SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

<table>
<thead>
<tr>
<th>Product form</th>
<th>: Sub stance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical state</td>
<td>: Gas</td>
</tr>
<tr>
<td>Substance name</td>
<td>: GERMANE 99.99+%</td>
</tr>
<tr>
<td>Product code</td>
<td>: GEG5001</td>
</tr>
<tr>
<td>Formula</td>
<td>: GeH4</td>
</tr>
<tr>
<td>Synonyms</td>
<td>: MONOGERMANE; GERMANIUM HYDRIDE; GERMANIUM TETRAHYDRIDE</td>
</tr>
<tr>
<td>Chemical family</td>
<td>: GERMANE</td>
</tr>
</tbody>
</table>

1.2. Relevant identified uses of the substance or mixture and uses advised against

1.2.1. Relevant identified uses

Use of the substance/mixture : Chemical intermediate

1.2.2. Uses advised against

No additional information available

1.3. Details of the supplier of the safety data sheet

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

GELEST INC.
Fritz-Klatte-Strasse 8
65933 Frankfurt
Germany
T +49 (0) 69 3535106-500 - F +49 (0) 69 3535106-501 - (M-F): 8:00 AM - 4:00 PM
info@gelestde.com - www.gelestde.com

1.4. Emergency telephone number

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

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification according to Regulation (EC) No. 1272/2008 [CLP]

| Flammable gases, Category 1 | H220 |
| Gases under pressure : Liquefied gas | H280 |
| Acute toxicity (inhalation:gas) Category 2 | H330 |
| Serious eye damage/eye irritation, Category 2 | H319 |
| Specific target organ toxicity — Single exposure, Category 3, Respiratory tract irritation | H335 |

Full text of H statements : see section 16

Adverse physicochemical, human health and environmental effects

No additional information available

2.2. Label elements

Labelling according to Regulation (EC) No. 1272/2008 [CLP]

Hazard pictograms (CLP) : GHS02 GHS06
GERMANE 99.99+%  
Safety Data Sheet

Signal word (CLP) : Danger
Hazard statements (CLP) :  
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 (CLP) :  
P284 - Wear respiratory protection.  
P280 - Wear protective gloves/protective clothing/eye protection/face protection.  
P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.  
P264 - Wash hands thoroughly after handling.  
P260 - Do not breathe gas.  
P312 - Call a doctor if you feel unwell.

2.3. Other hazards 
No additional information available

SECTION 3: Composition/information on ingredients

3.1. Substances 
Name: GERMANE 99.99+%  
CAS-No.: 7782-65-2  
EC-No.: 231-961-6

<table>
<thead>
<tr>
<th>Name</th>
<th>Product identifier</th>
<th>%</th>
<th>Classification according to Regulation (EC) No. 1272/2008 [CLP]</th>
</tr>
</thead>
</table>

Full text of 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 person to fresh air and keep comfortable for breathing. Get immediate medical advice/attention.

First-aid measures after skin contact: Wash with plenty of 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, both 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. Indication of any immediate medical attention and special treatment needed 
No additional information available

SECTION 5: Firefighting measures

5.1. 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.
GERMANE 99.99+%  
Safety Data Sheet

5.2. Special hazards arising from the substance or mixture

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. Advice for firefighters

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 vapour 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 vapours 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 formation of vapour. 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 vapour 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.

7.3. Specific end use(s)

No additional information available

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

<table>
<thead>
<tr>
<th></th>
<th>Australia</th>
<th>TWA (mg/m³)</th>
<th>0.63 mg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Australia</td>
<td>TWA (ppm)</td>
<td>0.2 ppm</td>
</tr>
<tr>
<td>Germanium tetrahydride (7782-65-2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>MAK (mg/m³)</td>
<td>0.6 mg/m³</td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>MAK (ppm)</td>
<td>0.2 ppm</td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>MAK Short time value (mg/m³)</td>
<td>1.2 mg/m³</td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>MAK Short time value (ppm)</td>
<td>0.4 ppm</td>
<td></td>
</tr>
<tr>
<td>Belgium</td>
<td>Limit value (mg/m³)</td>
<td>0.64 mg/m³</td>
<td></td>
</tr>
</tbody>
</table>

Print date: 10/04/2019  EN (English)  SDS ID: GEG5001  3/10
8.2. Exposure controls

Appropriate engineering controls:

Provide local exhaust or general room ventilation.

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:**

[In case of inadequate ventilation] wear respiratory protection. NIOSH-certified combination organic vapor/acid gas (yellow cartridge) respirator.

## 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>
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<tr>
<td>Colour</td>
<td>Colourless</td>
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<tr>
<td>Odour</td>
<td>Disagreeable garlic-like</td>
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<tr>
<td>Odour threshold</td>
<td>No data available</td>
</tr>
<tr>
<td>Refractive index</td>
<td>No additional information available</td>
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<tr>
<td>pH</td>
<td>No data available</td>
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<tr>
<td>Relative evaporation rate (butylacetate=1)</td>
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<tr>
<td>Melting point</td>
<td>No data available</td>
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<tr>
<td>Freezing point</td>
<td>-165 °C</td>
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<tr>
<td>Boiling point</td>
<td>-88 °C</td>
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<tr>
<td>Flash point</td>
<td>&lt; -40 °C</td>
</tr>
<tr>
<td>Critical temperature</td>
<td>308 K</td>
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<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>Vapour pressure</td>
<td>&gt; 1 atm @ 20°C</td>
</tr>
<tr>
<td>Critical pressure</td>
<td>54.8 atm</td>
</tr>
<tr>
<td>Relative vapour 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>
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<tr>
<td>Log Pow</td>
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</tr>
<tr>
<td>Log Kow</td>
<td>No data available</td>
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<tr>
<td>Viscosity, kinematic</td>
<td>No data available</td>
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<tr>
<td>Viscosity, dynamic</td>
<td>No data available</td>
</tr>
<tr>
<td>Explosive properties</td>
<td>No data available</td>
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<tr>
<td>Explosive limits</td>
<td>No data available</td>
</tr>
<tr>
<td>Gas group</td>
<td>Press. Gas (Liq.)</td>
</tr>
</tbody>
</table>

### 9.2. Other information

### 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

Reacts 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**

Fatal if inhaled.
Germanium tetrahydride (7782-65-2)

LD50 oral mouse: 1250 mg/kg
LD50 intravenous rat: 56 mg/kg
LC50 inhalation mouse: 1380 mg/m³
ATE CLP (gases): 100 ppmv/4h

Skin corrosion/irritation: Not classified
Serious eye damage/irritation: Causes serious eye irritation.
Respiratory or skin sensitisation: Not classified
Germ cell mutagenicity: Not classified
Carcinogenicity: Not classified
Reproductive toxicity: Not classified
STOT-single exposure: May cause respiratory irritation.
STOT-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
Acute aquatic toxicity: Not classified
Chronic aquatic toxicity: Not classified

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. Results of PBT and vPvB assessment
No additional information available

12.6. Other adverse effects
No additional information available

SECTION 13: Disposal considerations

13.1. Waste treatment 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 vapours are flammable.
Ecology - waste materials: Avoid release to the environment.

SECTION 14: Transport information

14.1. UN number
In accordance with ADR / RID / IMDG / IATA / ADN

14.1. UN number
UN-No. (ADR): 2192
UN-No. (IMDG): 2192
UN-No. (IATA): 2192
UN-No. (ADN): 2192
UN-No. (RID): 2192

14.2. UN proper shipping name
Proper Shipping Name (ADR): GERMANE
Proper Shipping Name (IMDG): GERMANE
GERMANE 99.99+% Safety Data Sheet

Proper Shipping Name (IATA): Germane
Proper Shipping Name (ADN): GERMANE
Proper Shipping Name (RID): GERMANE
Transport document description (ADR): UN 2192 GERMANE, 2.3 (2.1), (B/D)
Transport document description (IMDG): UN 2192 GERMANE, 2.3 (2.1)
Transport document description (IATA): UN 2192 Germane, 2.3
Transport document description (ADN): UN 2192 GERMANE, 2.3 (2.1)
Transport document description (RID): UN 2192 GERMANE, 2.3 (2.1)

14.3. Transport hazard class(es)

ADR
Transport hazard class(es) (ADR): 2.3 (2.1)
Danger labels (ADR): 2.3, 2.1

IMDG
Transport hazard class(es) (IMDG): 2.3 (2.1)
Danger labels (IMDG): 2.3, 2.1

IATA
Transport hazard class(es) (IATA): 2.3 (2.1)

ADN
Transport hazard class(es) (ADN): 2.3 (2.1)
Danger labels (ADN): 2.3, 2.1

RID
Transport hazard class(es) (RID): 2.3 (2.1)
Danger labels (RID): 2.3, 2.1

14.4. Packing group
Packing group (ADR): Not applicable
Packing group (IMDG): Not applicable
Packing group (IATA): Not applicable
Packing group (ADN): Not applicable
Packing group (RID): Not applicable

14.5. Environmental hazards
Dangerous for the environment: No
GERMANCE 99.99+%
Safety Data Sheet

Marine pollutant : No
Other information : No supplementary information available

14.6. Special precautions for user

- Overland transport
Classification code (ADR) : 2TF
Special provisions (ADR) : 632
Limited quantities (ADR) : 0
Excepted quantities (ADR) : E0
Packing instructions (ADR) : P200
Mixed packing provisions (ADR) : MP9
Portable tank and bulk container instructions (ADR) : (M)
Vehicle for tank carriage : FL
Transport category (ADR) : 1
Special provisions for carriage - Loading, unloading and handling (ADR) : CV9, CV10, CV36
Special provisions for carriage - Operation (ADR) : S2, S14
Hazard identification number (Kemler No.) : 263
Orange plates : 263 2192
Tunnel restriction code (ADR) : B/D
EAC code : 2PE
APP code : A(cf)

- Transport by sea
Limited quantities (IMDG) : 0
Excepted quantities (IMDG) : E0
Packing instructions (IMDG) : P200
EmS-No. (Fire) : F-D
EmS-No. (Spillage) : S-U
Stowage category (IMDG) : D
Stowage and handling (IMDG) : SW2
Properties and observations (IMDG) : Flammable, toxic, colourless gas with a pungent odour. Much heavier than air (2.6).

- Air transport
PCA Limited quantities (IATA) : Forbidden
PCA limited quantity max net quantity (IATA) : Forbidden
PCA packing instructions (IATA) : Forbidden
PCA max net quantity (IATA) : Forbidden
CAO packing instructions (IATA) : Forbidden
CAO max net quantity (IATA) : Forbidden
Special provisions (IATA) : A2
ERG code (IATA) : 10P

- Inland waterway transport
Classification code (ADN) : 2TF
Special provisions (ADN) : 632
Limited quantities (ADN) : 0
Excepted quantities (ADN) : E0
Equipment required (ADN) : PP, EP, EX, TOX, A
Ventilation (ADN) : VE01, VE02
Number of blue cones/lights (ADN) : 2

- Rail transport
Classification code (RID) : 2TF
Special provisions (RID) : 632
GERMANE 99.99+%  
Safety Data Sheet

Limited quantities (RID): 0  
Excepted quantities (RID): E0  
Packing instructions (RID): P200  
Mixed packing provisions (RID): MP9  
Portable tank and bulk container instructions (RID): (M)  
Transport category (RID): 1  
Special provisions for carriage - Loading, unloading and handling (RID): CW9, CW10, CW36  
Hazard identification number (RID): 263  

14.7. Transport in bulk according to Annex II of Marpol and the IBC Code
Not applicable

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

15.1.1. EU-Regulations
No REACH Annex XVII restrictions  
GERMANE 99.99+% is not on the REACH Candidate List  
GERMANE 99.99+% is not on the REACH Annex XIV List  

% Volatiles: 100 %

15.1.2. National regulations

Germany
12th Ordinance Implementing the Federal Immission Control Act - 12.BImSchV: Is not subject of the 12. BImSchV (Hazardous Incident Ordinance)

Netherlands
SZW-lijst van kankerverwekkende stoffen: The substance is not listed  
SZW-lijst van mutagene stoffen: The substance is not listed  
NIET-limitatieve lijst van voor de voortplanting giftige stoffen – Borstvoeding: The substance is not listed  
NIET-limitatieve lijst van voor de voortplanting giftige stoffen – Vruchtbaarheid: The substance is not listed  
NIET-limitatieve lijst van voor de voortplanting giftige stoffen – Ontwikkeling: The substance is not listed

Denmark
Class for fire hazard: Class I-1  
Store unit: 1 liter  
Classification remarks: F+ <Flam. Gas 1; Press. Gas (Liq.); Emergency management guidelines for the storage of flammable liquids must be followed  
Danish National Regulations: Young people below the age of 18 years are not allowed to use the product

15.2. Chemical safety assessment
No additional information available

SECTION 16: Other information

Abbreviations and acronyms:
Abbreviations: ND: Not Determined, No Data; NA: Not Applicable; LD: Lethal Dose; LC: Lethal Concentration; ATE: Acute Toxicity Estimates; H: hour; °: °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

Other information: Prepared by safety and environmental affairs.
GERMANE 99.99+%  
Safety Data Sheet

Full text of H- and EUH-statements:

<table>
<thead>
<tr>
<th>Acute Tox. 2 (Inhalation: gas)</th>
<th>Acute toxicity (inhalation:gas) Category 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye Irrit. 2</td>
<td>Serious eye damage/eye irritation, Category 2</td>
</tr>
<tr>
<td>Flam. Gas 1</td>
<td>Flammable gases, Category 1</td>
</tr>
<tr>
<td>Press. Gas (Liq.)</td>
<td>Gases under pressure : Liquefied gas</td>
</tr>
<tr>
<td>STOT SE 3</td>
<td>Specific target organ toxicity — Single exposure, Category 3, Respiratory tract irritation</td>
</tr>
<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>
<tr>
<td>H330</td>
<td>Fatal if inhaled.</td>
</tr>
<tr>
<td>H335</td>
<td>May cause respiratory irritation.</td>
</tr>
</tbody>
</table>

SDS EU (REACH Annex II) - Custom

The information contained in this document has been gathered from reference materials and/or Gelest, Inc. test data and is to the best knowledge and belief of Gelest, Inc. accurate and reliable. Such information is offered solely for your consideration, investigation and verification. It is not suggested or guaranteed that the hazard precautions or procedures described are the only ones which exist. Gelest, Inc. makes no warranties, express or implied, with respect to the use of such information and assumes no responsibility therefore. Information on this safety data sheet is not intended to constitute a basis for product specifications.

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