not transport chemicals around the room in beakers.
- Never pour chemicals back into the original container.

## Storage waste chemical

Store chemicals in accordance with compatibility. Incompatible chemicals coming into contact can generate extremely violent chemical reaction resulting in catastrophic explosions.

- Store waste chemical near the floor to minimize the danger of falling from shelves.
- Store in areas that are cool, dry, and well-ventilated, and away from sunlight.
- Storage area should not be subject to rapid changes in humidity or temperature.

## Disposal chemical

Appropriate and adequate disposal of waste is critical in preventing unnecessary risk to the environment, as well as lowering the likelihood of unsafe conditions

### Hazardous Waste Disposal Pickup Request Form

- Select waste type –chemical/Bio waste
- Fill out the form completely
- Transaction Number will be sent by email after fill out the pick up request form. Label all containers with this transaction number.
- Once the form submitted, the pick-up will be scheduled for **Tuesday** and **Thursday** accordingly

# Lab safety

Note for lab safety training/talk on Nov.20,  
2011

Environmental Health & Safety website: <http://www.depts.ttu.edu/ehs/Web/>

# Required documents

- SOPs for anything potentially dangerous
  - Including how to change MOCVD bubbler, dump sharp/chemical waste, use fume hood
- **Lab safety plan** – must have, in written form
  - Approved by PI
  - Risk analysis from EHS (optional)
  - eg. annual inspection, training
- MSDS
  - Storage(flammable/reactive)
  - Shipping requirements

# Training

- Location of first-aid, fire extinguishers and spill kits
- Personal Protective Equipments (PPE)
  - Gloves: one time use, take care to dispose in regular trash
  - Body cover: no exposed skin
  - Shoes: full foot coverage, no cloth or absorbent materials
  - Eyewear, respirator/ventilation
- Waste management
  - Waste chemicals: separately stored in labeled containers mark with full name and date.
  - Waste sharp items: special container or sharp edge secured



# Training

- Chemical Hygiene
  - Designated area - fume hood: sash below mark
  - Separate flammable/reactive/waste inside fume hood
  - Glassware: rinse after use, label if left in fume hood
  - Store chemicals accordingly
    - Separate flammable/inflammable, base / acid, HF
    - Specialized cabinet / refrigerator (EHS can provide)
  - Handle spills: call (2-3876) immediately if unsure
    - Use spill kits if comfortable
  - HF: especially dangerous, penetrate gloves in seconds.