



## Coaxial Tubing for Silane

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The value of using coaxial tubing for silane lines has been debated for many years. The original intent was to provide a high pressure containment barrier should the inner tube corrode from the product going through it or to protect the inner tube from the environment surrounding it. Silane is not a corrosive gas so the value of using coaxial tubing is questionable. The standards are more concerned with minimizing potential leak points therefore they require tubing to be metal with welded connections. If a mechanical connection is used they must be a higher leak integrity fitting such as a face metal seal type (VCR) which is enclosed in an exhausted enclosure. In some standards, coaxial tubing is mandated for highly toxic gases to provide better physical protection and in theory to prevent accidental or early detection of tubing breaches by routine maintenance activities. This has not prevented maintenance or others from cutting the wrong tube. The author is aware of arsine and silane coaxial lines being cut in error, in both cases the inner and outer tubes were quickly sliced through using an electric saw. Some facilities require a tubing cutter to be used therefore preventing the simultaneous penetration of the inner tube.

In the US there is no regulation or standard requiring silane supply tubing to be coaxial. The primary standard for silane is ANSI/CGA-G-13 "Storage & Handling of Silane and Silane Mixtures". Section 10.1.3 states:

### Secondary containment

Secondary containment of piping systems shall not be required for piping used to convey silane or silane mixtures that are neither toxic nor highly toxic. When secondary containment or coaxial piping or tubing is provided, the secondary containment shall be of metal construction that is rated to contain the maximum pressure expected based on system design under failure of the primary piping or tubing system.

NFPA 55 "Compressed Gases and Cryogenic Fluids Code", International Fire Code Chapter 64 "Pyrophoric Materials" and NFPA 318 "Standard for the Protection of Semiconductor Fabrication Facilities" all reference CGA G13. None require coaxial tubing for silane.

NFPA 318, 2012 edition recognized the use for corrosive gases but does not mandate the use.

8.3.2.1 Where double containment of highly corrosive gases is used, the use of combustible piping and a combustible outerjacket shall be permitted.

This was moved in the 2015 edition to the appendix which is explanatory material and no longer even recognizes its use for corrosive gases

A.7.1.3.3 If the distribution piping is of noncombustible construction, a combustible outer jacket can be used for secondary containment



The IFC in Chapter 50, “Hazardous Materials – General Provisions” mandates secondary containment for hazardous liquids and solids not gases. It is defined as

SECONDARY CONTAINMENT. That level of containment that is external to and separate from primary containment.

SEMI S18-1102 Standard: **Environmental, Health and Safety Guideline for Silane Family Gases Handling (2011 revision)** states in note 46,

13.3.2 Coaxial Piping see A3-3 Coaxial Piping

NOTE 82: Some jurisdictions require flammable silicon compound gas piping inside buildings to be of secondarily contained (coaxial) construction. Some believe there is little evidence that coaxial piping for these gases is appropriate, as long as non-welded fittings are within secondary enclosures. Coaxial piping may add substantial costs and other hazards which should then be addressed. However, pressurized, monitored, and interlocked coax lines provide a local warning to persons who accidentally damage the jacket. The sound of the escaping inert gas used to pressurize the jacket alerts the worker. The interlock alerts the facility of the breach, and may reduce the total amount of process gas released if the inner line is damaged.

A3-3.1 When coaxial piping is installed, the annular space should be pressurized with inert gas (for example, Nitrogen, Argon), purged, or maintained at a vacuum.

A3-3.1.1 If a purge method is used, the purge gases from the coaxial piping should be monitored with detectors for the flammable silicon compound in the inner piping. This detector should shut off the source when a leak is detected.

A3-3.1.2 If a pressure or vacuum method is used, the pressure or vacuum in this annular space should be monitored and should alarm at a constantly attended location when a change occurs. The pressure sensor should also shut off the flammable silicon compound gas at the nearest up-stream valve.

FM Global Property Loss Prevention Sheet 7-7 “Semiconductor Fabrication Facilities” 17-12 has no requirements for coaxial tubing. 2.2.12.12 states that connections should be kept to a minimum. FM Global Property Loss Prevention Sheet 7-108 Silane also has no requirement.

The California Toxic Gas Ordinance (TGO) mandates the use of coaxial tubing for corrosives like chlorine trifluoride but does not include silane. The California fire code supplement “SILANE GAS INSTALLATION SUPPLEMENT”, does not require coaxial tubing .

SEMI F6-92 Guide for secondary containment of hazardous gas piping systems is the only standard that requires coaxial tubing for silane and other gases. Section 6.3.3 mandates secondary containment for



pyrophoric materials. This standard is from 1992 and has not been updated. Doubtful that it is being used, it references the Uniform Fire Code (UFC) Article 80. The UFC was replaced by the IFC in 2000.

While no standard or regulation requires the use of coaxial tubing for silane, some semiconductor facilities have adopted the use of coaxial tubing as an expensive company “Best Practice”. This is of importance when the tubing run is the bulk supply system that has exterior runs that could be mechanically impacted by vehicles or construction.

Eugene Ngai

