

Digermene (Ge₂H₆) Safety Data Sheet

SECTION 1 – PRODUCT AND COMPANY INFORMATION

For emergency assistance (accident, fire, vandalism, exposure, or leak):

Contact PERS-ER 1-800-633-8253 in North America,

801-629-0667 from overseas or visit www.pers-er.com

Manufacturer: Metaloid Precursors, Inc.
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Product Family: Saturated liquid, toxic inhalation hazard, flammable.
Product Name: Digermene (Ge₂H₆)
Synonyms: Germanium hydride, digermanium hexahydride, germanium (III) hydride, germanium trihydride.
Recommended Uses: Germanium precursor in thin films and silicon-germanium (SiGe) alloy hetero-structures.

SECTION 2 – HAZARD IDENTIFICATION

Classification of the substance

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

H224: Extremely flammable liquid and vapor (Category 1)

H280: Contains gas under pressure (10.28psia); may explode if heated

H331: Toxic if inhaled (Category 1).



Pictogram: Flammable Gas – Gas Under Pressure – Acute Toxicity (by inhalation) - Health Hazard

GHS Label elements, including precautionary statements

Hazard statements

H224: Extremely flammable liquid and vapor.

H280: Contains gas under pressure (10.28psia); may explode if heated.

H331: Toxic if inhaled.

Precautionary statements

P210: Keep away from heat/sparks/open flames/hot surfaces. - No smoking.

P260: Do not breathe fume/ gas/ vapor/ spray.

P264: Wash skin thoroughly after handling.

P270: Do not eat, drink or smoke when using this product.

P271: Use only outdoors or in a well-ventilated area.

P284: Wear respiratory protection.

P304 + P340: IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.

P310: Immediately call a POISON CENTER or doctor/ physician.

P320: Specific treatment is urgent (see first aid instructions).

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 an approved waste disposal plant.

Physical Hazard: Flammable Gases - Category 1 - Extremely flammable gas. Contains gas under pressure (vacuum); may explode if heated. Can form explosive mixtures with air.

Health Hazards: Acute toxicity, inhalation - Category 2 – Fatal if inhaled.



Semiconductor process gases

; Released: May 31, 2015; Supersedes all MSDS versions.

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Specific Target Organ Toxicity - Repeated Exposure (Category 2) May causes damage to organs (kidney and liver) through prolonged or repeated exposure.

Environmental Hazards: None

Precautionary statements

Prevention: Do not handle until all safety precautions have been read and understood. Do not breathe fumes or mist. Use only outdoors or in a well-ventilated area. In case of inadequate ventilation wear respiratory protection. Keep away from heat/sparks/open flames/hot surfaces. - No smoking. Keep container tightly closed. Ground/bond container and receiving equipment. Use explosion-proof electrical/ ventilating/ lighting/ equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Avoid breathing dust/ fume/ gas/ mist/ vapors/ spray. Use only outdoors or in a well-ventilated area. Wear protective gloves/ eye protection/ face protection.

Response: **In case of leakage:** Eliminate all ignition sources.
Leaking gas fire: Do not extinguish, unless leak can be stopped safely. In case of leakage, eliminate all ignition sources if safe to do so.
If inhaled: Remove person to fresh air and keep comfortable for breathing. Immediately get medical attention. Specific treatment is urgent (see First Aid on this label)

If exposed or concerned: CALL A POISON CENTER. Manufacturer/supplier or the competent authority to specify the appropriate source of emergency medical advice

Storage: Store in a well-ventilated place. Keep container tightly closed. Store in a well-ventilated place. Keep cool. Store locked up. Protect from sunlight. Keep container tightly closed. Store locked up.

Disposal: Dispose of contents/ container to an approved waste disposal plant.

HNOC:* None

Supplemental Info: None

* Hazards not otherwise classified (HNOC) or not covered by GHS

SECTION 3 – COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS Number	Composition
Digermene	13818-89-8	100%

SECTION 4 – FIRST AID MEASURES

Inhalation: Remove the affected person from the gas source or contaminated area. Personal Protective Equipment (PPE), including positive pressure, self-contained breathing apparatus, may be required to assure the safety of the rescuer. If the affected person is not breathing spontaneously, administer rescue breathing. If the affected person does not have a pulse, administer CPR. If medical oxygen and appropriately trained personnel are available, administer 100% oxygen to the affected person. Keep the affected person warm, comfortable, and at rest while awaiting first responders. Seek medical assistance immediately.

Skin Contact: Flush with a copious stream of water while removing contaminated clothing. Immediately contact a physician. Continue flushing for no less than fifteen minutes. Treat thermal burns by flushing with cool water to assure that affected area is cool, then applying dry sterile dressings. Obtain professional medical assistance immediately.

Eye Contact: Flush continuously with clean water until the professional medical assistance arrives, but for no less than thirty minutes. Continuation of flushing until patient is transferred to an ophthalmologist or emergency physician is recommended.

Ingestion: Ingestion is not an expected route of exposure to gaseous hazardous materials.

Chronic Effects: None is known.

Note to Physicians: Exposure to germane responds to diuresis, hemodialysis, peritoneal dialysis and exchange transfusions.

SECTION 5 – FIREFIGHTING MEASURES

Extinguishing Media: None.

Fire Fighting Instructions: The only safe way to extinguish a flammable gas fire is to stop the flow of gas. If the flow cannot be stopped, allow the entire contents of the cylinder to burn. Cool the cylinder and surroundings with water from a suitable distance. Extinguishing the fire without stopping the flow of gas may permit the formation of ignitable or explosive mixtures with air. These mixtures may propagate to a source of ignition. Excessive pressure may develop in gas cylinders exposed to fire, which may result in explosion, regardless of the cylinder's content. Cylinders with pressure relief devices



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(PRD's) may release their contents through such devices if the cylinder is exposed to fire. Cylinders without PRD's have no provision for controlled release and are therefore more likely to explode if exposed to fire. Positive pressure, self-contained breathing apparatus is required for all fire-fighting involving hazardous materials. Full structural fire-fighting gear is the *minimum* acceptable. The need for proximity, entry, and flashover protection and special protective clothing should be determined for each incident by a competent firefighting safety professional.

Flammability and Explosivity: Material can propagate a decomposition flame in the absence of air at subsonic speeds.
Known or Anticipated Hazardous Products of Combustion: Germanium oxide.

Properties that may Initiate or Intensify Fire: Heating cylinder to the point of activation of the pressure relief device or to the point of initiating thermal decomposition.

Reactions which Release Flammable Gases: Decomposition of digermene releases hydrogen (fire/overpressure hazard).

SECTION 6 – ACCIDENTAL RELEASE MEASURES

Containment: As this material is a liquid under its own vapor pressure at atmospheric conditions, the only means of containment is the enclosure of the space into which the material is released. Such containment is described in Section 7.

Clean Up: Clean up consists of passing the entire fluid volume of the enclosure through appropriate exhaust gas treatment equipment (EGTE). Purge the enclosure with a non-reactive gas, such as nitrogen, through the EGTE until an acceptably low level of contamination remains. Equipment contaminated by this material must then be cleaned or decommissioned appropriately.

Evacuation: If the release is not contained in an appropriate device or system, all personnel not appropriately protected (see Section 8) must evacuate the contaminated spaces. Consider evacuation of additional areas, as a precaution against the spread of the release or subsequent explosion or fire.

Special Instructions: As leaks will not auto ignite, consider the possible formation of ignitable or explosive mixtures with air.

SECTION 7 – HANDLING AND STORAGE

Handling: Handle this material only in sealed, purged systems. Consider the use of doubly-contained piping; diaphragm or bellows sealed, soft seat valves; backflow prevention devices; flash arrestors; and flow monitoring or limiting devices. Gas cabinets, with appropriate exhaust treatment, are recommended, as is automatic monitoring of the secondary enclosures and work areas for release. Handle sealed gas cylinders in accordance with CGA P-1, *Safe Handling of Compressed Gases in Containers*. As some material may have accumulated behind the outlet plug, face the outlet away from you and wear appropriate protective equipment when removing the plug to connect the cylinder to your system. Never introduce any substance into a gas cylinder. If you believe your cylinder may have been contaminated, notify the supplier immediately, providing as much information as possible on the nature and quantity of contamination.

Storage: Store cylinders in accordance with CGA P-1, *Safe Handling of Compressed Gases in Containers*, local building and fire codes and other relevant regulations. Materials should be segregated, by the hazards they comprise, for storage. Protect the cylinders from direct sunlight, precipitation, mechanical damage, and temperatures above 55°C (130°F). Ship and store cylinders with the outlet plug and valve protective cap in place.

SECTION 8 – EXPOSURE CONTROL AND PERSONAL PROTECTION

Control Parameters: By analogy to germane: TLV-TWA: 0.2 ppm (ACGIH). PEL-TWA: 0.2 ppm (0.6 mg/m³) (OSHA). TWA (10 hour): 0.2 ppm (NIOSH).

Exposure controls: Appropriate engineering controls in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of work day. Local exhaust is required for this product. Secondary containment, with appropriate exhaust gas treatment, is strongly encouraged and is required in some jurisdictions. Monitor the work area and the secondary containment continuously for release of the material. Automatic alerting of personnel and automatic shutdown of flow are appropriate in most applications and are required in some jurisdictions.

Personal protective equipment

Respiratory Protection: Positive pressure, full face, air supplied breathing apparatus should be used for work within the secondary containment equipment if a leak is suspected or the primary containment is to be opened, *e.g.*, for a cylinder change. Air supplied breathing apparatus is required for response to demonstrated or suspected releases from the primary containment.

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Eye/Face Protection: When using respiratory protection as described above, use a face mask that provides splash and impact protection for the face and eyes. For handling sealed cylinders, wear safety glasses.

Skin Protection: Wear appropriate gloves when handling sealed cylinders. Use gloves and other skin protection, as assigned by a competent safety professional, when working within the secondary enclosure with the primary enclosure compromised, e.g., cylinder changing, to protect both from exposure to the material and from fire that may result from its release to the air.

SECTION 9 – PHYSICAL AND CHEMICAL PROPERTIES

General Information:

Physical State	Liquid
Form	Liquid
Color	Clear
Odor	Pungent

Important Health, Safety and Environment Info

Boiling Point/Range	31.7°C
Flash Point and Auto Ignition temperature	N/A
Lower and Lower Flammability Limits	N/A
Vapor Pressure	10.28 psia at 21°C (NIST Chemistry Webbook)
Vapor density	1.98 g/L at 0°C
Freezing Point/Melting Point	-109°C
Solubility (Water) at standard conditions	Sparingly

Other Information:

Molar mass	151.328 g/mol
Critical temperature	150.9°C
Critical pressure	N/A
OEL / IDLH	0.2ppm / 20-30ppm (by reference to germane).

Note: Physical Data is typical values based on material tested.

SECTION 10 – STABILITY AND REACTIVITY

Stability: Digermene is stable at room temperature, but decomposes at elevated temperature to germanium and hydrogen.

Conditions to Avoid: Temperatures above 50°C (122°F), sources of ignition, exposure to air.

Incompatibility with Other Materials: Oxidizers, halogens.

Hazardous Decomposition, Reaction and Oxidation Products: Hydrogen, germanium oxide.

Hazardous Polymerization: Has not been observed.

SECTION 11 – TOXICOLOGICAL INFORMATION

Information on toxicological effects: By analogy to primary hydride germane: Acute toxicity: Exposure by inhalation: LC₅₀, 1-hour, unspecified animal: 622 ppm for pure germane. The primary effect is hemolysis. The respiratory LC₅₀ for germane in mice is 1380 mg/m³. In this study, clinical signs were dyspnea, convulsion and coma. Autopsy revealed congested internal organs, hemorrhages, nerve cell vacuolization and degenerative changes in the cells of parenchymal organs. Guinea pigs exposed to 80 – 480ppm germane revealed similar pathological changes. Germane is listed in the Registry of Toxic Effects of Chemical Substances (RTECS).

Inhalation: No data available

Skin corrosion/irritation: No data available

Serious eye damage/eye irritation: No data available

Respiratory or skin sensitization: No data available

Germ cell mutagenicity: No data available

Carcinogenicity: IARC ACGIH NTP OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen.

Reproductive toxicity: No data available

Specific target organ toxicity - single exposure: No data available

Specific target organ toxicity - repeated exposure: No data available

Aspiration hazard: No data available



Additional Information: None

SECTION 12 – ECOLOGICAL INFORMATION

Toxicity: No data available

Persistence and degradability: No data available

Bioaccumulative potential: No data available

Mobility in soil: No data available

Results of PBT and vPvB assessment: PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

Other adverse effects: An environmental hazard cannot be excluded in the event of unprofessional handling or disposal. Harmful to aquatic life.

SECTION 13 – DISPOSAL CONSIDERATION

Classification under RCRA, 40 CFR 261: Not listed.

US EPA waste number and descriptions: D001 (ignitability).

Special Instructions and Limitations: Treat process and other exhaust streams appropriately before release to the atmosphere.

Notice: Federal controls are subject to change and state and local controls may also apply. As proper waste disposal is the responsibility of the owner of the waste, the user is encouraged to consult with appropriate experts in developing a disposal plan.

SECTION 14 – TRANSPORT INFORMATION

U.S. DOT 49 CFR 172.101:

PROPER SHIPPING NAME: Digermane; ID NUMBER: UN 2929; HAZARD CLASS OR DIVISION: 6.1; LABELING REQUIREMENTS: 6.1; PASSENGER AIRCRAFT: Forbidden; CARGO AIRCRAFT ONLY: Forbidden; RAILCAR: Forbidden; CAR/STATION WAGON: Forbidden; ADDITIONAL SHIPPING DESCRIPTION: Toxic-Inhalation Hazard Zone B; PARKING GROUP: I

SECTION 15 – REGULATORY INFORMATION

TSCA Status: Digermane is a "by-product" (40 CFR 730.3 (d)) in a commercial process and its supply to end-user is restricted by TSCA to research and development purposes (40 CFR 730.3 (cc) and 40 CFR 730.36) under the supervision of a "technically qualified individual" (40 CFR 730.3 (ee)). The sourcing or acquisition of digermane for "commercial purposes" as defined by 40 CFR 730.3 (r) is disallowed in the United States. Similar restrictions may apply in other countries.

CERCLA Reportable Quantity (40CFR302.40): This material is not listed. The Reportable Quantity (RQ) for "Unlisted" Hazardous Wastes Characteristic of Ignitability" (D001) of 45.4 kg (100 lbs.) therefore applies.

SARA Title III Status (Section 302 (40CFR355), Section 311/312, Section 313 (40CFR372)): No Threshold Planning Quantity (TPQ) or Reportable Quantity (RQ) is listed for these substances. The default federal MSDS submission and inventory requirement filing threshold of 4,540 kg (10,000 lbs.) therefore applies. *Note:* State and local requirements may be more stringent.

SECTION 16 – OTHER INFORMATION

Disclaimer: This SDS summarizes to our best knowledge at the date of issue, the chemical health and safety hazards of the material and general guidance on how to safely handle the material in the workplace. Metaloid Precursors, Inc cannot anticipate or control the conditions under which the product may be used, each user must, prior to usage, assess and control the risks arising from its use of the material. If clarification or further information is needed, the user should contact a company representative using the contact details in Section 1 of this SDS.

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