SECTION 1: Identification

1.1. Identification

Product name: GERMANE 99.99+%
Product code: GEG5001
Product form: Substance
Physical state: Gas
Formula: GeH4
Synonyms: MONOGERMANE; GERMANIUM HYDRIDE; GERMANIUM TETRAHYDRIDE
Chemical family: GERMANE

1.2. Recommended use and restrictions on use

Recommended use: Chemical intermediate

1.3. Supplier

GELEST, INC.
11 East Steel Road
Morrisville, PA 19067
USA
T 215-547-1015 - F 215-547-2484 - (M-F): 8:00 AM - 5:30 PM EST
info@gelest.com - www.gelest.com

1.4. Emergency telephone number

Emergency number: CHEMTREC: 1-800-424-9300 (USA); +1 703-527-3887 (International)

SECTION 2: Hazard(s) identification

2.1. Classification of the substance or mixture

GHS-US classification

Flammable gases Category 1
Gases under pressure Liquefied gas
Acute toxicity (inhalation:gas) Category 2
Serious eye damage/eye irritation Category 2A
Specific target organ toxicity (single exposure) Category 3

Full text of H statements: see section 16

2.2. GHS Label elements, including precautionary statements

GHS US labeling

Hazard pictograms (GHS US):

Signal word (GHS US): Danger
Hazard statements (GHS US):
H220 - Extremely flammable gas
H280 - Contains gas under pressure; may explode if heated
H319 - Causes serious eye irritation
H330 - Fatal if inhaled
H335 - May cause respiratory irritation

Precautionary statements (GHS US):
P284 - [In case of inadequate ventilation] wear respiratory protection.
P280 - Wear protective gloves/protective clothing/eye protection/face protection.
P260 - Do not breathe gas.
P264 - Wash hands thoroughly after handling.
P310 - Immediately call a doctor
P210 - Keep away from heat, open flames, sparks. - No smoking.
P271 - Use only outdoors or in a well-ventilated area.
P304+P340 - If inhaled: Remove person to fresh air and keep comfortable for breathing
P305+P351+P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
P307+P361 - If eye irritation persists: Get medical advice/attention.
P377 - Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381 - Eliminate all ignition sources if safe to do so.
P403+P233 - Store in a well-ventilated place. Keep container tightly closed.
P405 - Store locked up.
P410+P403 - Protect from sunlight. Store in a well-ventilated place.
P501 - Dispose of contents/container to licensed waste disposal facility.
GERMANE 99.99+%
Safety Data Sheet

2.3. Hazards not otherwise classified (HNOC)
No additional information available

2.4. Unknown acute toxicity (GHS US)
Not applicable

SECTION 3: Composition/Information on ingredients

3.1. Substances
Substance type: Mono-constituent
Name: GERMANE 99.99+
CAS-No.: 7782-65-2

<table>
<thead>
<tr>
<th>Name</th>
<th>Product identifier</th>
<th>%</th>
<th>GHS-US classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germanium tetrahydride</td>
<td>(CAS-No.) 7782-65-2</td>
<td>&gt; 99</td>
<td>Flam. Gas 1, H220</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Press. Gas (Liq.), H280</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Acute Tox. 2 (Inhalation:gas), H330</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Eye Irrit. 2A, H319 STOT SE 3, H335</td>
</tr>
</tbody>
</table>

Full text of hazard classes and H-statements: see section 16

3.2. Mixtures
Not applicable

SECTION 4: First-aid measures

4.1. Description of first aid measures
First-aid measures general: Remove contaminated clothing and shoes. In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). If possible show this sheet; if not available show packaging or label.

First-aid measures after inhalation: Remove victim to fresh air and keep at rest in a position comfortable for breathing. Get immediate medical advice/attention.

First-aid measures after skin contact: Wash with plenty of soap and water.

First-aid measures after eye contact: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical advice/attention.

First-aid measures after ingestion: Never give anything by mouth to an unconscious person. Get medical advice/attention.

4.2. Most important symptoms and effects (acute and delayed)
Symptoms/effects after inhalation: Fatal if inhaled. May cause respiratory irritation. Hemolytic gas.
Symptoms/effects after skin contact: May cause skin irritation.
Symptoms/effects after eye contact: Causes serious eye irritation. At levels below the flammability limit, silane is expected to affect the eyes by absorption and deposition of silicon dioxide, causing severe irritation and possible corneal damage.
Symptoms/effects after ingestion: May be harmful if swallowed.

4.3. Immediate medical attention and special treatment, if necessary
No additional information available

SECTION 5: Fire-fighting measures

5.1. Suitable (and unsuitable) extinguishing media
Suitable extinguishing media: If unable to stop the flow of gas, germane should be allowed to burn until consumed. Secondary fires may be extinguished with alcohol resistant foam, carbon dioxide, dry chemical. Use of high expansion foam (100:1) is recommended to cover flames.

5.2. Specific hazards arising from the chemical
Fire hazard: Extremely flammable gas. Irritating fumes and organic acid vapors may develop when material is exposed to elevated temperatures or open flame.
Explosion hazard: Germane ignites readily in air.

5.3. Special protective equipment and precautions for fire-fighters
Firefighting instructions: Exercise caution when fighting any chemical fire. Leaking gas fire: Do not extinguish, unless leak can be stopped safely. Eliminate all ignition sources if safe to do so. Germane should be allowed to burn until consumed. Excessive pressure may develop in gas cylinders exposed to fire-heated. Heated germane may explode on contact with air. Cool cylinders and surroundings with water from a suitable distance.

Protection during firefighting: Do not enter fire area without proper protective equipment, including respiratory protection. Avoid all eye and skin contact and do not breathe vapor and mist.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures
General measures: Ventilate area. Eliminate every possible source of ignition. Use special care to avoid static electric charges.
6.1.1. For non-emergency personnel
Emergency procedures: Evacuate unnecessary personnel.

6.1.2. For emergency responders
Protective equipment: Equip cleanup crew with proper protection.

6.2. Environmental precautions
Prevent entry to sewers and public waters. Notify authorities if liquid enters sewers or public waters.

6.3. Methods and material for containment and cleaning up
Methods for cleaning up: Stop flow of gas if possible. The potential exists for spontaneous ignition and explosion. Allow vapors to disperse.

6.4. Reference to other sections
See Heading 8. Exposure controls and personal protection.

SECTION 7: Handling and storage

7.1. Precautions for safe handling
Additional hazards when processed: Flammable gas. Germane ignites readily in air. Handle empty containers with care because residual vapors are flammable.
Precautions for safe handling: Containers must be properly grounded before beginning transfer. Use only non-sparking tools. Provide good ventilation in process area to prevent accumulation of vapors. Use only outdoors or in a well-ventilated area. Systems utilizing germane that do not involve complete consumption of germane should be equipped with burn boxes. See Book of SEMI Standards, Facilities Standards and Safety Guidelines, Mountain View, CA, Semiconductor Equipment and Materials Int'l, 1993. Avoid all eye and skin contact and do not breathe vapor and mist.
Hygiene measures: Wash hands and other exposed areas with mild soap and water before eating, drinking or smoking and when leaving work. Wash contaminated clothing before reuse.

7.2. Conditions for safe storage, including any incompatibilities
Technical measures: Proper grounding procedures to avoid static electricity should be followed.
Storage conditions: Store in sealed cylinders in isolated area.
Storage area: Store in a well-ventilated place. Store away from heat.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

<table>
<thead>
<tr>
<th>Substance</th>
<th>ACGIH TWA (ppm)</th>
<th>NIOSH REL (TWA) (mg/m³)</th>
<th>NIOSH REL (TWA) (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germanium tetrahydride (7782-65-2)</td>
<td>0.2 ppm</td>
<td>0.6 mg/m³</td>
<td>0.2 ppm</td>
</tr>
</tbody>
</table>

8.2. Appropriate engineering controls
Appropriate engineering controls: Provide local exhaust or general room ventilation.

8.3. Individual protection measures/Personal protective equipment

Personal protective equipment:
Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Avoid all unnecessary exposure.

Hand protection:
Neoprene or nitrile rubber gloves

Eye protection:
Chemical goggles. Contact lenses should not be worn

Skin and body protection:
Wear suitable protective clothing

Respiratory protection:
Wear respiratory protection. NIOSH-certified combination organic vapor/acid gas (yellow cartridge) respirator.
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SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical state</td>
<td>Gas</td>
</tr>
<tr>
<td>Appearance</td>
<td>Flammable gas.</td>
</tr>
<tr>
<td>Molecular mass</td>
<td>76.62 g/mol</td>
</tr>
<tr>
<td>Color</td>
<td>Colorless.</td>
</tr>
<tr>
<td>Odor</td>
<td>Disagreeable garlic-like.</td>
</tr>
<tr>
<td>Odor threshold</td>
<td>No data available</td>
</tr>
<tr>
<td>Refractive index</td>
<td>No data available</td>
</tr>
<tr>
<td>pH</td>
<td>No data available</td>
</tr>
<tr>
<td>Relative evaporation rate (butyl acetate=1)</td>
<td>No data available</td>
</tr>
<tr>
<td>Melting point</td>
<td>No data available</td>
</tr>
<tr>
<td>Freezing point</td>
<td>-165 °C</td>
</tr>
<tr>
<td>Boiling point</td>
<td>-88 °C</td>
</tr>
<tr>
<td>Flash point</td>
<td>&lt; -40 °C</td>
</tr>
<tr>
<td>Critical temperature</td>
<td>308 K</td>
</tr>
<tr>
<td>Auto-ignition temperature</td>
<td>No data available</td>
</tr>
<tr>
<td>Decomposition temperature</td>
<td>No data available</td>
</tr>
<tr>
<td>Flammability (solid, gas)</td>
<td>Extremely flammable gas</td>
</tr>
<tr>
<td>Vapor pressure</td>
<td>&gt; 1 atm @ 20°C</td>
</tr>
<tr>
<td>Critical pressure</td>
<td>54.8 atm</td>
</tr>
<tr>
<td>Relative vapor density at 20 °C</td>
<td>3.2 g/l</td>
</tr>
<tr>
<td>Relative density</td>
<td>1.53</td>
</tr>
<tr>
<td>% Volatiles</td>
<td>100 %</td>
</tr>
<tr>
<td>Solubility</td>
<td>Insoluble in water.</td>
</tr>
<tr>
<td>Log Pow</td>
<td>No data available</td>
</tr>
<tr>
<td>Log Kow</td>
<td>No data available</td>
</tr>
<tr>
<td>Viscosity, kinematic</td>
<td>No data available</td>
</tr>
<tr>
<td>Viscosity, dynamic</td>
<td>No data available</td>
</tr>
<tr>
<td>Explosive properties</td>
<td>No data available</td>
</tr>
<tr>
<td>Oxidizing properties</td>
<td>No data available</td>
</tr>
<tr>
<td>Explosion limits</td>
<td>No data available</td>
</tr>
</tbody>
</table>

9.2. Other information

Gas group: Press. Gas (Liq.)

SECTION 10: Stability and reactivity

10.1. Reactivity

No additional information available

10.2. Chemical stability

Stable in sealed cylinders stored under a dry inert atmosphere.

10.3. Possibility of hazardous reactions

React with oxygen in air, sometimes igniting spontaneously. Mixtures with mercury explode when shaken in the presence of air. Platinum, platinum and iron salts and other Lewis acids can cause generation of flammable hydrogen gas.

10.4. Conditions to avoid

Heat. Sparks. Open flame.

10.5. Incompatible materials


10.6. Hazardous decomposition products

Germanium dioxide.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity: Not classified

<table>
<thead>
<tr>
<th>Route</th>
<th>LD50 Value mg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germanium tetrahydride (7782-65-2)</td>
<td></td>
</tr>
<tr>
<td>LD50 oral mouse</td>
<td>1250</td>
</tr>
<tr>
<td>LD50 intravenous rat</td>
<td>56</td>
</tr>
</tbody>
</table>
GERMANE 99.99+%  
Safety Data Sheet

<table>
<thead>
<tr>
<th>Germanium tetrahydride (7782-65-2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC50 inhalation mouse</td>
</tr>
<tr>
<td>ATE US (gases)</td>
</tr>
</tbody>
</table>

- **Skin corrosion/irritation**: Not classified
- **Serious eye damage/irritation**: Causes serious eye irritation.
- **Respiratory or skin sensitization**: Not classified
- **Germ cell mutagenicity**: Not classified
- **Carcinogenicity**: Not classified
- **Reproductive toxicity**: Not classified
- **Specific target organ toxicity – single exposure**: May cause respiratory irritation.
- **Specific target organ toxicity – repeated exposure**: Not classified
- **Aspiration hazard**: Not classified
- **Symptoms/effects after inhalation**: Fatal if inhaled. May cause respiratory irritation. Hemolytic gas.
- **Symptoms/effects after skin contact**: May cause skin irritation.
- **Symptoms/effects after eye contact**: Causes serious eye irritation. At levels below the flammability limit, silane is expected to affect the eyes by absorption and deposition of silicon dioxide, causing severe irritation and possible corneal damage.
- **Symptoms/effects after ingestion**: May be harmful if swallowed.

**SECTION 12: Ecological information**

12.1. **Toxicity**  
No additional information available

12.2. **Persistence and degradability**  
No additional information available

12.3. **Bioaccumulative potential**  
No additional information available

12.4. **Mobility in soil**  
No additional information available

12.5. **Other adverse effects**  
- **Effect on the ozone layer**: No additional information available
- **Effect on global warming**: No known effects from this product.
- **GWPmix comment**: No known effects from this product.

**SECTION 13: Disposal considerations**

13.1. **Disposal methods**  
Product/Packaging disposal recommendations: Incinerate. Dispose in a safe manner in accordance with local/national regulations. Dispose of contents/container to licensed waste disposal facility.

Additional information: Handle empty containers with care because residual vapors are flammable.

Ecology - waste materials: Avoid release to the environment.

**SECTION 14: Transport information**

14.1. **UN number**  
UN-No.(DOT): 2192  
DOT NA no.: UN2192

14.2. **UN proper shipping name**  
- **Transport document description**: UN2192 Germane, 2.3 (2.1)
- **Proper Shipping Name (DOT)**: Germane
- **Class (DOT)**: 2.3 - Class 2.3 - Poisonous gas 49 CFR 173.115
- **Hazard labels (DOT)**: 2.3 - Poison gas 2.1 - Flammable gas
GERMANE 99.99+%  
Safety Data Sheet

| DOT Packaging Non Bulk (49 CFR 173.xxx) | : 302 |
| DOT Packaging Bulk (49 CFR 173.xxx)   | : 245 |
| DOT Packaging Exceptions (49 CFR 173.xxx) | : None |

14.3. Additional information

Emergency Response Guide (ERG) Number : 119

Other information : No supplementary information available.

Transport by sea

DOT Vessel Stowage Location : D - The material must be stowed “on deck only” on a cargo vessel and on a passenger vessel carrying a number of passengers limited to not more than the larger of 25 passengers or one passenger per each 3 m of overall vessel length, but the material is prohibited on passenger vessels in which the limiting number of passengers is exceeded.

DOT Vessel Stowage Other : 40 - Stow “clear of living quarters”

Air transport

DOT Quantity Limitations Passenger aircraft/rail (49 CFR 173.27) : Forbidden

DOT Quantity Limitations Cargo aircraft only (49 CFR 175.75) : Forbidden

SECTION 15: Regulatory information

15.1. US Federal regulations

Germanium tetrahydride (7782-65-2)

Listed on the United States TSCA (Toxic Substances Control Act) inventory

15.2. International regulations

CANADA

Germanium tetrahydride (7782-65-2)

Listed on the Canadian DSL (Domestic Substances List)

| WHMIS Classification | Class A - Compressed Gas  
|                       | Class B Division 6 - Reactive Flammable Material  
|                       | Class D Division 1 Subdivision A - Very toxic material causing immediate and serious toxic effects |

EU-Regulations

Germanium tetrahydride (7782-65-2)

Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

National regulations

Germanium tetrahydride (7782-65-2)

Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China)  
Listed on the Japanese ENCS (Existing & New Chemical Substances) inventory  
Listed on the Japanese ISHL (Industrial Safety and Health Law)  
Listed on the Korean ECL (Existing Chemicals List)  
Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances)  
Japanese Poisonous and Deleterious Substances Control Law  
Listed on the Canadian IDL (Ingredient Disclosure List)  
Listed on INSQ (Mexican National Inventory of Chemical Substances)

15.3. US State regulations

California Proposition 65 - This product does not contain any substances known to the state of California to cause cancer, developmental and/or reproductive harm

Germanium tetrahydride (7782-65-2)

U.S. - Massachusetts - Right To Know List  
U.S. - New Jersey - Right to Know Hazardous Substance List  
U.S. - Pennsylvania - RTK (Right to Know) List

SECTION 16: Other information

Full text of H-phrases:

<table>
<thead>
<tr>
<th>H-Phrase</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H220</td>
<td>Extremely flammable gas</td>
</tr>
<tr>
<td>H280</td>
<td>Contains gas under pressure; may explode if heated</td>
</tr>
<tr>
<td>H319</td>
<td>Causes serious eye irritation</td>
</tr>
</tbody>
</table>

Print date: 04/10/2019  
EN (English US)  
SDS ID: GEG5001
### Abbreviations and acronyms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ND</td>
<td>Not Determined, No Data; NA: Not Applicable; LD: Lethal Dose; LC: Lethal Concentration; ATE: Acute Toxicity Estimates; H: hour; °C: °C unless otherwise stated; mm: millimeters Hg, torr; PEL: permissible exposure level; TWA: time weighted average; TLV: threshold limit value; TG: Test Guideline; NIOSH: National Institute for Occupational Safety and Health; IARC: International Agency for Research on Cancer; NTP: National Toxicology Program; HMIS: Hazardous Material Information System; CAS No.: Chemical Abstract Service Registration Number; EC No.: European Commission Registration Number; EC Index No.: European Commission Index Number; OECD: The Organisation for Economic Co-operation and Development; GHS: The Globally Harmonized System of Classification and Labelling; APF: Assigned Protection Factor.</td>
</tr>
</tbody>
</table>

### Hazard Rating

**Health**: 4 Severe Hazard - Life-threatening, major or permanent damage may result from single or repeated overexposures

**Flammability**: 4 Severe Hazard - Flammable gases, or very volatile flammable liquids with flash points below 73 F, and boiling points below 100 F. Materials may ignite spontaneously with air. (Class IA)

**Physical**: 3 Serious Hazard - Materials that may form explosive mixtures with water and are capable of detonation or explosive reaction in the presence of a strong initiating source. Materials may polymerize, decompose, self-react, or undergo other chemical change at normal temperature and pressure with moderate risk of explosion

Prepared by safety and environmental affairs.

Date of issue: 01/05/2015  
Version: 1.0