SAFETY DATA SHEET
Ethylene Glycol

1. CHEMICAL PRODUCT/COMPANY IDENTIFICATION

PRODUCT IDENTIFIER:
Ethylene Glycol

ADDITIONAL IDENTIFICATION:
1,2-Ethanediol
HOCH2CH2OH
Glycol, Ethylene
Refined Glycol
Ethylene Glycol, Virgin

RECOMMENDED USE AND USE RESTRICTIONS:
Ethylene glycol used in polymer manufacturing. See attached DAK Caution Bulletin No. 1 at end of SDS for use restrictions.

MANUFACTURER / SUPPLIER:
DAK Americas LLC
5925 Carnegie Blvd., Suite 500
Charlotte, NC 28209
www.DAKAmericas.com

EMERGENCY PHONE NUMBERS:
Product Information: 1-800-227-6335
Transport Emergency: CHEMTREC 1-800-424-9300

2. HAZARDS IDENTIFICATION

OSHA HAZARD CLASSIFICATION:
Acute Toxicity, Oral (Hazard Category 4)
Specific Target Organ Toxicity – Single Exposure (Hazard Category 2)

SIGNAL WORD, HAZARD STATEMENTS, SYMBOLS AND PRECAUTIONARY STATEMENTS

SIGNAL WORD: Warning

HAZARD STATEMENT(S):
- Harmful if swallowed.
- May cause damage to organs; Kidneys, through prolonged or repeated exposure if swallowed.

SYMBOL(S):

PRECAUTIONARY STATEMENT(S):
- Prevention: Do not breathe dust/fume/gas/mist/ vapors/spray. Wash skin thoroughly after handling. Do not eat, drink or smoke when using this product.
- Response: If swallowed: Call a Poison Center or doctor/physician if you feel unwell. Rinse mouth.
- Storage: Store locked up.
- Disposal: Dispose of contents/container to an approved waste disposal plant, in accordance with local/regional/national/international regulations.
3. COMPOSITION/INFORMATION ON INGREDIENTS

<table>
<thead>
<tr>
<th>COMPONENTS:</th>
<th>CAS Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethylene Glycol</td>
<td>107-21-1</td>
<td>95–100</td>
</tr>
<tr>
<td>Diethylene Glycol</td>
<td>111-46-6</td>
<td>0–5</td>
</tr>
</tbody>
</table>

4. FIRST AID MEASURES

DESCRIPTION OF NECESSARY MEASURES:

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

SKIN CONTACT: Flush skin with water after contact. Wash contaminated clothing before reuse.

EYE CONTACT: In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

INGESTION: If swallowed, immediately give 2 glasses of water and induce vomiting. Never give anything by mouth to an unconscious person. Call a physician.

MOST IMPORTANT SYMPTOMS/EFFECTS, ACUTE AND DELAYED: Harmful if swallowed; may damage kidneys.

INDICATION OF IMMEDIATE MEDICAL ATTENTION AND SPECIAL TREATMENT:

NOTE TO PHYSICIANS: Ethanol (ETOH) is antidotal and should be administered early in the treatment. Ethanol is a potent inhibitor of Ethylene Glycol metabolism because it is preferentially acted on by liver alcohol dehydrogenase, thus delaying or preventing toxic metabolites from Ethylene Glycol. Treatment is started after residual ingested substance is removed from the stomach. Ethanol is administered orally or IV with a goal of maintaining a blood alcohol level of approximately 22 mmol/L or 1.0 mg/L. To prepare antidote, make a solution using 100 mL of 100 proof ethyl alcohol and 1900 mL of water. Give 1.5 mL/kg or 100 mL for an average adult. This may be mixed with orange juice for oral use if necessary. More Ethanol is to be given at 2 hour intervals to achieve and maintain the desired blood alcohol levels. Treatment may be necessary for several days. The patient should be monitored for metabolic acidosis. Use of appropriate buffering solutions, such as bicarbonate, may be indicated. Hemodialysis may be required.

5. FIRE FIGHTING MEASURES

SUITABLE EXTINGUISHING MEDIA: Water, Water Spray, Foam, Carbon Dioxide (CO₂), or Dry Chemical.

SPECIFIC HAZARDS ARISING FROM CHEMICAL:
HAZARDOUS COMBUSTION PRODUCTS: Carbon dioxide and carbon monoxide.

SPECIAL PROTECTIVE EQUIPMENT AND PRECAUTIONS FOR FIRE-FIGHTERS: Keep personnel removed and upwind of fire. Wear self-contained breathing apparatus. Wear full protective equipment. Hose with water from a distance to prevent splashing on personnel. Cool tank/container with water spray. Water or foam may cause violent frothing.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS / PROTECTIVE EQUIPMENT / EMERGENCY PROCEDURES
Review Section 5. FIRE FIGHTING MEASURES and Section 7. PRECAUTIONS FOR SAFE HANDLING before proceeding with clean-up. Use appropriate Personal Protective
Equipment during clean-up. Evacuate personnel, thoroughly ventilate area, use self-contained breathing apparatus.

**METHODS AND MATERIALS FOR CONTAINMENT AND CLEANING UP:**
Remove source of heat, sparks, flame, impact, friction or electricity. Dike spill. Prevent material from entering sewers, waterways, or low areas. Recover free liquid for reuse or reclamation. Soak up with sawdust, sand, oil dry or other absorbent material.

7. **HANDLING AND STORAGE**

**PRECAUTIONS FOR SAFE HANDLING:**
- Avoid breathing vapors or mist. Avoid contact with eyes, skin, or clothing.
- Wash thoroughly after handling.
- Do not eat, drink or smoke when using this product.
- Keep away from heat, sparks and flames.

**CONDITIONS FOR SAFE STORAGE, INCLUDING ANY INCOMPATIBILITIES:**
Keep container tightly closed. Store locked up.

8. **EXPOSURE CONTROLS/PERSONAL PROTECTION**

**EXPOSURE LIMITS:**

<table>
<thead>
<tr>
<th></th>
<th>Ethylene Glycol</th>
<th>Diethylene Glycol</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEL (OSHA):</td>
<td>None Established</td>
<td>None Established</td>
</tr>
<tr>
<td>TLV (ACGIH):</td>
<td>10 mg/m³ (2015 NIC**–I)</td>
<td>25 ppm (2015 NIC–IFV)</td>
</tr>
<tr>
<td></td>
<td>50 ppm (2015 NIC–STEL)</td>
<td>None Established</td>
</tr>
</tbody>
</table>

*All exposure limits presented are 8–hour time weighted average (TWA) limits unless otherwise noted.

**APPROPRIATE ENGINEERING CONTROLS:**
- Keep container tightly closed.
- Use sufficient ventilation to keep employee exposure below recommended exposure limits.

**INDIVIDUAL PROTECTION MEASURES / PERSONAL PROTECTIVE EQUIPMENT:**

**EYE/FACE PROTECTION:** Wear safety glasses. Wear coverall chemical splash goggles and face shield when the possibility exists for eye and face contact due to splashing or spraying of material.

**RESPIRATORY PROTECTION:** A NIOSH approved air purifying respirator with an organic vapor with dust/mist filter cartridge or canister may be permissible under certain circumstances where airborne concentrations are expected to exceed exposure limits. Protection provided by air purifying respirators is limited. Use a positive pressure air supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air purifying respirators may not provide adequate protection. Respiratory protection use should be in accordance with the OSHA Respiratory Protection Standard (29 CFR 1910.134).

**PROTECTIVE CLOTHING:** Wear impervious clothing, such as gloves, apron, boots or whole bodysuit made from Neoprene, as appropriate. If there is potential contact with hot/molten material, wear heat resistant clothing and footwear.

**RECOMMENDED DECONTAMINATION FACILITIES:** Eyewash station, safety shower, washing facilities.
9. PHYSICAL AND CHEMICAL PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Appearance</td>
<td>Viscous liquid, Colorless</td>
</tr>
<tr>
<td>Odor</td>
<td>Mild</td>
</tr>
<tr>
<td>Odor Threshold</td>
<td>0.1 ppm</td>
</tr>
<tr>
<td>pH</td>
<td>6–8 @ 558g/l H₂O</td>
</tr>
<tr>
<td>Melting Point</td>
<td>No data available</td>
</tr>
<tr>
<td>Initial Boiling Point and Boiling Range</td>
<td>197.6 °C @ 760 mm Hg</td>
</tr>
<tr>
<td>Flash Point</td>
<td>115.6 °C</td>
</tr>
<tr>
<td>Evaporation Rate</td>
<td>0.01 (Butyl Acetate=1)</td>
</tr>
<tr>
<td>Flammability</td>
<td>No data available</td>
</tr>
<tr>
<td>Flammability Limits (Upper/Lower)</td>
<td>15.3% / 3.2%</td>
</tr>
<tr>
<td>Vapor Pressure</td>
<td>0.1 mm Hg @ 25 °C</td>
</tr>
<tr>
<td>Vapor Density</td>
<td>2.14 (Air=1)</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>1.115 @ 20 °C</td>
</tr>
<tr>
<td>Solubility in Water</td>
<td>100% WT%</td>
</tr>
<tr>
<td>Partition coefficient</td>
<td>No data available</td>
</tr>
<tr>
<td>Auto-Ignition Temperature</td>
<td>413 °C</td>
</tr>
<tr>
<td>Temperature</td>
<td>No data available</td>
</tr>
<tr>
<td>Decomposition Temperature</td>
<td>No data available</td>
</tr>
<tr>
<td>Viscosity</td>
<td>No data available</td>
</tr>
<tr>
<td>Percent Volatiles</td>
<td>Negligible</td>
</tr>
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</table>

10. STABILITY AND REACTIVITY

REACTIVITY:
None known.

CHEMICAL STABILITY:
Stable. Polymerization will not occur.

POSSIBILITY OF HAZARDOUS REACTIONS:
None known.

CONDITIONS TO AVOID:
Decomposes with heat.

INCOMPATIBLE MATERIALS:
Incompatible with strong bases at high temperatures, strong acids, and strong oxidizers.

HAZARDOUS DECOMPOSITION PRODUCTS:
Hazardous gases/vapors produced are carbon monoxide and/or carbon dioxide.

11. TOXICOLOGICAL INFORMATION

INFORMATION ON LIKELY ROUTES OF EXPOSURE:
Ethylene glycol mists may be inhaled. Ethylene glycol may contact eyes and skin during handling. Accidental ingestion of ethylene glycol.

SYMPTOMS RELATED TO PHYSICAL, CHEMICAL AND TOXICOLOGICAL CHARACTERISTICS:
- Immediate effects of overexposure through inhalation may include: Irritation of the nose and throat with sneezing, sore throat or runny nose.
- Immediate effects of overexposure through skin contact may include: Irritation with itching, burning, redness, swelling or rash. Animal testing indicates ethylene glycol is a mild skin irritant.
- Immediate effects of overexposure through eye contact may include: Eye irritation with tearing, pain or blurred vision. Animal testing indicates ethylene glycol is a mild eye irritant.
- Immediate effects of overexposure through ingestion may include: Headache, nausea.
ACUTE, DELAYED, AND CHRONIC EFFECTS FROM SHORT AND LONG-TERM EXPOSURE:

- Gross inhalation overexposure may cause: Pulmonary edema (body fluid in the lungs) with cough, wheezing, abnormal lung sounds, possibly progressing to severe shortness of breath and bluish discoloration of the skin; symptoms may be delayed.
- Skin permeation may occur in amounts capable of producing the effects of systemic toxicity. There are inconclusive or unverified reports of human sensitization.
- Gross ingestion overexposure may cause: Central nervous system depression with dizziness, confusion, lack of coordination, drowsiness or unconsciousness. Convulsions. Altered kidney function which may be accompanied by abnormal urine volume, low back pain, discomfort or edema. Kidney failure. Deposits of calcium oxalate in the brain, spinal cord and kidneys. Liver abnormalities. High blood pressure. Irregular heart beat with a strange sensation in the chest, "heart thumping", apprehension, lightheadedness, feeling of fainting, dizziness, weakness, sometimes progressing to loss of consciousness and death. Congestive heart failure. Retention of acid in the blood, making oxygen less available in the blood stream and leading to symptoms of increased breathing rate, nausea, vomiting, confusion and weakness which may progress to loss of consciousness. Low blood sugar. Low blood calcium. Muscle twitching. Involuntary movement of the eyes. Facial paralysis. Other effects include fatality.
- No increases in chromosomal changes were noted in the circulating blood of exposed workers. Increased susceptibility to the effects of this material may be observed in persons with pre-existing disease of the kidneys.
- In animal testing, repeated inhalation exposure to ethylene glycol caused: Histopathological changes of the liver, lungs. Eye irritation. Clouding of the eye (corneal opacity). No deaths occurred in animals exposed to saturated vapors of the compound.
- In animal testing ethylene glycol has not caused carcinogenicity.
- For ethylene glycol, reproductive data on adult animals show: Interference with reproduction only at levels which produce other toxic effects in the adult animal. Tests have shown this material to cause developmental toxicity in animals. This material has not produced genetic damage in bacterial cultures. There are reports indicating that this material does not produce genetic damage in some animal or mammalian cell culture tests; however, there are reports in the literature that suggest positive results.
- Animal testing indicates that diethylene glycol is a mild eye irritant but not a skin irritant.
- Single exposure by ingestion to high doses of diethylene glycol caused lethargy, incoordination, abnormal kidney function and tubular necrosis, increased urine output, altered enzyme levels, and liver degeneration. Repeated exposure caused liver and kidney deposition. Long-term exposure caused bladder stones and histologic changes in the pancreas. Tests in some animals exposed to diethylene glycol demonstrate carcinogenic activity, possibly due to chronic irritation produced by bladder stones that occurred in these animals. Animal data show developmental effects only at exposure levels producing other toxic effects in the adult animal. One published study indicated some reproductive toxicity in mice given high oral doses. Tests have shown that diethylene glycol does not cause genetic damage in bacterial or mammalian cell cultures. No adequate reports of genetic testing in animals were found.
NUMERICAL MEASURES OF TOXICITY

- The estimated approximate lethal oral dose of ethylene glycol in humans is 100 mL.
- The estimated approximate lethal oral dose of diethylene glycol in humans is 13–89 mL (15–100 grams).
- Skin: LD$_{50}$, rabbit: > 20 mL/kg (ethylene glycol)
- Ingestion: LD$_{50}$, female rat: 4,000 mg/kg (ethylene glycol)
- Dermal LD$_{50}$: 11.9 mL/kg (13,324 mg/kg) in rabbit (diethylene glycol)
- Oral LD$_{50}$: 20,760 mg/kg in rats (diethylene glycol)

CARCINOGENICITY INFORMATION:
None of the components present in this material at concentrations equal to or greater than 0.1% are listed by NTP, IARC, OSHA or ACGIH as a carcinogen.

12. ECOLOGICAL INFORMATION

AQUATIC TOXICITY

Ethylene glycol: 96-hour LC$_{50}$, Fathead minnow: 49,000 mg/L
Diethylene glycol: 96-hour LC$_{50}$, Mosquito fish: >32,000 mg/L

13. DISPOSAL CONSIDERATIONS

Treatment, storage, transportation, and disposal must be in accordance with applicable Federal, State/Provincial, and Local regulations. Recover for reclamation. Recover nonusable free liquid and dispose of in approved and permitted incinerator. Do not flush to surface water or sanitary sewer system.

14. TRANSPORTATION INFORMATION

SHIPPING INFORMATION:

DOT/IMO
Proper Shipping Name: ENVIRONMENTALLY HAZARDOUS SUBSTANCE, LIQUID, N.O.S. (ETHYLENE GLYCOL)
Hazard Class: 9
UN No.: UN 3082
Packing Group: III
Reportable quantity: 5,000 LBS

SHIPPING CONTAINERS
Tank Cars.

NOTE: Packages containing less than 5,000 lbs ethylene glycol are not regulated by DOT, IMO (for water), or IATA/ICAO (for air).

15. REGULATORY INFORMATION

U.S. FEDERAL REGULATIONS:

- TSCA Inventory Status: Reported/Included.
- Title III Hazard Classification Sections 311, 312
  - Acute: Yes  - Reactivity: No
  - Chronic: Yes  - Pressure: No
  - Fire: No
- Lists
  - SARA Extremely Hazardous Substance: No
  - CERCLA Hazardous Material: No
  - SARA Toxic Chemical: Yes
16. ADDITIONAL INFORMATION

The data in this 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.

SDS Revision Date: April 22, 2015

End of SDS
DAK CAUTION BULLETIN NO.1

DO NOT USE DAK MATERIALS IN MEDICAL APPLICATIONS INVOLVING PERMANENT, BRIEF, OR TEMPORARY IMPLANTATION IN THE HUMAN BODY OR PERMANENT CONTACT WITH INTERNAL BODY FLUIDS OR TISSUES, UNLESS THE MATERIAL HAS BEEN PROVIDED DIRECTLY FROM DAK UNDER A CONTRACT WHICH EXPRESSLY ACKNOWLEDGES THE CONTEMPLATED USE.

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THE CONTENT OF DAK MATERIAL IS NOT CERTIFIED FOR IMPLANTS.
DAK materials are not designed or manufactured for use in implantation in the human body or in contact with internal body fluids or tissues. DAK has not performed clinical testing of these materials for implantation. DAK will not provide to customers making implantable devices any notice concerning its materials, as specified under 21 CFR section 820.50, or any other information necessary for medical device use of the materials under any other statute or FDA regulation. DAK has neither sought, nor received, approval from the FDA for the use of these materials in implantation in the human body or in contact with internal body fluids or tissues.

ALL IMPLANTABLE MEDICAL DEVICES CARRY A RISK OF FAILURE AND ADVERSE CONSEQUENCES
The medical judgment of a physician, a medical device seller and the FDA should be relied upon for identification of both harmful consequences and life-saving benefits from an implantation device comprised of specific materials. These benefits and risks can be found in published medical cases performing clinical medical studies of an implantable medical device. DAK does not support the use of its products in these applications and cannot weigh the benefits against the risk defined in these articles. DAK can not offer a medical judgment on the safety or efficacy of the use of its materials in such devices.

DO NOT MAKE REFERENCE TO THE DAK NAME OR ANY DAK TRADEMARK IN ASSOCIATION WITH AN IMPLANTABLE MEDICAL DEVICE.
Do not use a DAK trademark or licensed trademark as the descriptive name of an implantable medical device (e.g. do not call it the "Delcron®" prosthesis, or do not call it a "Laser+® device").

End of Bulletin