



Silane Incident Notes

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Silane can easily be released without immediate ignition

This will almost always ignite when the flow is shutoff

FM Global found that Silane did not ignite in 11 out of 12 release tests at 33 psig from 1/8" line. Even at 7.8 psig

For a 1/4" line it was 70 psig

Of all the Pyrophoric Gases, Silane is the most unpredictable. When released into air, Silane will react in one of the following manner:

- Delayed Ignition (Explosion)

- No Ignition

- Immediate Ignition

This unpredictability has caused major incidents

In the last 30 years, a number of major incidents have occurred with Silane use.

- Release and detonation of gas cabinet

- Release and detonation of duct

- Release and Fire

- Explosion of Cylinder

- Reaction of Solid Byproducts

- Pressure Relief Device Leak

- Aluminum Cylinder rupture

Considerable testing has been done to better understand the behavior of Silane. CGA Pamphlet G-13 on Silane was developed based on bulk release testing, further testing to revised G13 was done in June 2011 and 2012.

Silane has been involved in a number of major incidents when it did not immediately ignite

Silane has been involved in more fatal accidents (12 fatalities in 25 years) than arsine, phosphine, diborane, etc put together)

While the frequency of a major event is 1×10^{-6} , the severity can be extreme

Significant Gas Cabinet Explosions (known)

- Germany, 1976 – 1 fatality

- Japan, 1989, 1 fatality & 1 injury (Leakage during cylinder purge)



Japan, Dec. 13, 1989 – 2 fatality & 2 injuries
US, Jan 1992 – 1 injury (Cylinder change)
US, Feb 7, 1996 – no injuries (Corroded Cylinder)
Japan, Dec. 21, 1996 – 1 fatality (Cylinder change)
US Dept of Energy, Date Unknown – no injuries
US, 2003, no injuries
US Jan 16, 2005, 2 injuries
Taiwan, Nov 23, 2005 – 1 fatality (cylinder change)
India, March 2007 – 1 fatality
China June 2009, 1 injury
China, 2010, 1 injury
China – 2011 – 3 injuries (cylinder change)

These incidents involved cylinder 50 liter or smaller and mostly were during or immediately after cylinder change

Silane incidents continue despite 40 years of training

Trying to remove the wrong cylinder

Mechanical connections such as VCR and DISS are mechanically weak

Leaks have occurred because of

- Twisting (Pigtail movement to remove cylinder)
- Impact (Bumping of fitting with tool)
- Improper torque
- Rapid Cooling (Rapid Expansion of high pressure)
- Bad gasket
- Reuse of gasket
- Double gasket
- No gasket
- Use of elastomer gasket and high pressure cold flow

Contamination of silane cylinder have occurred through the purge gas system

The Gollub incident in 1988 and Osaka University in 1991 were due to Nitrous Oxide. 5 fatalities

Best Practice is a separate high pressure purge cylinder for silane

Devalving a cylinder full of silane has occurred at least twice