

**APPENDIX D -- PART D**

**MATERIAL SAFETY DATA SHEETS (MSDS)**

- Sulfuric Acid ( $\text{H}_2\text{SO}_4$ )
- Sodium Hydroxide ( $\text{NaOH}$ )
- Sodium Thiosulfate ( $\text{Na}_2\text{S}_2\text{O}_3$ )

# Mallinckrodt Material Safety Data

Emergency Phone Number: 314-982-5000

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Mallinckrodt, Inc., Science Products Division, P.O. Box M, Paris, KY 40361.

## SULFURIC ACID 96%

### PRODUCT IDENTIFICATION:

Synonyms: Oil of Vitriol  
Formula CAS No.: 7664-93-9  
Molecular Weight: 98.07  
Chemical Formula:  $H_2SO_4$   
Hazardous Ingredients: Not applicable.

### SECTION 1. Physical Data

Appearance: Colorless, oily liquid.  
Odor: Odorless.  
Solubility: Infinite @ 20°C.  
Boiling Point: ca. 310°C (590°F)  
Melting Point: ca. -14°C (6°F).  
Specific Gravity: 1.84  
Vapor Density (Air=1): < 0.3 @ 25°C (77°F)  
Vapor Pressure (mm Hg): 1 @ 146°C (297°F).  
Evaporation Rate: No information found.

### PRECAUTIONARY MEASURES

**DANGER CORROSIVE. LIQUID AND MIST  
 CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL  
 IF SWALLOWED. HARMFUL IF INHALED. INHALATION MAY  
 CAUSE LUNG DAMAGE.**

Do not get in eyes, on skin, or on clothing.  
Do not breathe mist.  
Keep container closed.  
Use only with adequate ventilation.  
Wash thoroughly after handling.  
This substance is classified as a POISON under the Federal Causic  
Poison Act.

### EMERGENCY/FIRST AID

In all cases call a physician. In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. If swallowed, DO NOT INDUCE VOMITING! Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen.  
SEE SECTION 5.

DOT Hazard Class: Corrosive Material

### SECTION 3. Reactivity Data

**Stability:**  
Stable under ordinary conditions of use and storage.

### **Hazardous Decomposition Products:**

Toxic fumes of oxides of sulfur. Will react with water or steam to produce toxic and corrosive fumes. Reacts with carbonates to generate carbon dioxide gas, and with cyanides and sulfides to form poisonous hydrogen cyanide and hydrogen sulfide respectively.

### **Hazardous Polymerization:**

Will not occur.

### **Incompatibilities:**

Water, bases, organic material, halogens, metal acetylides, oxides and hydroxides, strong oxidizing and reducing agents and many other reactive substances.

### SECTION 4. Leak/Spill Disposal Information

Dike and cover leaking or spilled liquid with dirt, vermiculite, kitty-litter or other inert absorbent. Cover spill with sodium bicarbonate or soda ash and mix. Clean-up personnel require protective clothing and respiratory protection from vapors and mist. Neutralized waste may be containerized and disposed in a RCRA approved waste disposal facility. Flush area of spill with dilute soda ash solution and discard to sewer.

Reportable Quantity (RQ)(CWA/CERCLA) : 1000 lbs.

Ensure compliance with local, state and federal regulations.

### SECTION 2. Fire and Explosion Information

**Fire:**  
Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition. Reacts with most metals releasing flammable, potentially explosive hydrogen gas.

**Explosion:**  
Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition.

**Fire Extinguishing Media:**  
Dry chemical, foam or carbon dioxide. Water spray may be used to keep fire exposed containers cool.

**Special Information:**  
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

NEPA Ratings: Health: 3 Flammability: 0 Reactivity: 2 Other: Water reactive

SULFURIC ACID 96%

Effective Date: 10-21-86 Supersedes 09-05-85

**SULFURIC ACID 96%**

Date: 10-21-80 Supersedes 09-05-85

**SECTION 5 Health Hazard Information**

**A. EXPOSURE / HEALTH EFFECTS**

**Inhalation:**  
Inhalation produces damaging effects on the mucous membranes and upper respiratory tract. May cause lung edema. Symptoms may include irritation of the nose and throat, and labored breathing.

**Ingestion:**  
Corrosive. Swallowing can cause severe burns of the mouth, throat, and stomach, leading to death. Can cause sore throat, vomiting, diarrhea.

**Skin Contact:**  
Corrosive. Symptoms of redness, pain, and severe burn can occur.

**Eye Contact:**  
Corrosive. Splashes can cause blurred vision, redness, pain and severe tissue burns.

**Chronic Exposure:**  
Long-term exposure to mist or vapors may cause damage to teeth.

**Aggravation of Pre-existing Conditions:**  
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the substance.

**B. FIRST AID**

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

**Ingestion:**  
If swallowed, DO NOT induce vomiting. Give large quantities of water or milk if available. Call a physician immediately. Never give anything by mouth to an unconscious person.

**Skin Exposure:**  
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician.

**Eye Exposure:**  
Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

**C. TOXICITY DATA (RTECS, 1982)**

Oral rat LD50: 2140 mg/kg. Inhalation Guinea Pig LC50: 18 mg/m<sup>3</sup>.

**SECTION 6 Occupational Control Measures**

**Airborne Exposure Limits:**  
-OSHA Permissible Exposure Limit (PEL):  
1 mg/m<sup>3</sup> (TWA).  
-ACGIH Threshold Limit Value (TLV):  
1 mg/m<sup>3</sup> (TWA).

**Ventilation Systems:**

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

**Personal Respirators: (NIOSH Approved)**  
If the TLV is exceeded a full facepiece chemical cartridge respirator may be worn, in general, up to 100 times the TLV or the maximum use concentration specified by the respirator supplier, whichever is less. Alternatively, a supplied air full facepiece respirator or airlined hood may be worn.

**Skin Protection:**

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls to prevent skin contact.

**Eye Protection:**

Use chemical safety goggles and/or a full face shield where splashing is possible. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

**SECTION 7 Storage and Special Information**

Store in a cool, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it for other purposes. When diluting, always add the acid to water, never add water to the acid.

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DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49 CFR 172.101 AND  
SUBPART E:  
CORROSIVE

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49 CFR 173.249  
EXCEPTIONS: 49 CFR 173.244

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TOXICITY

SODIUM HYDROXIDE:  
IRRITATION DATA: 500 MG/24 HOURS SKIN-RABBIT SEVERE; 1% EYE-RABBIT SEVERE;  
50 UG/24 HOURS EYE-RABBIT SEVERE; 1 MG/24 HOURS EYE-RABBIT SEVERE; 400 UG  
EYE-RABBIT MILD; 1 MG/30 SECONDS RINSED EYE-RABBIT SEVERE; 1X/24 HOURS  
EYE-MONKEY SEVERE.  
TOXICITY DATA: 140-340 MG/KG ORAL-RAT LD50 (VAN WATERS & ROGERS INC. MSDS);  
500 MG/KG ORAL-RABBIT LD50; 1350 MG/KG SKIN-RABBIT LD50 (VAN WATERS & ROGERS  
INC. MSDS); 40 MG/KG INTRAPERITONEAL-MOUSE LD50; MUTAGENIC DATA (RTECS).  
CARCINOGEN STATUS: NONE.  
LOCAL EFFECTS: CORROSIVE- EYE, SKIN, MUCOUS MEMBRANES.  
ACUTE TOXICITY LEVEL: TOXIC BY INGESTION; MODERATELY TOXIC BY DERMAL  
ABSORPTION.  
TARGET EFFECTS: NO DATA AVAILABLE.

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HEALTH EFFECTS AND FIRST AID

INHALATION:  
SODIUM HYDROXIDE:  
CORROSIVE. 250 MG/M3 IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.  
ACUTE EXPOSURE- EFFECTS DUE TO INHALATION OF DUSTS OR MIST MAY VARY FROM  
MILD IRRITATION OF THE NOSE AT 2 MG/M3 TO SEVERE PNEUMONITIS DEPENDING  
ON THE SEVERITY OF EXPOSURE. LOW CONCENTRATIONS MAY CAUSE MUCOUS MEMBRANE  
IRRITATION WITH SORE THROAT, COUGHING, AND DYSPNEA. INTENSE EXPOSURES MAY  
RESULT IN DESTRUCTION OF MUCOUS MEMBRANES AND DELAYED PULMONARY EDEMA  
OR PNEUMONITIS. SHOCK MAY OCCUR.  
CHRONIC EXPOSURE- REPEATED EXPOSURES OF 5000 MG/L WERE HARMLESS TO RATS,  
BUT 10,000 MG/L LED TO NERVOUSNESS, SORE EYES, DIARRHEA AND RETARDED  
GROWTH. PROLONGED EXPOSURE TO HIGH CONCENTRATIONS OF DUSTS OR MISTS  
MAY CAUSE DISCOMFORT AND ULCERATION OF NASAL PASSAGES. RATS EXPOSED  
30 MINUTES/DAY TO UNMEASURED CONCENTRATIONS OF SODIUM HYDROXIDE AEROSOLS  
SUFFERED PULMONARY DAMAGE AFTER 2-3 MONTHS. DEATH OCCURRED IN 2 OF 10 RATS  
EXPOSED TO AN AEROSOL OF 40% AQUEOUS SODIUM HYDROXIDE FOR 30 MINUTES,  
TWICE A WEEK FOR 3 WEEKS. HISTOPATHOLOGICAL EXAMINATION SHOWED MOSTLY  
NORMAL LUNG TISSUE WITH FOCI OF ENLARGED ALVEOLAR SEPTAE, EMPHYSEMA,  
BRONCHIAL ULCERATION, AND ENLARGED LYMPH ADENOIDAL TISSUES. AN  
EPIDEMIOLOGIC STUDY OF 291 WORKERS CHRONICALLY EXPOSED TO CAUSTIC DUSTS  
FOR 30 YEARS OR MORE FOUND NO SIGNIFICANT INCREASE IN MORTALITY IN  
RELATION TO DURATION OR INTENSITY OF SUCH EXPOSURES.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING  
HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD  
PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND  
AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. ADMINISTRATION OF OXYGEN  
SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION  
IMMEDIATELY.

SKIN CONTACT:  
SODIUM HYDROXIDE:  
CORROSIVE.

ACUTE EXPOSURE- UPON CONTACT WITH THE SKIN, DAMAGE INCLUDING REDNESS,  
CUTANEOUS BURNS, SKIN FISSURES AND WHITE ESCHARS MAY OCCUR WITHOUT  
IMMEDIATE PAIN. EXPOSURE TO SOLUTIONS AS WEAK AS 0.03 N (0.12%) FOR 1  
HOUR HAS CAUSED INJURY TO HEALTHY SKIN. SOLUTIONS OF 25-50% CAUSED NO  
SENSATION OF IRRITATION WITHIN 3 MINUTES IN HUMAN SUBJECTS. WITH  
SOLUTIONS OF 0.4-4%, IRRITATION DOES NOT OCCUR UNTIL AFTER SEVERAL HOURS.  
SKIN BIOPSIES FROM HUMAN SUBJECTS HAVING 1 N SODIUM HYDROXIDE APPLIED TO  
THEIR ARMS FOR 15 TO 180 MINUTES SHOWED PROGRESSIVE CHANGES BEGINNING  
WITH DISSOLUTION OF THE CELLS IN THE HORNY LAYER AND PROGRESSING  
THROUGH EDEMA TO TOTAL DESTRUCTION OF THE EPIDERMIS IN 60 MINUTES.  
A 5% AQUEOUS SOLUTION CAUSED SEVERE NECROSIS TO THE SKIN OF RABBITS  
WHEN APPLIED FOR 4 HOURS. ALKALIES PENETRATE THE SKIN SLOWLY. THE EXTENT  
OF INJURY DEPENDS ON THE DURATION OF CONTACT. IF SODIUM HYDROXIDE IS NOT  
REMOVED FROM THE SKIN, SEVERE BURNS WITH DEEP ULCERATION MAY OCCUR.  
EXPOSURE TO THE DUST OR MIST MAY CAUSE MULTIPLE SMALL BURNS AND TEMPORARY  
LOSS OF HAIR. PATHOLOGIC FINDINGS DUE TO ALKALIES MAY INCLUDE GELATINOUS,  
NECROTIC AREAS AT THE SITE OF CONTACT.  
CHRONIC EXPOSURE- EFFECTS ARE DEPENDENT UPON CONCENTRATION AND DURATION  
OF EXPOSURE. DERMATITIS OR EFFECTS SIMILAR TO THOSE FOR ACUTE EXPOSURE  
MAY OCCUR.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED  
AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO  
EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF CHEMICAL  
BURNS, COVER AREA WITH STERILE, DRY DRESSING. BANDAGE SECURELY, BUT NOT  
TOO TIGHTLY. GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:  
SODIUM HYDROXIDE:

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SSODIUM HYDROXIDE SOLUTIONS, 40% AND 50%  
SSODIUM HYDROXIDE SOLUTIONS, 40% AND 50%  
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MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC  
CHEMICAL DIVISION  
1 REAGENT LANE  
FAIR LAWN NJ 07410  
(201) 796-7100

EMERGENCY CONTACTS:  
GASTON L. PILLORI: (201) 796-7100  
AFTER BUSINESS HOURS; HOLIDAYS:  
(201) 796-7523  
CHEMTREC ASSISTANCE: (800) 424-9300

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 1310-73-2

SUBSTANCE: SSODIUM HYDROXIDE SOLUTIONS, 40% AND 50%

TRADE NAMES/SYNONYMS:  
CAUSTIC SODA SOLUTION, LYE SOLUTION, SODA LYE, SODIUM HYDROXIDE SOLUTION,  
SODIUM HYDROXIDE LIQUID, WHITE CAUSTIC SOLUTION, 85-254, 85-710, 85-714,  
UN 1824, ACCT0174

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=1 PERSISTENCE=0  
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=1

COMPONENTS AND CONTAMINANTS

COMPONENT: SODIUM HYDROXIDE  
CAS# 1310-73-2

PERCENT: 40.0-50.0

COMPONENT: WATER

PERCENT: 50.0-60.0

EXPOSURE LIMITS:  
SODIUM HYDROXIDE:  
2 MG/M3 OSHA CEILING  
2 MG/M3 ACGIH CEILING  
2 MG/M3 NIOSH RECOMMENDED 15 MINUTE CEILING

1000 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY

PHYSICAL DATA

DESCRIPTION: CLEAR LIQUID BOILING POINT: 289 F (143 C)  
MELTING POINT: 59 F (12 C) SPECIFIC GRAVITY: 1.54  
VAPOR PRESSURE: 13 MMHG @ 60 C PH: ALKALINE  
SOLUBILITY IN WATER: COMPLETE

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:  
NEGLECTIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

FIREFIGHTING MEDIA:  
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM  
(1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM  
(1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:  
MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE. COOL CONTAINERS EXPOSED TO FLAMES  
WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK  
ENDS (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 60).

USE AGENT SUITABLE FOR TYPE OF FIRE; USE FLOODING QUANTITIES OF WATER AS FOG.  
APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING CORROSIVE VAPORS,  
KEEP UPWIND.

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49 CFR 172.101:  
CORROSIVE MATERIAL

MSDS

FROM: North Shore Lab

DATE: 9-25-90

CHEMICAL IN USE:

CHEMICAL NOT IN USE:

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**CORROSIVE.**

**ACUTE EXPOSURE-** CONTACT MAY CAUSE DISINTEGRATION AND SLOUGHING OF CONJUNCTIVAL AND CORNEAL EPITHELIUM, CORNEAL OPACIFICATION, MARKED EDEMA AND ULCERATION, AFTER 7 TO 13 DAYS EITHER GRADUAL RECOVERY BEGINS OR THERE IS PROGRESSION OF ULCERATION AND CORNEAL OPACIFICATION, COMPLICATIONS OF SEVERE EYE BURNS ARE SYMBLEPHARON WITH OVERGROWTH OF THE CORNEA BY A VASCULARIZED MEMBRANE, PROGRESSIVE OR RECURRENT CORNEAL ULCERATION AND PERMANENT CORNEAL OPACIFICATION, BLINDNESS MAY OCCUR.

**CHRONIC EXPOSURE-** EFFECTS ARE DEPENDENT UPON CONCENTRATION AND DURATION OF EXPOSURE. CONJUNCTIVITIS OR EFFECTS SIMILAR TO THOSE FOR ACUTE EXPOSURE MAY OCCUR.

**FIRST AID-** WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). CONTINUE IRRIGATING WITH NORMAL SALINE UNTIL THE PH HAS RETURNED TO NORMAL (30-60 MINUTES). COVER WITH STERILE BANDAGES, GET MEDICAL ATTENTION IMMEDIATELY.

**INGESTION:**  
**SODIUM HYDROXIDE:**  
**CORROSIVE/TOXIC.**

**ACUTE EXPOSURE-** THE REPORTED LETHAL DOSE IN RATS IS 140-340 MG/KG. INGESTION MAY CAUSE A BURNING SENSATION IN THE MOUTH, CORROSION OF THE LIPS, MOUTH, TONGUE AND PHARYNX, AND SEVERE ESOPHAGEAL AND ABDOMINAL PAIN, VOMITING OF BLOOD AND LARGE PIECES OF MUCOSA, AND BLOODY DIARRHEA. ASPHYXIA CAN OCCUR FROM SWELLING OF THE THROAT, MEDIASTITIS, ALKALEMIA, PALLOR, WEAK, SLOW PULSE, CARDIOVASCULAR COLLAPSE, SHOCK, COMA AND DEATH MAY OCCUR. PERFORATION OF THE ALIMENTARY TRACT AND CONSTRICTIVE SCARRING MAY RESULT. ESOPHAGEAL STRICTURE MAY OCCUR WEEKS, MONTHS, OR EVEN YEARS LATER TO MAKE SWALLOWING DIFFICULT. THE ESTIMATED FATAL DOSE IN MAN IS 5 GRAMS. CASES OF SQUAMOUS CELL CARCINOMA OF THE ESOPHAGUS HAVE OCCURRED WITH LATENT PERIODS OF 12 TO 42 YEARS AFTER INGESTION. THESE CANCERS WERE BELIEVED TO BE SEQUELA OF TISSUE DESTRUCTION AND POSSIBLY SCAR FORMATION RATHER THAN THE RESULT OF DIRECT CARCINOGENIC ACTION OF SODIUM HYDROXIDE.

**CHRONIC EXPOSURE-** DEPENDING ON THE CONCENTRATION, REPEATED INGESTION OF ALKALINE SUBSTANCES MAY RESULT IN INFLAMMATORY AND ULCERATIVE EFFECTS ON THE ORAL MUCOUS MEMBRANES AND OTHER EFFECTS AS WITH ACUTE INGESTION.

**FIRST AID-** DILUTE THE ALKALI BY GIVING WATER OR MILK IMMEDIATELY AND ALLOW VOMITING TO OCCUR. AVOID GASTRIC LAVAGE OR EMETICS. ESOPHAGOSCOPY IS THE ONLY WAY TO EXCLUDE THE POSSIBILITY OF CORROSION IN THE UPPER GASTROINTESTINAL TRACT; IF CORROSION IS SUSPECTED, ESOPHAGOSCOPY SHOULD USUALLY BE PERFORMED WITHIN 24 HOURS (DREISBACH, HANDBOOK OF POISONING, 12TH ED.). MAINTAIN AIRWAY AND TREAT SHOCK. IF VOMITING OCCURS, KEEP HEAD BELOW HIPS TO HELP PREVENT ASPIRATION. GET MEDICAL ATTENTION IMMEDIATELY.

**ANTIDOTE:**  
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

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**REACTIVITY**

**REACTIVITY:**  
REACTS EXOTHERMICALLY WITH WATER.

**INCOMPATIBILITIES:**  
**SODIUM HYDROXIDE:**

ACETALDEHYDE; MAY RESULT IN VIOLENT POLYMERIZATION.  
ACETIC ACID; MIXING IN CLOSED CONTAINER INCREASES TEMPERATURE AND PRESSURE.  
ACETIC ANHYDRIDE; MIXING IN A CLOSED CONTAINER INCREASES TEMPERATURE AND PRESSURE.  
ACIDS; MAY REACT VIOLENTLY.  
ACROLEIN; MAY RESULT IN AN EXTREMELY VIOLENT POLYMERIZATION.  
ACRYLONITRILE; MAY CAUSE VIOLENT POLYMERIZATION.  
ALLYL ALCOHOL + BENZENE SULFONYL CHLORIDE; POSSIBLE EXPLOSION HAZARD.  
ALLYL CHLORIDE; HYDROLYZES.  
ALUMINUM; VIGOROUS REACTION.  
ALUMINUM, ARSENIC TRIOXIDE, SODIUM ARSENATE; MAY GENERATE FLAMMABLE HYDROGEN GAS.  
AMMONIA AND SILVER NITRATE; PRECIPITATION OF EXPLOSIVE SILVER NITRIDE MAY OCCUR.  
AMMONIUM SALTS; MAY REACT VIOLENTLY EVOLVING AMMONIA GAS.  
BENZENE-1,4-DIOL; EXOTHERMIC REACTION.  
N,N'-BIS(TRINITROETHYL)UREA; FORMATION OF EXPLOSIVE COMPOUND.  
BROMINE; POSSIBLE EXPLOSION IF NOT STIRRED CONTINUOUSLY.  
CHLORINE TRIFLUORIDE; MAY CAUSE VIOLENT REACTION.  
CHLOROFORM AND METHYL ALCOHOL; EXOTHERMIC REACTION.  
CHLOROHYDRIN; MIXING IN A CLOSED CONTAINER CAUSES AN INCREASE IN TEMPERATURE AND PRESSURE.  
4-CHLORO-2-METHYLPHENOL; POSSIBLE IGNITION.  
CHLORONITROTOLUENES; POSSIBLE EXPLOSION.  
CHLOROPICRIN; MAY CAUSE VIOLENT REACTION.  
CHLOROSULFONIC ACID; MIXING IN A CLOSED CONTAINER CAUSES AN INCREASE IN TEMPERATURE AND PRESSURE.  
CINNAMALDEHYDE; EXOTHERMIC REACTION.  
COATINGS; MAY BE ATTACKED.  
CYANOGEN AZIDE; MAY FORM SODIUM 5-AZIDOTETRAZOLIDE, WHICH IS EXPLOSIVE IF ISOLATED.  
2,2-DICHLORO-3,3-DIMETHYLBUTANE; HAZARDOUS REACTION.

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1,2-DICHLOROETHYLENE: MAY FORM SPONTANEOUSLY FLAMMABLE MONOCHLOROACETYLENE.  
DIBORANE AND OCTANAL OXIME: EXOTHERMIC REACTION.  
ETHYLENE CYANOHYDRIN: MIXING IN A CLOSED CONTAINER CAUSES AN INCREASE IN TEMPERATURE AND PRESSURE.  
FLAMMABLE LIQUIDS: FIRE AND EXPLOSION HAZARD.  
GLYCOLS: MAY CAUSE EXOTHERMIC DECOMPOSITION WITH EVOLUTION OF HYDROGEN GAS.  
GLYOXAL: MIXING IN A CLOSED CONTAINER INCREASES TEMPERATURE AND PRESSURE.  
HALOGENATED HYDROCARBONS: VIOLENT REACTION.  
HYDROCHLORIC ACID: MIXING IN A CLOSED CONTAINER CAUSES AN INCREASE IN TEMPERATURE AND PRESSURE.  
HYDROFLUORIC ACID: MIXING IN A CLOSED CONTAINER CAUSES AN INCREASE IN TEMPERATURE AND PRESSURE.  
HYDROQUINONE: RAPID DECOMPOSITION OF HYDROQUINONE WITH EVOLUTION OF HEAT.  
LEAD: MAY BE ATTACKED; FLAMMABLE HYDROGEN GAS MAY BE LIBERATED.  
LEATHER: MAY BE ATTACKED.  
MALEIC ANHYDRIDE: EXPLOSIVE DECOMPOSITION.  
METALS: CORRODES METALS, REACTING TO FORM FLAMMABLE HYDROGEN GAS.  
4-METHYL-2-NITROPHENOL: EXOTHERMIC REACTION.  
NITRIC ACID: MIXING IN CLOSED CONTAINER INCREASES TEMPERATURE AND PRESSURE.  
NITROBENZENE: POSSIBLY EXPLOSIVE REACTION UPON HEATING IN PRESENCE OF WATER.  
NITROETHANE: FORMS AN EXPLOSIVE SALT.  
NITROMETHANE: FORMS AN EXPLOSIVE SALT.  
NITROPARAFFINS: THE NITROPARAFFINS, IN THE PRESENCE OF WATER, FORM DRY SALTS WITH ORGANIC BASES. THE DRY SALTS ARE EXPLOSIVE.  
NITROPROPANE: FORMS AN EXPLOSIVE SALT.  
O-NITROTOLUENE: POSSIBLE EXPLOSION.  
OLEUM: MIXING IN A CLOSED CONTAINER CAUSES AN INCREASE IN TEMPERATURE AND PRESSURE.  
ORGANIC PEROXIDES: INCOMPATIBLE.  
PENTOL (3-METHYL-2-PENTENE-4-YN-1-OL): POSSIBLE EXPLOSION.  
PHOSPHORUS: MAY FORM MIXED PHOSPHINES WHICH MAY IGNITE SPONTANEOUSLY IN AIR.  
PHOSPHORUS PENTOXIDE: MAY REACT VIOLENTLY WHEN HEATED.  
PLASTICS: MAY BE ATTACKED.  
B-PROPIOLACTONE: MIXING IN A CLOSED CONTAINER CAUSES AN INCREASE IN TEMPERATURE AND PRESSURE.  
PROPYLENE OXIDE: IGNITION OR EXPLOSION MAY OCCUR.  
RUBBER: MAY BE ATTACKED.  
SODIUM TETRAHYDROBORATE: DRY MIXTURES WITH SODIUM HYDROXIDE CONTAINING 15-40% OF TETRAHYDROBORATE LIBERATE HYDROGEN EXPLOSIVELY AT 230-270 C.  
SULFURIC ACID: MIXING IN A CLOSED CONTAINER CAUSES AN INCREASE IN TEMPERATURE AND PRESSURE.  
1,2,4,5-TETRACHLOROBENZENE: VIOLENT REACTION.  
TETRACHLOROBENZENE + METHYL ALCOHOL: POSSIBLE EXPLOSION.  
TETRACHLOROETHYLENE: POSSIBLE EXPLOSION.  
TETRAHYDROFURAN: SERIOUS EXPLOSIONS CAN OCCUR.  
TIN: EVOLUTION OF HYDROGEN GAS WHICH MAY FORM AN EXPLOSIVE MIXTURE.  
1,1,1-TRICHLOROETHANOL: EXPLOSION MAY OCCUR.  
TRICHLOROETHYLENE: FORMATION OF EXPLOSIVE MIXTURES OF DICHLOROACETYLENE.  
TRICHLORONITROMETHANE + METHANOL: MAY CAUSE VIOLENT REACTION.  
WOOL: MAY BE ATTACKED.  
ZINC (DUST): FIRE AND EXPLOSION HAZARD.  
ZIRCONIUM: MAY CAUSE EXPLOSIVE REACTION UPON HEATING.

DECOMPOSITION:  
THERMAL DECOMPOSITION MAY RELEASE TOXIC FUMES OF SODIUM OXIDE.

POLYMERIZATION:  
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

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STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

\*\*\*STORAGE\*\*

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

\*\*\*DISPOSAL\*\*

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40 CFR 262. EPA HAZARDOUS WASTE NUMBER D002. 100 POUND CERCLA SECTION 103 REPORTABLE QUANTITY.

\*\*\*\*\*  
CONDITIONS TO AVOID

AVOID CONTACT WITH OR STORAGE WITH WATER, ACIDS, AND OTHER INCOMPATIBILITIES. FLAMMABLE, POISONOUS GASES MAY ACCUMULATE IN TANKS AND HOPPER CARS.

\*\*\*\*\*  
SPILL AND LEAK PROCEDURES

SOIL SPILL:

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DIG HOLDING AREA SUCH AS LAGOON, POND OR PIT FOR CONTAINMENT.  
USE SOIL, SAND BAGS, FOAMED POLYURETHANE, OR FOAMED CONCRETE TO DIKE SURFACE FLOW.  
USE FLY ASH OR CEMENT POWDER TO ABSORB BULK LIQUID.  
USE VINEGAR OR OTHER DILUTE ACID TO NEUTRALIZE.

**WATER SPILL:**  
ADD SUITABLE AGENT TO NEUTRALIZE SPILLED MATERIAL TO PH-7.

**OCCUPATIONAL SPILL:**  
DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR SMALL DRY SPILLS, WITH CLEAN SHOVEL PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER. MOVE CONTAINERS FROM SPILL AREA. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.

**REPORTABLE QUANTITY (RQ): 1000 POUNDS**  
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-2802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D. C. AREA (40 CFR 302.6).

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**PROTECTIVE EQUIPMENT**

**VENTILATION:**  
PROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

**RESPIRATOR:**  
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U. S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS; NIOSH CRITERIA DOCUMENTS OR BY THE U. S. DEPARTMENT OF LABOR, 29 CFR 1910 SUBPART Z.  
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION (NIOSH-MSHA).

**SODIUM HYDROXIDE:**

- 50 MG/M3- ANY POWERED AIR-PURIFYING RESPIRATOR WITH A DUST AND MIST FILTER, ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS FLOW MODE.
  - 100 MG/M3- ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE, ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE, ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR WITH A HIGH EFFICIENCY PARTICULATE FILTER.
  - 250 MG/M3- ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE AND OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.
- ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR WITH A HIGH EFFICIENCY PARTICULATE FILTER, ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

- SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.
- SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN 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.

**CLOTHING:**  
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT ANY POSSIBILITY OF SKIN CONTACT WITH THIS SUBSTANCE.

**GLOVES:**  
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

**EYE PROTECTION:**  
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE.

**EMERGENCY WASH FACILITIES:**  
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

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DIUM THIOSULFATE\*\*  
SODIUM THIOSULFATE\*\*  
SODIUM THIOSULFATE\*\*

FROM: JESYUE  
DATE: 7-26-90  
CHEMICAL IN USE: ✓  
CHEMICAL NOT IN USE: ✓

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC  
CHEMICAL DIVISION  
1 REAGENT LANE  
FAIR LAWN NJ 07410  
(201) 796-7100

EMERGENCY CONTACTS:  
GASTON L. PILLORI: (201) 796-7100  
AFTER BUSINESS HOURS, HOLIDAYS:  
(201) 796-7523  
CHEMTREC ASSISTANCE: (800) 424-9300

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 7772-98-7

SUBSTANCE: SODIUM THIOSULFATE\*\*

TRADE NAMES/SYNONYMS:

THIOSULFURIC ACID (H2S2O3), DISODIUM SALT, THIOSULFURIC ACID, DISODIUM SALT, DISODIUM THIOSULFATE, SODIUM HYPOSULFITE, SODIUM THIOSULFATE ANHYDROUS, SODIUM THIOSULPHATE, DISODIUM THIOSULPHATE, SODIUM THIOSULFATE (NA2S2O3), SODIUM OXIDE SULFIDE, SODIUM OXIDE SULFIDE (NA2S2O3), HYPO, SODIOTHIOIOL, CHLORINE CONTROL, S-HYDRIL, CHLORINE CURE, DECHLOR-IT, S-446, NA2S2O3, ACC21710

CHEMICAL FAMILY:  
INORGANIC SALT

MOLECULAR FORMULA: NA2-S2-O3

MOLECULAR WEIGHT: 158.11

RATINGS (SCALE 0-3): HEALTH=1 FIRE=0 REACTIVITY=0 PERSISTENCE=0  
RATINGS (SCALE 0-4): HEALTH=1 FIRE=0 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: SODIUM THIOSULFATE PERCENT: 100  
CAS# 7772-98-7

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:  
NO OCCUPATIONAL EXPOSURE LIMITS ESTABLISHED BY OSHA, ACGIH, OR NIOSH.

PHYSICAL DATA

DESCRIPTION: ODORLESS, COLORLESS, MONOCLINIC CRYSTALS OR HYGROSCOPIC POWDER.

MELTING POINT: NOT AVAILABLE SPECIFIC GRAVITY: 1.667

PH: 6.5-8.0 IN SOLUTION SOLUBILITY IN WATER: 50%

SOLVENT SOLUBILITY: INSOLUBLE IN ALCOHOL.

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:  
NEGLECTIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

FIREFIGHTING MEDIA:  
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM  
(1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM.  
(1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:  
NO ACUTE HAZARD. MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. AVOID BREATHING  
OR DUSTS; KEEP UPWIND.

TOXICITY

SODIUM THIOSULFATE:  
ANHYDROUS: 4 GM/KG SUBCUTANEOUS-RABBIT LDLO; 6 GM/KG SUBCUTANEOUS-FROG LDLO.  
PENTAHYDRATE: 300 MG/KG/7 DAYS ORAL-HUMAN TDLO; 5600 MG/KG

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INTRAPERITONEAL-MOUSE LD50; 2350 MG/KG INTRAVENOUS-MOUSE LD50; 3000 MG/KG  
INTRAVENOUS-DOG LDLO.  
MUTAGENICITY STATUS: NONE.  
SODIUM THIOSULFATE MAY BE IRRITATING. THE TOXICITY HAS NOT BEEN FULLY  
CHARACTERIZED.

-----  
HEALTH EFFECTS AND FIRST AID

INHALATION:  
SODIUM PENTAHYDRATE:  
ACUTE EXPOSURE- NO DATA AVAILABLE.  
CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING  
HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST.  
TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:  
SODIUM THIOSULFATE:  
ACUTE EXPOSURE- MAY BE IRRITATING.  
CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED  
AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO  
EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL  
ATTENTION IMMEDIATELY.

EYE CONTACT:  
SODIUM THIOSULFATE:  
ACUTE EXPOSURE- MAY BE IRRITATING.  
CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER OR NORMAL SALINE.  
OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL  
REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:  
SODIUM THIOSULFATE:  
ACUTE EXPOSURE- SODIUM THIOSULFATE IS POORLY ABSORBED FROM THE BOWEL AND  
ACTS AS AN OSMOTIC CATHARTIC. INGESTION OF LARGE AMOUNTS MAY CAUSE  
DIARRHEA. THE PROBABLE LETHAL DOSE FOR HUMANS IS 0.5-5.0 GM/KG.  
CHRONIC EXPOSURE- HUMAN EXPOSURE TO 300 MG/KG OF THE PENTAHYDRATE, FOR SEVEN  
DAYS, RESULTED IN CYANOSIS. SODIUM THIOSULFATE IS PERMITTED AS A FOOD  
ADDITIVE. POSSIBLE HUMAN EXPOSURE EXISTS, DUE TO MIGRATION TO FOOD FROM  
PACKAGING MATERIALS.

FIRST AID- TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION  
IMMEDIATELY. IF VOMITING OCCURS, KEEP HEAD LOWER THAN HIPS TO PREVENT  
ASPIRATION.

ANTIDOTE:  
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

-----  
REACTIVITY

STABILITY:  
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:  
SODIUM THIOSULFATE:  
ACIDS: REACTS RELEASING SULFUR DIOXIDE.  
CHLORINE (SOLUTIONS): FORMS SODIUM HYDROSULFATE.  
HALOGENS: REACTS.  
IODINE: INCOMPATIBLE.  
LEAD SALTS: INCOMPATIBLE.  
MERCURY SALTS: INCOMPATIBLE.  
METAL NITRATES: MAY FORM EXPLOSIVE MIXTURES.  
OXIDANTS: REACTS.  
POTASSIUM NITRATE: MIXTURE IS EXPLOSIVE ON HEATING.  
SILVER SALTS: INCOMPATIBLE.  
SODIUM NITRATE: MIXTURE IS EXPLOSIVE ON HEATING.  
SODIUM NITRITE: MAY EXPLODE VIOLENTLY ON HEAT DRYING.

DECOMPOSITION:  
THERMAL DECOMPOSITION MAY RELEASE TOXIC OXIDES OF SULFUR AND TOXIC SODIUM  
OXIDE.

POLYMERIZATION:  
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL  
TEMPERATURES AND PRESSURES.

-----  
STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING  
OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE  
ENVIRONMENTAL PROTECTION AGENCY.

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**\*\*STORAGE\*\***

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

\*\*\*\*\*  
CONDITIONS TO AVOID

NONE REPORTED.

\*\*\*\*\*  
SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:  
SWEEP UP AND PLACE IN SUITABLE CLEAN, DRY CONTAINERS FOR RECLAMATION OR LATER  
DISPOSAL. DO NOT FLUSH WITH WATER. KEEP UNNECESSARY PEOPLE AWAY.

-----  
**PROTECTIVE EQUIPMENT**

**VENTILATION:**  
PROVIDE GENERAL DILUTION VENTILATION.

**RESPIRATOR:**  
THE FOLLOWING RESPIRATORS ARE RECOMMENDED BASED ON INFORMATION FOUND IN THE  
PHYSICAL DATA, TOXICITY AND HEALTH EFFECTS SECTIONS. THEY ARE RANKED IN  
ORDER FROM MINIMUM TO MAXIMUM RESPIRATORY PROTECTION.  
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND  
IN THE WORK PLACE. MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND  
BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND  
HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION (NIOSH-MSHA).

DUST AND MIST RESPIRATOR WITH A FULL FACEPIECE.

AIR-PURIFYING FULL FACEPIECE RESPIRATOR WITH A HIGH-EFFICIENCY PARTICULATE  
FILTER.

POWERED AIR-PURIFYING RESPIRATOR WITH A TIGHT-FITTING FACEPIECE AND  
HIGH-EFFICIENCY PARTICULATE FILTER.

AIR SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN  
PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE OR WITH A FULL FACEPIECE,  
HELMET OR HOOD OPERATED IN CONTINUOUS-FLOW MODE.

SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN  
PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN  
PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN 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.

**CLOTHING:**  
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT  
TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

**GLOVES:**  
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS  
SUBSTANCE.

**EYE PROTECTION:**  
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT  
EYE CONTACT WITH THIS SUBSTANCE.

EMERGENCY EYE WASH: WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES  
BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH  
FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

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