Praxair Material Safety Data Sheet

1. Chemical Product and Company Identification

Product Name: Germane (MSDS No. P-4821-E)	**Trade Names:** Germane
Chemical Name: Germanium tetrahydride	**Synonyms:** Germanium hydride, germanomethane, monogermane
Chemical Family: Inorganic hydride	**Product Grades:** None assigned.

Telephone: **Emergencies:** 1-800-645-4633* **Company Name:** Praxair, Inc.
CHEMTREC: 1-800-424-9300* 39 Old Ridgebury Road
Routine: 1-800-PRAXAIR Danbury, CT 06810-5113

**Call emergency numbers 24 hours a day only for spills, leaks, fire, exposure, or accidents involving this product. For routine information, contact your supplier, Praxair sales representative, or call 1-800-PRAXAIR (1-800-772-9247).*

2. Hazards Identification

EMERGENCY OVERVIEW

DANGER! Poisonous, flammable liquid and gas under pressure.
May be fatal if inhaled.
Causes severe blood, liver, kidney, and other organ damage.
Symptoms may be delayed.
May form explosive mixtures with air.
May ignite on contact with air.
Self-contained breathing apparatus and protective clothing must be worn by rescue workers.
Under ambient conditions, this is a colorless gas with a pungent odor.

OSHA REGULATORY STATUS: This material is considered hazardous by the OSHA Hazard Communications Standard (29 CFR 1910.1200).

POTENTIAL HEALTH EFFECTS:

Effects of a Single (Acute) Overexposure

Inhalation. May be fatal if inhaled. Severely irritates the upper respiratory tract, resulting in coughing, choking, and a feeling of fullness in the center of the chest. Delayed symptoms may include pulmonary edema (fluid in the lungs), massive hemolysis (breakdown of red blood cells), cyanosis (bluish lips and fingernails due to oxygen-poor blood), kidney failure, liver damage, and liver and spleen enlargement.

Skin Contact. May cause slight discomfort from a slight irritation seen as a mild local redness.

Swallowing. A highly unlikely route of exposure. This product is a gas at normal temperature and pressure.

Copyright © 1984, 1988, 1996-1997, 2003, 2007, Praxair Technology, Inc.
All rights reserved.

A vertical line in the left margin indicates revised or new material.

Eye Contact. Irritates the eyes, causing redness and swelling of the conjunctiva with excess blinking and tear production.

Effects of Repeated (Chronic) Overexposure. May damage the kidneys, liver, blood cells, and respiratory tract.

Other Effects of Overexposure. None known.

Medical Conditions Aggravated by Overexposure. Breathing gas may aggravate asthma and inflammatory or fibrotic pulmonary disease.

CARCINOGENICITY: Germane is not listed by the NTP, IARC, or OSHA.

POTENTIAL ENVIRONMENTAL EFFECTS: None known. For further information, see section 12, Ecological Information.

3. Composition/Information on Ingredients

See section 16 for important information about mixtures.

COMPONENT	CAS NUMBER	CONCENTRATION
Germanium tetrahydride	7782-65-2	>99%*

**The symbol > means "greater than."*

4. First Aid Measures

INHALATION: If inhaled, or on suspicion of any exposure, immediately remove to fresh air. If not breathing, give artificial respiration with supplemental oxygen. If breathing, give oxygen. Call a physician, even if no symptoms are present.

SKIN CONTACT: Immediately flush skin with plenty of water while removing contaminated clothing and shoes. Call a physician. Wash clothing before reuse.

SWALLOWING: An unlikely route of exposure. This product is a gas at normal temperature and pressure.

EYE CONTACT: Immediately flush eyes thoroughly with water for at least 15 minutes. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly. See a physician, preferably an ophthalmologist, immediately.

NOTES TO PHYSICIAN: *Germane is a hemolytic agent capable of causing hemoglobinuria and liver disease. Keep under medical observation. Symptoms may be delayed one or two days. Consider any exposure as a potentially toxic dose.*

Contact the Poison Control Center in your area for additional information on patient management and follow-up.

5. Fire Fighting Measures

FLAMMABLE PROPERTIES: Gas may ignite spontaneously in air. Forms explosive mixtures with air and oxidizing agents.

SUITABLE EXTINGUISHING MEDIA: CO_2, dry chemical, water spray, or fog

PRODUCTS OF COMBUSTION: Germanium dioxide

PROTECTION OF FIREFIGHTERS: DANGER! Poisonous, flammable liquid and gas under pressure (see section 3). Evacuate all personnel from danger area. Do not approach area

without self-contained breathing apparatus and protective clothing. Immediately cool cylinders with water spray from maximum distance, taking care not to extinguish flames. Solid streams of water may be ineffective. Remove ignition sources if without risk. If flames are accidentally extinguished, explosive reignition may occur. Reduce toxic vapors with water spray or fog. Stop flow of gas if without risk, while continuing cooling water spray. Remove all containers from area of fire if without risk. Allow fire to burn out. On-site fire brigades must comply with OSHA 29 CFR 1910.156.

Specific Physical and Chemical Hazards. Heat of fire can build pressure in cylinder and cause it to rupture. To provide maximum containment up to cylinder burst pressure, germane cylinders are not equipped with a pressure relief device. No part of cylinder should be subjected to a temperature higher than 125°F (52°C). If leaking or spilled germane catches fire, do not extinguish flames. Flammable and toxic vapors may spread from leak and could explode if reignited by sparks or flames. Explosive atmospheres may linger. Before entering area, especially confined areas, check with an appropriate device. Backflow into cylinder may cause explosion.

Protective Equipment and Precautions for Firefighters. Firefighters should wear self-contained breathing apparatus and full fire-fighting turnout gear.

6. Accidental Release Measures

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:

DANGER! Poisonous, flammable liquid and gas under pressure.

Personal Precautions. Immediately evacuate all personnel from danger area. Do not approach area without self-contained breathing apparatus and protective clothing. Gas forms explosive mixtures with air (see section 5). Toxic, flammable vapors may spread from spill. Before entering area, especially a confined area, check atmosphere with an appropriate device. Remove all sources of ignition if without risk. Reduce vapors with fog or fine water spray. Prevent runoff from contaminating surrounding environment. Shut off flow if without risk. Ventilate area of leak or move cylinder to well-ventilated area.

Environmental Precautions. Prevent waste from contaminating the surrounding environment. Keep personnel away. Discard any product, residue, disposable container, or liner in an environmentally acceptable manner, in full compliance with federal, state, and local regulations. If necessary, call your local supplier for assistance.

7. Handling and Storage

PRECAUTIONS TO BE TAKEN IN HANDLING: May be fatal if inhaled. Do not breathe gas. Do not get vapors or liquid in eyes, on skin, or on clothing. Keep away from heat, sparks, or open flame. Keep away from oxidizing agents and from other flammables. Have safety showers and eyewash fountains immediately available. Protect cylinders from damage. Use only spark-proof tools and explosion-proof equipment. Use a suitable hand truck to move cylinders; do not drag, roll, slide, or drop. Electrical equipment must be non-sparking or explosion-proof. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. Never insert an object (e.g., wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. Open valve slowly. Close valve after each use; keep closed even when empty. If valve is hard to open, discontinue use and contact your supplier.

PRECAUTIONS TO BE TAKEN IN STORAGE: Store and use with adequate ventilation in closed systems. Separate germane cylinders from oxygen and other oxidizers by at least 20 ft (6.1 m) or use a barricade of noncombustible material. This barricade should be at least 5 ft (1.53 m) high and have a fire resistance rating of at least ½ hour. Firmly secure cylinders upright to keep them from falling or being knocked over. Screw valve protection cap firmly in place by hand. Store only where temperature will not exceed 125°F (52°C). Store full and empty cylinders separately. Use a first-in, first-out inventory system to prevent storing full cylinders for long periods. Post "No Smoking or Open Flames" signs in storage and use areas. There must be no sources of ignition. All electrical equipment in storage areas must be explosion-proof. Storage areas must meet national electric codes for Class 1 hazardous areas.

RECOMMENDED PUBLICATIONS: For additional information on storage, handling, and use of this product, see NFPA 55, *Standard for the Storage, Use, and Handling of Compressed and Liquefied Gases in Portable Cylinders*, published by the National Fire Protection Association. Also see Praxair publication P-14-153, *Guidelines for Handling Gas Cylinders and Containers*. Obtain from your local supplier.

8. Exposure Controls/Personal Protection

COMPONENT	OSHA PEL	ACGIH TLV-TWA (2007)
Germanium tetrahydride	N.E.*	0.2 ppm

*N.E.–Not Established.

TLV-TWAs should be used as a guide in the control of health hazards and not as fine lines between safe and dangerous concentrations.

IDLH = Not available.

ENGINEERING CONTROLS:

Local Exhaust. Inadequate

Mechanical (General). Inadequate

Special. A canopy type of forced-air fume hood equipped with an explosion-proof device is preferred.

Other. Not applicable.

PERSONAL PROTECTIVE EQUIPMENT:

Skin Protection. Wear work gloves when handling cylinders; neoprene where contact with product is possible. Metatarsal shoes for cylinder handling and protective clothing where needed. Select per OSHA 29 CFR 1910.132 and 1910.133. Regardless of protective equipment, never touch live electrical parts.

Eye/Face Protection. Wear safety glasses when handling cylinders. Select per OSHA 29 CFR 1910.133.

Respiratory Protection. Use an air-supplied respirator or a full-face, positive-pressure, self-contained breathing apparatus. Respiratory protection must conform to OSHA rules as specified in 29 CFR 1910.134. Select per OSHA 29 CFR 1910.134 and ANSI Z88.2.

9. Physical and Chemical Properties

APPEARANCE:	Colorless gas
ODOR:	Pungent
ODOR THRESHOLD:	Not available.
PHYSICAL STATE:	Gas at normal temperature and pressure
pH:	Not applicable.
MELTING POINT at 1 atm**:**	-266.6°F (-165.89°C)
BOILING POINT at 1 atm**:**	-126.67°F (-88.15°C)
FLASH POINT (test method)**:**	Not available.
EVAPORATION RATE (Butyl Acetate = 1)**:**	Not applicable
FLAMMABILITY:	Flammable
FLAMMABLE LIMITS IN AIR, % by volume**:**	**LOWER:** Unknown **UPPER:** Unknown
LIQUID DENSITY at 77°F (25°C)**:**	53.6 lb/ft^3 (859 kg/m^3)
VAPOR PRESSURE at 70°F (21.1°C)**:**	594.6 psia (4099.62 kPa, abs)
VAPOR DENSITY at 70°F (21.1°C) and 1 atm**:**	01982 lb/ft^3 (3.174 kg/m^3)
SPECIFIC GRAVITY (H_2O = 1) at 19.4°F (-7°C)**:**	Not available.
SPECIFIC GRAVITY (Air = 1) at 1 atm**:**	2.646
SOLUBILITY IN WATER 68°F (20°C)**:**	Negligible
PARTITION COEFFICIENT: n-octanol/water:	Not available.
AUTOIGNITION TEMPERATURE:	Not available.
DECOMPOSITION TEMPERATURE:	536°F (280°C)
PERCENT VOLATILES BY VOLUME:	100
MOLECULAR WEIGHT:	76.642
MOLECULAR FORMULA:	GeH_4

10. Stability and Reactivity

CHEMICAL STABILITY: ☒ Unstable ☐ Stable

CONDITIONS TO AVOID: Temperatures in excess of 536°F (280°C).

INCOMPATIBLE MATERIALS: Air, oxidizing agents, halogens, halogenated compounds.

HAZARDOUS DECOMPOSITION PRODUCTS: Germanium, germanium oxides, hydrogen.

POSSIBILITY OF HAZARDOUS REACTIONS: ☒ May Occur ☐ Will Not Occur

Thermal decomposition may produce germanium, germaninum oxides, and hydrogen.

11. Toxicological Information

ACUTE DOSE EFFECTS: LC_{50} = 622 ppm, 1 hr, rat

STUDY RESULTS: None known.

12. Ecological Information

ECOTOXICITY: No known effects.

OTHER ADVERSE EFFECTS: Germane does not contain any Class I or Class II ozone-depleting chemicals.

13. Disposal Considerations

WASTE DISPOSAL METHOD: Do not attempt to dispose of residual or unused quantities. Return cylinder to supplier.

14. Transport Information

DOT/IMO SHIPPING NAME: Germane

HAZARD CLASS: 2.3	**PACKING GROUP/Zone:** NA/B	**IDENTIFICATION NUMBER:** UN2192	**PRODUCT RQ:** None

SHIPPING LABEL(s):	POISON GAS, FLAMMABLE GAS *
PLACARD (when required):	POISON GAS, FLAMMABLE GAS *

**The words in the POISON GAS diamond are INHALATION HAZARD.*

NA=Not available.

SPECIAL SHIPPING INFORMATION: Cylinders should be transported in a secure position, in a well-ventilated vehicle. Cylinders transported in an enclosed, nonventilated compartment of a vehicle can present serious safety hazards.

Additional Marking Requirement: INHALATION HAZARD

Shipment of compressed gas cylinders that have been filled without the owner's consent is a violation of federal law [49 CFR 173.301(b)].

MARINE POLLUTANTS: Germane is not listed as a marine pollutant by DOT.

15. Regulatory Information

The following selected regulatory requirements may apply to this product. Not all such requirements are identified. Users of this product are solely responsible for compliance with all applicable federal, state, and local regulations.

U.S. FEDERAL REGULATIONS:

EPA (ENVIRONMENTAL PROTECTION AGENCY)

CERCLA: COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT OF 1980 (40 CFR Parts 117 and 302):

Reportable Quantity (RQ): None

SARA: SUPERFUND AMENDMENT AND REAUTHORIZATION ACT:

SECTIONS 302/304: Require emergency planning based on Threshold Planning Quantity (TPQ) and release reporting based on Reportable Quantities (RQ) of Extremely Hazardous Substances (EHS) (40 CFR Part 355):

TPQ: None
EHS RQ (40 CFR 355): None

SECTIONS 311/312: Require submission of MSDSs and reporting of chemical inventories with identification of EPA hazard categories. The hazard categories for this product are as follows:

IMMEDIATE: Yes **PRESSURE:** Yes
DELAYED: Yes **REACTIVITY:** Yes
FIRE: Yes

SECTION 313: Requires submission of annual reports of release of toxic chemicals that appear in 40 CFR Part 372.

Germane is not subject to reporting under Section 313.

40 CFR 68: RISK MANAGEMENT PROGRAM FOR CHEMICAL ACCIDENTAL RELEASE PREVENTION: Requires development and implementation of risk management programs at facilities that manufacture, use, store, or otherwise handle regulated substances in quantities that exceed specified thresholds.

Germane is not listed as a regulated substance.

TSCA: TOXIC SUBSTANCES CONTROL ACT: Germane is listed on the TSCA inventory.

OSHA: OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION:

29 CFR 1910.119: PROCESS SAFETY MANAGEMENT OF HIGHLY HAZARDOUS CHEMICALS: Requires facilities to develop a process safety management program based on Threshold Quantities (TQ) of highly hazardous chemicals.

Germane is not listed in Appendix A as a highly hazardous chemical. However, any process that involves a flammable gas on site in one location in quantities of 10,000 lb (4536 kg) or greater is covered under this regulation unless the gas is used as a fuel.

STATE REGULATIONS:

CALIFORNIA: Germane is not listed by California under the SAFE DRINKING WATER AND TOXIC ENFORCEMENT ACT OF 1986 (Proposition 65).

PENNSYLVANIA: Germane is subject to the PENNSYLVANIA WORKER AND COMMUNITY RIGHT-TO-KNOW ACT (35 P.S. Sections 7301-7320).

16. Other Information

Be sure to read and understand all labels and instructions supplied with all containers of this product.

OTHER HAZARDOUS CONDITIONS OF HANDLING, STORAGE, AND USE: ***Poisonous, flammable liquid and gas under pressure.*** Use piping and equipment adequately designed to withstand pressures to be encountered. ***May form explosive mixtures with air.*** Gas may ignite spontaneously in air. Ground all equipment. ***Prevent reverse flow.*** Reverse flow into cylinder may cause rupture. Use a check valve, backflow prevention device, or other protective device in any line or piping from the cylinder. ***Store and use with adequate ventilation at all times.*** Use only in a closed system with equipment purged with an inert gas or evacuated prior to discharge from cylinder. ***Never work on a pressurized system.*** If there is a leak, close the cylinder valve. Blow the system down in an environmentally safe manner in compliance with all federal, state, and local laws; then repair the leak. ***Follow safe practices when returning cylinder to supplier.*** Be sure valve is closed; then install valve outlet cap or plug, leak-tight. ***Never place a compressed gas cylinder where it may become part of an electrical circuit.***

Mixtures. When you mix two or more gases or liquefied gases, you can create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an industrial hygienist or other trained person when you evaluate the end product. Remember, gases and liquids have properties that can cause serious injury or death.

RECOMMENDED EQUIPMENT: In semiconductor process gas and other suitable applications, Praxair recommends the use of engineering controls such as gas cabinet enclosures, automatic gas panels (used to purge systems on cylinder changeout), excess-flow valves throughout the gas distribution system, double containment for the distribution system, and continuous gas monitors.

HAZARD RATING SYSTEMS:

NFPA RATINGS:		**HMIS RATINGS:**	
HEALTH	= 4	HEALTH	= 2
FLAMMABILITY	= 4	FLAMMABILITY	= 4
INSTABILITY	= 3	PHYSICAL HAZARD	= 3
SPECIAL	= ~~W~~		

STANDARD VALVE CONNECTIONS FOR U.S. AND CANADA:

THREADED:	CGA-350
PIN-INDEXED YOKE:	Not applicable.
ULTRA-HIGH-INTEGRITY CONNECTION:	CGA-632

Use the proper CGA connections. **DO NOT USE ADAPTERS.** Additional limited-standard connections may apply. See CGA pamphlet V-1 listed below.

Ask your supplier about free Praxair safety literature as referred to in this MSDS and on the label for this product. Further information can be found in the following materials published by the Compressed Gas Association, Inc. (CGA), 4221 Walney Road, 5th Floor, Chantilly, VA 20151-2923, Telephone (703) 788-2700, http://www.cganet.com/Publication.asp.

AV-1	*Safe Handling and Storage of Compressed Gases*
P-1	*Safe Handling of Compressed Gases in Containers*
V-1	*Compressed Gas Cylinder Valve Inlet and Outlet Connections*
—	*Handbook of Compressed Gases, Fourth Edition*

Praxair asks users of this product to study this MSDS and become aware of product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this MSDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.

The opinions expressed herein are those of qualified experts within Praxair, Inc. We believe that the information contained herein is current as of the date of this Material Safety Data Sheet. Since the use of this information and the conditions of use of the product are not within the control of Praxair, Inc., it is the user's obligation to determine the conditions of safe use of the product.

Praxair MSDSs are furnished on sale or delivery by Praxair or the independent distributors and suppliers who package and sell our products. To obtain current MSDSs for these products, contact your Praxair sales representative or local distributor or supplier, or download from www.praxair.com. If you have questions regarding Praxair MSDSs, would like the form number and date of the latest MSDS, or would like the names of the Praxair suppliers in your area, phone or write the Praxair Call Center (**Phone:** 1-800-PRAXAIR; **Address:** Praxair Call Center, Praxair, Inc., PO Box 44, Tonawanda, NY 14151-0044).

Praxair and the *Flowing Airstream* design are trademarks or registered trademarks of Praxair Technology, Inc. in the United States and/or other countries.

Praxair, Inc.
39 Old Ridgebury Road
Danbury, CT 06810-5113

Printed in USA