The MSDS format adheres to the standards and regulatory requirements of the United States and may not meet regulatory requirements in other countries.

DuPont                        Page   1
Material Safety Data Sheet

-----------------------------------------------------------------------
Dimethyl Sulfate
4180CR                    Revised 21-AUG-2000
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CHEMICAL PRODUCT/COMPANY IDENTIFICATION

Material Identification

- Corporate MSDS Number : DU000286
- CAS Number              : 77-78-1
- Formula                 : (CH3)2SO4
- CAS Name                : SULFURIC ACID, DIMETHYL ESTER
- Grade                   : TECHNICAL

Tradenames and Synonyms

- DMS
- METHYL SULFATE

Company Identification

MANUFACTURER/DISTRIBUTOR
DuPont Chemical Solutions Enterprise
1007 Market Street
Wilmington, DE  19898

PHONE NUMBERS
- Product Information  : 1-800-441-7515 (outside the U.S. 302-774-1000)
- Transport Emergency  : CHEMTREC 1-800-424-9300(outside U.S. 703-527-3887)
- Medical Emergency    : 1-800-441-3637 (outside the U.S. 302-774-1000)

COMPOSITION/INFORMATION ON INGREDIENTS

Components

<table>
<thead>
<tr>
<th>Material</th>
<th>CAS Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>*DIMETHYL SULFATE</td>
<td>77-78-1</td>
<td>&gt;99.8</td>
</tr>
</tbody>
</table>

* Disclosure as a toxic chemical is required under Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR part 372.
HAZARDS IDENTIFICATION

# Potential Health Effects

This compound is extremely hazardous because of its lack of warning properties and delayed biological effects. It may cause burns of the skin, eyes, and mucous membranes. Eye damage may be permanent. Effects may be delayed occurring hours after exposure. Skin permeation may occur in toxic amounts. Both the fumes and the liquid may produce severe irritation. Inhalation may cause irritation of the nose, throat and lungs. Death may occur from overexposure. Prolonged exposures may cause liver and kidney effects. DuPont controls this compound as a potential carcinogen.

HUMAN HEALTH EFFECTS:

Dimethyl sulfate vapor and liquid is extremely hazardous because of its deficient warning properties (NO ODOR THRESHOLD, LOOKS LIKE WATER, AND HAS ANALGESIC EFFECTS) and delayed biological effects. DMS hydrolyzes to methyl hydrogen sulfate and eventually sulfuric acid and methanol.

Skin or eye contact with low concentrations of Dimethyl Sulfate may cause analgesia (numbness). Therefore, the corrosive action of Dimethyl Sulfate may not be readily detected.

Skin contact with Dimethyl Sulfate may cause skin burns or ulceration. Initial effects include itching, reddening of the skin followed hours later by severe blistering. Evidence suggests that skin permeation can occur in amounts capable of producing the effects of systemic toxicity.

Eye contact with Dimethyl Sulfate may cause eye corrosion with corneal or conjunctival ulceration. Permanent eye damage may occur. Both the vapors and the liquid can cause severe irritation; upon slight vapor exposure the whites of the eyes turn red (bloodshot).

Ingestion of Dimethyl Sulfate may cause severe irritation of the mucous membranes of the mouth, throat and gastrointestinal tract.

Inhalation of Dimethyl Sulfate may cause irritation of the upper respiratory passages, angioneurotic edema of larynx with hoarseness, difficulty in swallowing; temporary lung irritation effects with productive cough, discomfort, difficulty breathing, chest pain, shortness of breath or cyanosis; or possibly modest initial symptoms, followed in hours by severe shortness of breath, requiring prompt medical attention. In severe poisonings, central nervous system effects may occur which include unconsciousness, cramps or convulsions, and paralysis. Fatality may result from gross overexposure.
Additional effects from inhalation or skin contact may include nonspecific discomfort, such as nausea, vomiting, diarrhea, giddiness, fever, headache, or weakness.

Prolonged exposures may lead to abnormal liver function with jaundice; abnormal kidney function with blood or albumin in the urine.

Several studies of workers occupationally exposed to DMS for various periods between 1932 and 1972 report a low incidence of lung tumors in these workers. All of the studies are limited by small numbers; no ability to formally analyze smoking effects; and the presence of exposure to other workplace chemicals. None of the studies indicate an increased risk of respiratory cancer for workers exposed to DMS at the present guideline levels.

Individuals with preexisting diseases of the lungs, skin, liver, or kidneys may have increased susceptibility to the toxicity of excessive exposures.

Carcinogenicity Information

The following components are listed by IARC, NTP, OSHA or ACGIH as carcinogens.

<table>
<thead>
<tr>
<th>Material</th>
<th>IARC</th>
<th>NTP</th>
<th>OSHA</th>
<th>ACGIH</th>
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<tbody>
<tr>
<td>Dimethyl Sulfate</td>
<td>2A</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DuPont controls the following materials as carcinogens:

- Dimethyl Sulfate.

FIRST AID MEASURES

First Aid

START TREATMENT IMMEDIATELY IF EXPOSURE IS SUSPECTED, EVEN IF THERE IS NO EVIDENCE OF INJURY. REDNESS OF THE EYES (BLOODSHOT) INDICATES EXPOSURE TO VERY LOW CONCENTRATIONS OF VAPOR.

INHALATION

If inhaled, remove to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

SKIN CONTACT

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 CONTACT

In case of contact, immediately flush eyes with plenty of
(FIRST AID MEASURES - Continued)

        water for at least 15 minutes. Call a physician.

INGESTION
        If swallowed, do not induce vomiting. Give large
        quantities of water or activated charcoal slurry. Call a
        physician immediately. Never give anything by mouth to
        an unconscious person.

NOTE:
        To prepare activated charcoal slurry, suspend 50 grams of
        activated charcoal in 400 mL of water and mix thoroughly.
        Give 5 mL/kg, or 350 mL for an average adult.

Notes to Physicians

        Severe symptoms may be delayed for 10 hours or more.

FIREFIGHTING MEASURES

Flammable Properties

        Flash Point : 83 C (181 F)
        Method : TCC
        Flammable limits in Air, % by Volume
        LEL : 3.6
        UEL : 23.3
        Autoignition : 495 C (923 F)

Actual AIT's can be affected by concentration of vapors and
        oxygen, vapor/air contact time, pressure, volume, catalytic
        impurities, etc. Process conditions should be analyzed to
        determine if the AIT may be higher or lower.

Fire and Explosion Hazards:

        OSHA Class III A Combustible Liquid. Follow appropriate
        National Fire Protection Association (NFPA) codes. Toxic
        sulfur oxide (e.g., SO2, SO3) vapors will be produced in a
        fire. DMS vapors will be released if not ignited.

Extinguishing Media

        Water, Foam, Dry Chemical.

        Carbon Dioxide (CO2).
Fire Fighting Instructions

Evacuate area. Stay upwind and carefully avoid smoke and any possible fumes. If contact with smoke, fumes, and liquid DMS cannot be avoided, wear butyl rubber chemical-proof suit with hood and breathing air supply. Use water spray to cool containers. Use caution in approaching advanced or massive fires. Product may generate pressure from heat and rupture drums. Decontaminate all equipment including personal protective equipment used in firefighting efforts before returning to service.

------------------------------------------------------------------
ACCIDENTAL RELEASE MEASURES
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Safeguards (Personnel)

NOTE: Review FIRE FIGHTING MEASURES and HANDLING (PERSONNEL) sections before proceeding with clean-up. Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean-up.

Spill Clean Up

Accidental Release Measures

Test air with Draeger detector tubes if spill is suspected. Evacuate area; keep upwind. Wear full butyl rubber chemical proof suit with hood and breathing air supply to enter spill area. Dike spill; neutralize with dry soda ash followed by water flood, 2-5% solution of ammonia, or dilute caustic soda solution. Let stand until a negative test for DMS is obtained, then transfer to containers for disposal and flush spill area with plenty of water. Check area again with Draeger detector tubes to be sure all traces of DMS have been eliminated. Comply with Federal, State, and local regulations on reporting releases. The Superfund reportable discharge is 100 lbs.

DuPont Emergency Exposure Limits (EEL) are established to facilitate site or plant emergency evacuation, and to specify airborne concentrations of brief durations which should not result in permanent adverse health effects or interfere with escape. EEL’s are expressed as airborne concentrations multiplied by time (CxT) for up to a maximum of 60 minutes and as a ceiling airborne concentration. These limits are used in conjunction with engineering controls/monitoring and as an aid in planning for episodic releases and spills. For more information on the applicability of EEL’s, contact DuPont.

The Emergency Exposure Limit (EEL) for Dimethyl Sulfate is 30 ppm-minutes (for example, 2 ppm for 15 minutes; 1.5 ppm
for 20 minutes; etc.) with a not-to-exceed ceiling of 2 ppm.

HANDLING AND STORAGE

Handling (Personnel)

Do not breathe vapor or mist. Do not get in eyes, on skin, or on clothing.

Wash thoroughly after handling and before eating or smoking. Avoid contact with any liquid in vicinity of vessels containing DMS; assume liquid is DMS.

Storage

Store in a well-ventilated area away from heat and flame and out of direct sun. Keep containers closed. Do not store with concentrated ammonia solutions and other strong alkaline materials or strong oxidizers. Close empty drums tightly before returning to DuPont. Use entire container, do not wash out.

EXPOSURE CONTROLS/PERSONAL PROTECTION

Engineering Controls

Use with sufficient ventilation to keep employee exposure below recommended limits. Handle in a closed system, if possible.

# Personal Protective Equipment

Wear appropriate protective equipment to prevent any eye or skin contact with liquid or vapor.

EYE/FACE PROTECTION:

Wear gas-tight chemical splash goggles with full-length face shield.

PROTECTIVE CLOTHING:

Wear appropriate butyl rubber clothing to prevent any contact with liquid or vapor such as gloves, boots and impervious chemical suit with hood. Use butyl rubber gloves for possible direct contact with liquid DMS, or neoprene gloves, which are less likely to tear, for routine work.

DuPont permeation data indicate that impervious materials such as butyl rubber (9 and 17 mils) afford adequate protection for greater than 480 minutes. DuPont permeation data indicate that impervious materials such as neoprene (12
and 20 mils) have breakthrough times of 23 and 73 minutes respectively.

**RESPIRATORS:**

Where this is potential for airborne exposure in excess of applicable limits, use NIOSH approved full facepiece, positive pressure supplied air respirator.

**NOTE:**

Thorough decontamination of personal protective equipment is necessary before removal.

**Exposure Guidelines**

**Exposure Limits**

**Dimethyl Sulfate**

| PEL (OSHA) | 1 ppm, 5 mg/m3, 8 Hr. TWA, Skin |
| TLV (ACGIH) | 0.1 ppm, 0.52 mg/m3, 8 Hr. TWA, Skin, A3 |
| AEL * (DuPont) | 0.01 ppm, 8 & 12 Hr. TWA, Skin |

* AEL is DuPont’s Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence.

**Exposure Guideline Comments**

The "Skin" notation above indicates that DMS liquid and vapor can penetrate skin and mucous membranes; therefore, control of vapor inhalation alone may not be sufficient to prevent absorption of an excessive dose. Skin contact should also be avoided.

**PHYSICAL AND CHEMICAL PROPERTIES**

**Physical Data**

- **Boiling Point**: 189 C (372 F) @ 760 mm Hg
- **Vapor Pressure**: 0.7 mm Hg @ 25 C (77 F)
  1.1 mm Hg @ 38 C (100 F)
- **Vapor Density**: 4.3 (Air = 1)
- **Melting Point**: -32 C (-26 F)
- **Evaporation Rate**: (Butyl Acetate = 1)
  Less than 1
- **Solubility in Water**: 2.8 WT% @ 18 C (64 F)
- **Odor**: Almost odorless
- **Form**: Oily liquid
- **Color**: Colorless
- **Specific Gravity**: 1.3
pH Information: At 18 deg C (64 deg F) or above, hydrolyzes to methyl hydrogen sulfate and eventually to sulfuric acid and methanol.

STABILITY AND REACTIVITY

Chemical Stability

Stable.

Incompatibility with Other Materials

Incompatible with strong ammonia solutions and other strong alkaline materials, sodium azide, and strong oxidizers including strong caustic solutions.

Decomposition

Reacts with water or moisture to give methyl hydrogen sulfate and, eventually, sulfuric acid and methanol.

Polymerization

Polymerization will not occur.

TOXICOLOGICAL INFORMATION

Animal Data

Dimethyl Sulfate:

Inhalation 4 hour LC50: 30 ppm in rats
Oral LD50: 440 mg/kg in rats

Dimethyl Sulfate is corrosive to skin and the eyes, but is not a skin sensitizer in animals. DMS is classified as a DOT corrosive.

Effects in animals to single high exposures by inhalation include respiratory irritation, corneal damage, weight loss, and structural functional changes of the thymus. DMS was also a potent methylating agent of the nasal mucosa in rats. Repeated exposure caused microscopic changes to the lymph nodes, inflammation and tumors of the nasal cavity, lung and brain tumors, pneumonia and mortality. Prolonged exposure to DMS has resulted in severe irritation to the respiratory tract.

Tests in some animals demonstrate carcinogenic activity. There is insufficient information available to adequately categorize the reproductive toxicity of DMS. Data indicate that this material does not specifically harm the unborn
Dimethyl sulfate is a strong alkalating agent and does produce genetic damage in animals and in bacterial and mammalian cell cultures. It has not been tested adequately for heritable genetic damage.

ECOLOGICAL INFORMATION

Ecotoxicological Information

Aquatic Toxicity

96-hour LC50, bluegill sunfish: 7.5 ppm

DISPOSAL CONSIDERATIONS

Waste Disposal

This material is a RCRA hazardous waste. Comply with Federal, State, and local regulations on disposal. May be incinerated in a permitted hazardous waste incinerator, or transferred to a licensed waste disposal contractor.

TRANSPORTATION INFORMATION

Shipping Information

DOT/IMO

Proper Shipping Name : DIMETHYL SULFATE
Hazard Class : 6.1
UN No. : 1595
DOT/IMO Label : POISON, CORROSIVE
Special Information : POISON-INHALATION HAZARD, HAZARD ZONE B
Subsidiary Hazard Class : 8
Packing Group : I

Shipping Containers

Tank Cars.
Tank Trucks.

Portable Tanks

ISO Containers

Reportable Quantity : 100 lbs/45.4 kg
REGULATORY INFORMATION

U.S. Federal Regulations

TSCA Inventory Status : Reported/Included.

TITLE III HAZARD CLASSIFICATIONS SECTIONS 311, 312

Acute : Yes
Chronic : Yes
Fire : Yes
Reactivity : No
Pressure : No

LISTS:

Extremely Hazardous Substance - Yes
CERCLA Hazardous Substance - Yes
Toxic Chemicals - Yes

CANADIAN WHMIS CLASSIFICATION:

D-1A; D-2A; B-3; E

State Regulations (U.S.)

WARNING:

Dimethyl Sulfate has been listed by the State of California as a substance known to cause cancer.

OTHER INFORMATION

NFPA, NPCA-HMIS

NFPA Rating
Health : 4
Flammability : 2
Reactivity : 0

NPCA-HMIS Rating
Health : 3
Flammability : 2
Reactivity : 0

Personal Protection rating to be supplied by user depending on use conditions.

Additional Information

For further information, see DuPont "Dimethyl Sulfate" Properties, Uses, Storage, and Handling bulletin.
The data in this Material Safety Data Sheet relates only to the specific material designated herein and does not relate to use in combination with any other material or in any process.

Responsible for MSDS : MSDS Coordinator
> : DuPont Chemical Solutions Enterprise
Address : Wilmington, DE 19898
Telephone : (800) 441-7515

# Indicates updated section.

This information is based upon technical information believed to be reliable. It is subject to revision as additional knowledge and experience is gained.

End of MSDS