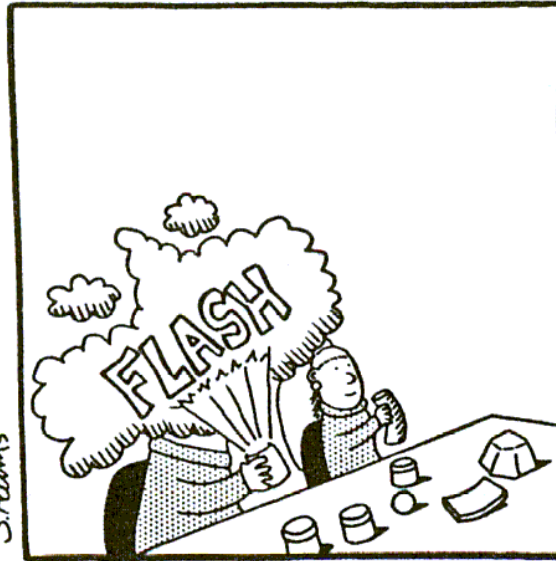
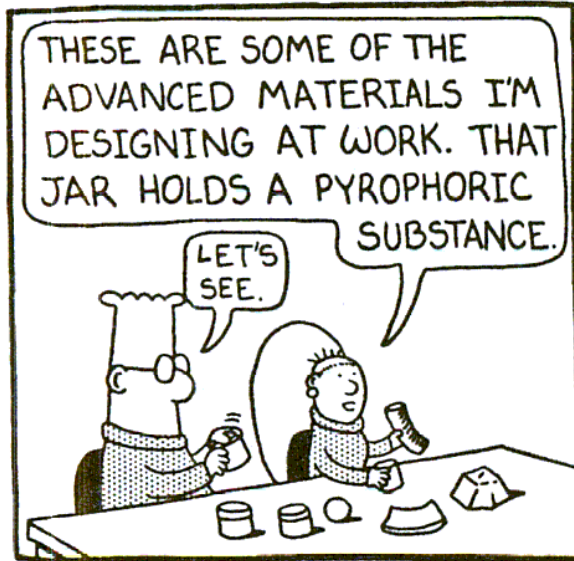


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Silane

What's the Big Deal?

Silane

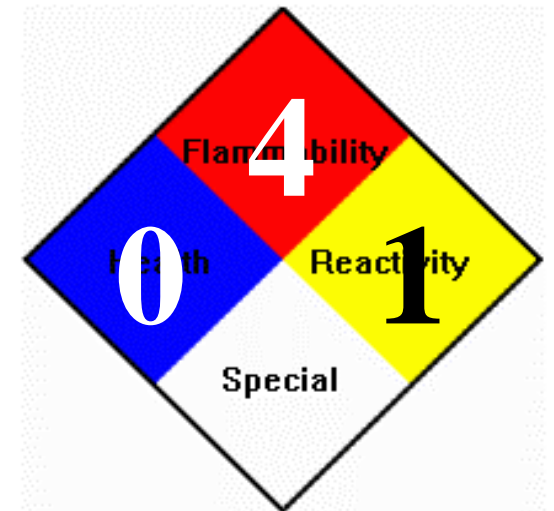


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Silane SiH₄

Pyrophoric

- Flammable Range 1.37-96%
- TLV = 5ppm
- High concentrations may not autoignite but may detonate
- Turns into Silicon Dioxide SiO₂
 - Crusting, powder
- Dichlorosilane, Trichlorosilane





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November 23, 2005

Taiwan Semiconductor Fab

THIS

Could Be YOUR Fab





























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Silane

Maintenance Activities

Silane Maintenance

- Routine bottle change procedures
- Troubleshooting bottle/cabinet problems
- PPE



CGA Pamphlet P-32

- A key finding of the SEMATECH study was that almost 30% of the Silane incidents occurred during cylinder change. For this reason and quality, the industry is moving to bulk supply to reduce the number of cylinder changes
- The Compressed Gas Association (CGA) spearheaded and funded the risk assessment and release testing of bulk Silane ISO Modules.
- The safety guidelines developed by these studies have been incorporated into CGA Silane pamphlet P-32, 2000 edition which is now referenced by many of the US Fire regulations for Silane Storage and Use.
- It currently undergoing ANSI balloting and will become CGA G-13 in 2006

Silane Cabinet Safety

- The key safeguard in a system is prevention of a leak
- If a leak should occur, it should be detected immediately and the system shutdown
- Studies have shown that the only effective control for a Silane leak is to dilute it as quickly as possible below the LFL of 1.37%. For safety reasons this has been reduced to 0.4% in a gas cabinet
- A Silane cylinder at 1,500 psig with a 0.010" RFO will initially flow at 2.5 cfm. To dilute this flow to 0.4% requires an exhaust of 750 cfm
- Studies have also shown that even with higher exhaust flow rates the cabinets if not designed properly will pocket the silane where it will develop a metastable mixture which could detonate. The standards require ventilation flow across all fittings of 200 fpm
- High pressure releases of Silane may not immediately ignite. A slowdown of the flow due to pressure decay or shutting off of the source will cause it to ignite. Flow disturbances or obstructions will also cause it to ignite

Best Practices - Silane Equipment and Use

● Prevention of Leaks and Reactions

- Use rigid, coiled pigtail that is all-welded for higher strength. No fittings or adaptors installed on pigtail. Don't use flexible hose pigtail.
- DISS cylinder connection with proper gaskets (don't reuse) and proper torquing (with torque wrench).
- Minimize number of fittings and use high-integrity components (non-packed valves and VCR fittings).
- Restrain cylinders during use.
- Metallic materials of construction rated for maximum pressures involved (no polymer lines). Metallic exhaust ducting (no Fiberglas or plastic ducts).
- Leak check system with inert gas at 110% of use pressure or maximum pressure before startup, after each cylinder change or after system maintenance.
- Co-axial delivery lines with leak detection on primary containment.
- System purging – automated purge and evacuation cycles with cycle times sufficient to purge dead ends and orifice areas. Inert gas trickle purge of pigtail and lines during disconnection. Dedicated inert purge gas supply.
- Continuous inert trickle purge of all vent lines to prevent silane reaction in lines prior to discharge to atmosphere or abatement system (burner).

Best Practices – Silane storage and Handling

- Both cylinder cap and outlet seal are tightly installed all times cylinder is not connected (including storage, handling, return shipment).
- Secure cylinder during storage and handling.
- Wear proper personal protective equipment depending on silane operations.
- Use a proper cart when moving cylinders.
- Protect storage area from the elements.
- Proper segregation of product hazard classes and full / empty cylinders. Limit silane storage quantity in same area (“nest”).
- Easy access and egress for personnel and emergency responders.
- Proper security.
- Good housekeeping.
- Use good inventory control (first in, first out).



Who: Chem Techs

When: Silane bottle change-out, cabinet maintenance, troubleshooting

PPE: Flame-resistant suits and hood, heat resistant gloves



Who: EPI Techs:

When: Exhaust material open to atmosphere

PPE: Flame-resistant cleanroom garments, safety glasses, face shield and FR gloves (use arc flash material)



Who: ERT

When: Silane emergency response

PPE: Aluminized suits, hood & gloves



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Emergency Response

Silane Monitoring & Response Strategy

- UV/IR flame detection and...
- Hydride detection - TLV 5ppm
 - Level 1 (warning – $\frac{1}{2}$ TLV) 2.5ppm
 - Chemical Services response?
 - ERT response?
 - Level 2 (Evacuation 1TLV)
 - ERT response?

Best Practices - Silane Equipment and Use

- Rapid Detection of Leaks with Shutdown
 - Gas detector and flame detector (UVIR) to cause automatic shutdown of a pneumatic silane cylinder valve and isolate leak right at the source (this protects against DISS connection leaks).
 - Remote shutdown signal capability away from hazardous usage area and/or facility Life Safety System.
 - Periodic retesting of critical interlocks and alarms to verify functionality.

Silane Emergency Response

Flame Showing

- Flame has been seen up to 3 feet long
- **Do NOT extinguish flame**
- (sprinklers to cool bottle not extinguish flame)
- SiO₂ crust will form and most likely close leak
 - Watch detection system for decrease/stop of hydride
 - Full PPE protection, close valve if possible
- Standard size bottle could take 4 hours to empty (where there is no VAC)
- **Remotely vent pigtail to thermal destruct unit** e.g., guardian, etc.
- Keep people out of the bunker/room
- Work with local FD to develop response plan



Silane Emergency Response

Flame Response PPE

- Nomex Suits
 - Operator burned wearing Nomex when trying to turn off leaking valve
- Aluminized suits, hood, leather gloves, hearing protection, or...
- Full fire/proximity suits

Silane Emergency Response

No Flame

- Hydride detection
- Crusting at leak
- Remote shut down through ACV, automated control valve
- Vent through thermal destruct unit
- Do NOT open cabinet
- Keep people out of room
- At 10 ppm, not significant (low level) remotely vent
- PPE: Aluminized suits, hoods, leather gloves?



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SESHA is giving away a free iPod, cash, and other prizes as part of our 2005-2006 membership campaign.



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WHAT DO YOU THINK?

| Forum | Topics | Posts | Last post |
|--|--------|-------|--|
| <input type="checkbox"/> Pro's and Con's of creating a full ERT | 1 | 3 | 2006-02-09 17:59:48 by mgordon |
| <input type="checkbox"/> ERT -- full time job or just an additional duty? | 2 | 15 | 2006-02-08 19:57:55 by safetyman |
| <input type="checkbox"/> When is a spill really a spill? <i>(Moderated by chemsaf)</i> | 2 | 12 | 2006-03-01 14:49:38 by chemsaf |
| <input type="checkbox"/> Would your company allow you to share incident information with SERF? | 1 | 19 | 2006-02-16 12:50:43 by Robert Barnes |
| <input type="checkbox"/> Should physical security be part of SERF's scope | 3 | 5 | 2005-07-07 10:54:16 by jay |
| <input type="checkbox"/> Trend Alert | 4 | 14 | 2006-02-28 19:40:51 by Scott Nacheman |

I HAVE A CONCERN ...

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|---|--------|-------|---|
| <input type="checkbox"/> How do you demonstrate the importance of safety/security issues to management? <i>(Moderated by bartbunz)</i> | 2 | 7 | 2006-02-09 18:12:45 by mgordon |
| <input type="checkbox"/> What are your major concerns regarding preparedness, response, or recovery? <i>(Moderated by bartbunz)</i> | 3 | 11 | 2006-02-07 10:13:00 by Robert Barnes |

Key Required Safety Features

- Flow Limiting (RFO and Excess Flow)
- Proper Ventilation
- Leak Test at Full Silane Pressure
- Proper Detection (Gas and Flame Detectors)
- Automatic Shutdown of Cylinder Valve on Alarm (with Remote Shutdown Capability)