

Principal Investigator: _____

Date Approved: _____

This document covers basic chemical safety protocols (CSP) for silane and supplements the laboratory Chemical Hygiene Plan as appropriate. Additional lab-specific safety operating procedures for silane may also be required. The use of any silane is subject to pre-approval by the Principal Investigator (PI) and/or the designated Laboratory Responsible Safety Person. DO NOT USE ANY SILANE UNTIL YOU HAVE OBTAINED THE NECESSARY PRE-APPROVAL AND TRAINING.

Silane

Silane is a pyrophoric gas (i.e. it may spontaneously ignite when exposed to air) commonly used in semiconductor fabrication. However, it does not always ignite immediately upon exposure to the atmosphere. Lack of instantaneous ignition can lead to delayed ignition, resulting in fireballs or vapor cloud explosions, which can range in character from deflagration to detonation.



Personal Protective Equipment & Personnel Monitoring

**Lab Coat**

Wear a flame-resistant lab coat whenever working with silane. Wear a Nomex suit and hood whenever changing out silane cylinders.

**Nomex Suit****Gloves**

Wear fire gloves when changing out silane cylinders and for any operations where accidental release is a possibility.

**Eye Protection**

ANSI Z87.1-compliant safety glasses or safety goggles **and** a face shield.

**Face Shield**

Labeling & Storage

Silane must be stored in a gas cabinet or exhausted enclosure away from combustible materials, oxidizing substances, and ignition sources.

NPFA 55 requires that flammable gas cylinders in storage be separated from oxidizing gas cylinders by a minimum distance of 20 feet or by a noncombustible barrier at least five feet high and with a fire resistance rating of least one-half hour. Section 4650 requires the barrier to be at least 18 inches above the tallest cylinder.

Silane compressed gas cylinders should be double chained to the inner wall of the gas cabinet or a stable structure within an exhausted enclosure. The first chain should be 1/3 from the bottom of the cylinder and the second chain should be 1/3 from the top of the cylinder. Alternatively, use a cylindrical casing to secure the cylinder to the floor within the exhausted enclosure next to your experimental setup. Refer to American Society of Mechanical Engineers code for Process Piping, ASME B31.3, to select compliant piping.

What not to do: Do not use table/bench clamps for securing cylinders. Never store cylinders on transportation carts. Remove regulators from cylinders when not in use and replace with the safety cap. Never use a cylinder without a regulator. Never permit the gas to enter the regulator suddenly. Never try to stop a leak between a cylinder and regulator by tightening the union nut unless the cylinder valve has been closed first. Never strike an electric arc on the cylinder.

Cautions & Considerations

Use and store only in fully-sprinklered buildings.

Use only spark-proof tools and explosion-proof equipment.

Silane is transported with a vapor-tight cap over the threaded connector which must be removed in order to connect the regulator. If silane is trapped between the vapor-tight cap and main valve, it may ignite when the cap is removed. Extra care must be taken when removing this cap and fitting a regulator onto a silane cylinder, including the following procedure:

1. Operators should wear all appropriate PPE including fire gloves, Nomex suit or Firefighter turnout, face shield, earplugs, and safety glasses.
2. Operators should have a "buddy" equipped with the same PPE visually observing the operation and ready to assist if necessary.
3. Physically secure the cylinder away from other hazards.
4. Stand to the side of the cylinder valve outlet, then remove the plastic bag and the hold-down wire.
5. Confirm that the valve is closed tightly.
6. Position the cylinder to pull down with a wrench (a box wrench is preferred) when loosening the vapor-tight outlet cap.
 - a. Be aware that flames can come out of the leak-check hole in a Diameter Index Safety System (DISS) vapor-tight outlet cap.
7. Pull down slowly on the vapor-tight outlet cap and anticipate the possibility of a leak. Be ready to push up on the cap to reseal the system if a leak does occur.
 - a. If silane is behind a vapor-tight outlet cap, one of the following will occur: Immediately ignite (a "flamer"), or Not ignite at all, or Ignite after a delay (a "popper")
8. Once the cap has been removed, visually check the valve outlet surface for damage or debris. Never look directly into the outlet. Instead, use a dental mirror for visual inspection.

Silane is capable of forming metastable mixtures with air. In the event that a leak occurs without ignition, DO NOT attempt to close the cylinder. The closing of the valve can trigger an explosion. Instead, evacuate the area immediately and call 911.

Engineering Controls, Equipment & Materials

Fume Hood

If your protocol does not permit the dispensing of these materials into a fume hood, contact the Department of Environmental Health, Safety, and Sustainability (EHSS) to determine whether alternative engineering controls and/or additional respiratory protection is warranted.

Burn Box

Consult with EHSS, ehs@vanderbilt.edu, to determine if a burn box is necessary for your operations.

Housekeeping

Waste

If the vendor does not have a method to return/refill a cylinder, refer to the laboratory *Chemical Hygiene Plan* (Section 6.7) for information on proper chemical waste disposal procedures.

First Aid & Emergencies

Releases

Immediately notify others in the area of the release and evacuate the location where the release occurred. Notify your PI/Responsible Safety Person and call Vanderbilt University Public Safety (VUPS) at 615-421-1911 or use the Vandysafe app on your smart phone. Report any exposure through Risk and Insurance Management's Origami portal and mark that it occurred in research when prompted. Both VUPS and the Origami system will notify EHS of the incident. Remain on-site at a safe distance to provide detailed information to first responders.

Skin or Eye Contact

Without putting yourself at risk, move person into fresh air. Remove contaminated clothing and accessories; flush affected area with water for at least 15 minutes. Get medical attention immediately.

Inhalation

Without putting yourself at risk, move person into fresh air. Get medical attention immediately.

