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

Product identification used on label
Product identifier
Phosphine ≥10% in Silane  MSDS ID : P005-A (Part Nbr: P005-A)

Details of the supplier of the safety data sheet
Air Liquide Advanced Materials
Post Office Box 5357
North Branch, New Jersey 08876-5357 USA
Voice: 908-231-9060 or 800-865-8249; Facsimile: 908-231-9063

Emergency telephone number
800-424-9300 or call collect 703-527-3887.

Other means of identification:

SECTION 2 Hazards identification

Classification of the chemical in accordance with paragraph (d) of §1910.1200;
GHS Hazard Symbols

GHS Classification
Flammable Gas Category 1
Gases under pressure - Compressed Gas
Acute Toxicity - Inhalation Gas Category 1
Skin Corrosion/Irritation Category 1B
Serious Eye Damage/Eye Irritation Category 1
Hazardous to the aquatic environment - Acute Category 1
Pyrophoric Gas Category 1

Signal Word
Danger

Hazard Statements
Extremely flammable gas.
Contains gas under pressure; may explode if heated.
Causes severe skin burns and eye damage.
Causes serious eye damage.
Fatal if inhaled.
Very toxic to aquatic life.
Catches fire spontaneously if exposed to air

Precautionary Statements
Keep away from heat/sparks/open flames/hot surfaces. – No smoking.
Do not breathe dust/fume/gas/mist/vapours/spray.
Wash thoroughly after handling.
Use only outdoors or in a well-ventilated area.
Avoid release to the environment.
Wear protective gloves/protective clothing/eye protection/face protection.
Wear respiratory protection.

Response
IF SWALLOWED: rinse mouth. Do NOT induce vomiting.
IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Con...
SECTION 3 Composition/information on ingredients

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>CAS #</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphine</td>
<td>7803-51-2</td>
<td>10</td>
</tr>
<tr>
<td>Silane</td>
<td>7803-62-5</td>
<td>30-60</td>
</tr>
</tbody>
</table>

SECTION 4 First aid measures

Inhalation

This is the primary route of exposure. Remove the affected person from the gas source or contaminated area. Note: 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 medical oxygen and appropriately trained personnel are available, administer 100% oxygen to the affected person. Summon an emergency ambulance. If an ambulance is not available, contact a physician, hospital, or poison control center for instruction. Keep the affected person warm, comfortable, and at rest while awaiting professional medical care. Monitor breathing and pulse continuously. If the affected person does not have a pulse, administer CPR.

Eyes

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.

Skin Contact

Flush with a copious stream of water while removing contaminated clothing. Continue flushing until the professional medical assistance arrives, but for no less than fifteen minutes. Assume the patient has also been exposed by inhalation and obtain professional medical assistance immediately. Treat thermal burns by flushing with cool water to assure that affected area is cool, then applying dry sterile dressings. If the patient is burned on the face, neck, head, or chest, assume that the airway may also have been burned and obtain professional medical assistance immediately.

Ingestion

Ingestion is not a commonly observed route of exposure to this material.

Note to Doctor

The reaction product of phosphine and moist air is phosphoric acid. Therefore, skin and eye burns should be treated as both thermal and chemical. The reaction product of silane with air is silicon oxide (silica). Therefore, skin and eye burns should be irrigated to the extent the physician feels necessary to remove the silicon oxide to an acceptable degree. Thereafter, treatment for burns is as usual.
SECTION 5 Firefighting measures

Flammability Summary

Pyrophoric

Extinguishing media

None.

Fire and/or Explosion Hazards

Vapors may be ignited by heat, sparks, flames or other sources of ignition at or above the low flash point giving rise to a fire (Class B). Vapors are heavier than air and may travel to a source of ignition and flash back.

Fire Fighting Methods and Protection

Do not enter fire area without proper protection including self-contained breathing apparatus and full protective equipment. Fight fire from a safe distance and a protected location due to the potential of hazardous vapors and decomposition products. 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 container or cylinder to burn.

Cool the container or cylinder, and surroundings with water from a suitable distance. Extinguishing the fire without stopping the flow of material 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 containers or cylinders exposed to fire, which may result in explosion, regardless of the its content.

Containers or cylinders with pressure relief devices (PRD's) may release their contents through such devices if the container or cylinder is exposed to fire.

Containers or 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 firefighting (bunker) gear is the minimum acceptable attire.

The need for proximity, entry, and flashover protection and special protective clothing should be determined for each incident by a competent firefighting safety professional.

Hazardous Combustion Products

Phosphorus oxide, which dissolves in water to form phosphoric acid., Silicon oxide (silica)

SECTION 6 Accidental release measures

Personal precautions, protective equipment and emergency procedures

Exposure to the spilled material may be irritating or harmful. Follow personal protective equipment recommendations found in Section VIII of this MSDS.

Additional precautions may be necessary based on special circumstances created by the spill including; the material spilled, the quantity of the spill, the area in which the spill occurred. Also consider the expertise of employees in the area responding to the spill. This material is a gas at atmospheric conditions. The only means of containment is the enclosure of the space into which the material is released. 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. As this material is a gas at atmospheric conditions, the only means of containment is the enclosure of the space into which the materials are released. Such containment is described in Section 7.

Prevent the spread of any spill to minimize harm to human health and the environment if safe to do so. Wear complete and proper personal protective equipment following the recommendation of Section VIII at a minimum. Dike with suitable absorbent material like granulated clay. Gather and store in a sealed container pending a waste disposal evaluation. Clean up consists of passing the entire gas volume of the
enclosure through appropriate exhaust gas treatment equipment (EGTE). Purge any 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. Most, but not all, releases of phosphine into air will autoignite. As all leaks might not react, consider the formation of ignitable or explosive mixtures with air. Purge the enclosure with a non-reactive gas, such as nitrogen, through the EGTE until an acceptably low level of contamination remains. 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 adjacent spaces, as a precaution against the spread or the release or subsequent explosion or fire.

SECTION 7 Handling and storage

Precautions for safe handling

Handle this material only in sealed, purged systems. The design of handling systems for hazardous materials is beyond the scope of this SDS, and should be performed by a competent, experienced professional. Consider the use of double-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 Gasses in Containers.

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 container to your system.

Never introduce any substance into a gas container. If you believe your container may have been contaminated, notify Air Liquide immediately. Provide as much information as possible on the nature and quantity of contamination. Vapors can ignite spontaneously if heated or subjected to static discharge. Discharge of vapors through vacuum pumps has been reported to cause “cracking” or “popping” sounds associated with ignition. Store containers in accordance with CGA P-1, Safe Handling of Compressed Gases in Cylinders, local building and fire codes, and other relevant regulations. Materials should be segregated by the hazards they comprise for storage.

Protect the containers from direct sunlight, precipitations, mechanical damage, and temperatures above 52°C (125°F).

Ship and store containers with the outlet plug and valve protective cap in place. Containers can generate pressure during storage. Release pressure in an inert atmosphere. 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 52 oC (125 oF). Ship and store cylinders with the outlet plug and valve protective cap in place.

Incompatible materials

Oxidizers, Halogens, Nitric acid, Oxidizing materials
SECTION 8 Exposure controls/personal protection

Control parameters

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>ACGIH TLV</th>
<th>ACGIH STEL</th>
<th>OSHA PEL</th>
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</thead>
<tbody>
<tr>
<td>Phosphine</td>
<td>0.3 ppm</td>
<td>1 ppm</td>
<td>0.3 ppm</td>
</tr>
<tr>
<td>Silane</td>
<td>5 ppm</td>
<td>Not Established</td>
<td>0.5 ppm</td>
</tr>
</tbody>
</table>

Engineering Measures

Local exhaust is required. Secondary containment, with appropriate exhaust gas treatment, is strongly encouraged and required in some jurisdictions.

Monitor the work area and the secondary containment 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.

Purge all primary containment systems with a nonreactive gas, such as nitrogen, before introducing this material. 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. Purge all primary containment systems with a nonreactive gas, such as nitrogen, before introducing this material.

Respiratory Protection

Respiratory protection may be required to avoid overexposure when handling this product. General or local exhaust ventilation is the preferred means of protection. Use a respirator if general room ventilation is not available or sufficient to eliminate symptoms. 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 container change. Air supplied breathing apparatus is required for response to demonstrated or suspected releases from the primary containment. 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.

Eye Protection

Wear chemically resistant safety glasses with side shields when handling this product. Do not wear contact lenses. 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. For handling sealed containers, wear safety glasses. When using respiratory protection as described above, use a face mask that provides splash and impact protection for the face and eyes.

Skin Protection

Not normally considered a skin hazard. Where use can result in skin contact, practice good personal hygiene. Wash hands and other exposed areas with mild soap and water before eating, drinking, and when leaving work. 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 from exposure to the material and from fire that may result from its release to the air. For response to demonstrated or suspected releases from the primary containment, the need for whole-body exposure protection should be determined by a competent safety professional. Wear appropriate gloves when handling sealed cylinders.

Gloves

Wear appropriate gloves when handling sealed cylinders. Wear appropriate (rubber, neoprene or nitrile) gloves when handling sealed containers. 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., container 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

Phosphine 15% in Silane

Revision Date 09-22-2015

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Safety Data Sheet FOR
Phosphine ≥10% in Silane

In an emergency, call CHEMTREC® at 800-424-9300 or collect 703-527-3887.

Color: Colorless
Odor: Strong garlic, decomposing fish, stale urine repulsive
Odor Threshold: No Data Available
pH: ND
Melting Point: -134 °C
Boiling Point: -112 °C
Evaporation Rate: No Data Available
Lower Flammable/Explosive Limit, % in air: 0.8
Upper Flammable/Explosive Limit, % in air: 98
Vapor Pressure: 35.6 bar at 20°C
Vapor Density: 1.53 g/L 1.342 g/L
Specific Gravity: 0
Autoignition Temperature: Approximately 38 °C
Solubility in Water: No Data Available
Octanol/Water Partition Coefficient: No Data Available
Viscosity: No Data Available
Volatile, % by weight: 0
Bulk Density: 0
Molecular Formula: PH3
Molecular Weight: 34 g/mol
Molecular Weight: 32.12 g/mol

SECTION 10 Stability and reactivity
Reactivity: No Data Available
Chemical stability: Stable under normal conditions. Diphosphine may also result from thermal decomposition. Silane is stable at room temperature and atmospheric pressure. Phosphine is stable at room temperature. At elevated temperature (above 150 C), phosphine decomposes to phosphorus and hydrogen. The diluents are stable.
Possibility of hazardous reactions: Oxidizers, Halogens, Nitric acid, Oxidizing materials
Conditions to avoid: Sparks, open flame, other ignition sources, and elevated temperatures. Temperatures above 55 oC, sources of ignition, exposure to air., Sources of ignition, exposure to air
Incompatible materials: Oxidizers, Halogens, Nitric acid, Oxidizing materials
Hazardous decomposition products: Phosphorus oxide, phosphorus, hydrogen, diphosphine., Silicon oxide, Hydrogen

SECTION 11 Toxicological information
Routes of Entry: The primary route of exposure is inhalation., At low concentration, At high concentrations, phosphine autoignites, creating a thermal burn risk., but reducing the toxic hazard., The primary route of exposure at low concentrations is inhalation., the material may ignite spontaneously in air, but reducing the toxic inhalation hazard.
Target Organs Potentially Affected by Exposure: Respiratory and cardiovascular systems. Neurological and gastrointestinal effects have also been reported, as have renal and hepatic toxicity.
Safety Data Sheet FOR
Phosphine ≥10% in Silane

In an emergency, call CHEMTREC® at 800-424-9300 or collect 703-527-3887.

Inhalation Irritation
Can cause minor respiratory irritation, dizziness, weakness, fatigue, nausea, and headache.

Inhalation Toxicity
Non-Toxic. Not known to cause systemic damage.

Skin Contact
No hazard in normal industrial use.

Skin Absorption
Minimal hazard in normal industrial use. May cause gastrointestinal discomfort.

Eye Contact
Mild eye irritant.

Ingestion Irritation
Ingestion is not an observed route of exposure to gaseous hazardous materials.

Ingestion Toxicity
Ingestion is not an observed route of exposure to gaseous hazardous materials.

Long-Term (Chronic) Health Effects
Carcinogenicity
None of the substances have been shown to cause cancer in long term animal studies. Not a carcinogen according to NTP, IARC, or OSHA.

Reproductive and Developmental Toxicity
No data available to indicate product or any components present at greater than 0.1% may cause birth defects.

Mutagenicity
No data available to indicate product or any components present at greater than 0.1% is mutagenic or genotoxic.

Inhalation
Upon prolonged and/or repeated exposure, no hazard in normal industrial use.

Skin Contact
Unlikely to cause irritation even on repeated contact.

Skin Absorption
Upon prolonged or repeated exposure, no hazard in normal industrial use.

Component Toxicology Data (NIOSH):

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>CAS Number</th>
<th>Inhalation (LC50 ppm - rat)</th>
<th>Ingestion (LD 50 mg/kg - rat)</th>
<th>Absorption</th>
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</thead>
<tbody>
<tr>
<td>Phosphine</td>
<td>7803-51-2</td>
<td>Inhalation LC50 (4h) Rat 11 ppm</td>
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<tr>
<td>Silane</td>
<td>7803-62-5</td>
<td>Inhalation LC50 (4h) Rat 9600 ppm</td>
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<td></td>
</tr>
</tbody>
</table>

SECTION 12 Ecological information

Overview
This material is not expected to be harmful to the ecology.

Mobility
No data

Persistence
No data

Bioaccumulation
No data

Ecological Toxicity Data
No data

SECTION 13 Disposal considerations

Waste Description for Spent Product
This material meets the criteria for an "acute hazardous waste".

Disposal Methods
Treat process and exhaust streams appropriately before release to the atmosphere.

Waste Disposal Code(s)
P096, D001 (ignitability)

SECTION 14 Transport information

UN number
UN1953

UN proper shipping name
COMPRESSED GAS, TOXIC, FLAMMABLE, N.O.S.

Technical Name
Phosphine 15% in Silane

Transport hazard class(es)
2.3, 2.1
Safety Data Sheet FOR
Phosphine ≥10% in Silane

In an emergency, call CHEMTREC® at 800-424-9300 or collect 703-527-3887.

Environmental hazards
Not a marine pollutant.

Toxic By Inhalation Zone: A

Via cargo aircraft shipments, IATA requirements: Forbidden
Via passenger aircraft shipments, IATA requirements: Forbidden
Via Air, IATA emergency response guide nbr: 10P
Via water, IMDG code: 2125-1
Via water, IMO Emergency Response Procedures (EmS Guide):
Via water, IMO Medical First Aid Guide (MFAG): F-D, S-U
USDOT Special Permits Air Liquide Advanced Materials is a party to for this product:

Domestic Transportation Labels

International Transportation Labels

Other Transportation Labels
No "Cargo only" label required. Not a marine pollutant.

SECTION 15 Regulatory information

TSCA Status All components in this product are on the TSCA Inventory.

<table>
<thead>
<tr>
<th>Chemical Name</th>
<th>CAS #</th>
<th>Regulation</th>
<th>% Range</th>
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<tbody>
<tr>
<td>Phosphine</td>
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<td>Phosphine</td>
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<td>SARA EHS</td>
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</table>

SECTION 16 Other information

Revision Date 09-22-2015

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