ATMI

The Source of Process Efficiency™

VAC® - A Safer Silane Package

Summary of an

Independent Fault Tree Analysis by

Omicron Safety and Risk Technologies

and

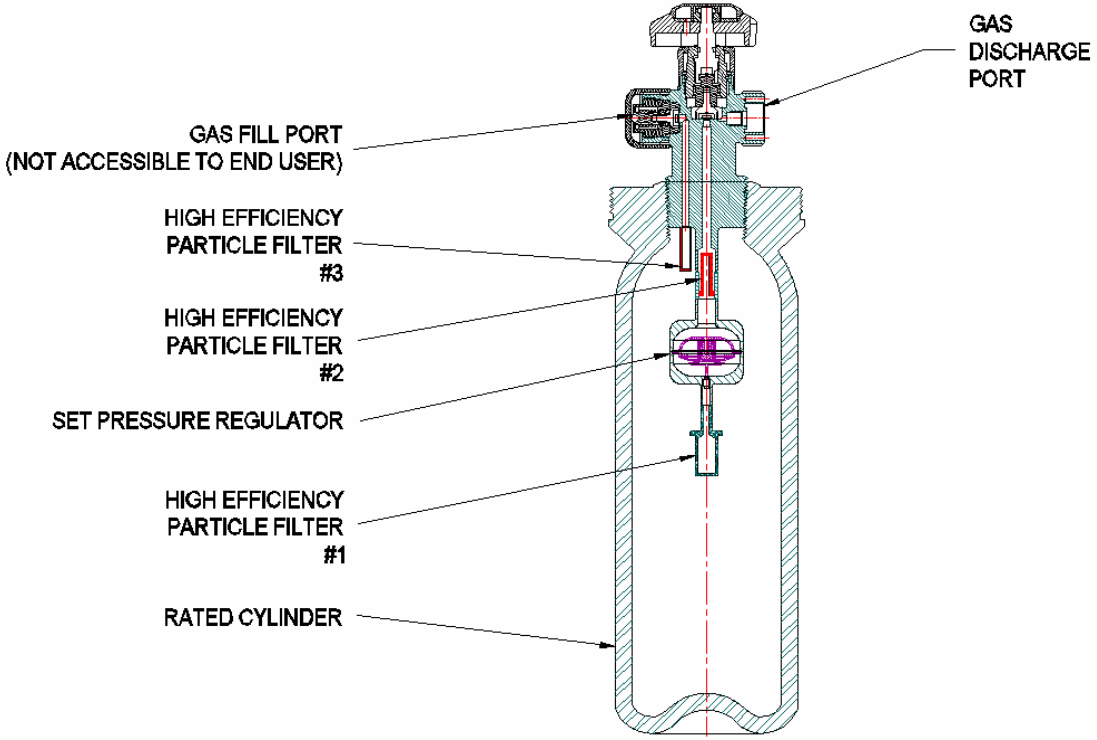
A look at controlled silane releases as tested at

Safety Management Services

Why VAC?

- **Safety**
  - **dramatic risk reduction**
- **Higher Cylinder Fill Densities**
  - **fewer cylinder changes/error opportunities**
- **Savings**
  - **heel recovery/less handling**
- **Data for Review**
  - **share performance data and expand existing industry knowledge/experience base**

VAC Schematic



For Gases: Pressure ⇒ Risk

- Risk is a function of cylinder delivery pressure.
- Pressure drives worst case release rates [WCR]: flow through an orifice.
- Sets exhaust rates and influences facilities decisions.

Silane Risk Analysis

Objective: Determine Relative Risk of Pre-Regulated vs. Standard Cylinders

- Compile All Possible Gas Release Scenarios
- Assign Frequencies of Occurrence
- Sum the Events and Determine Risk

$$\text{Risk} = \sum [\text{events x consequences}]$$

Independent Risk Assessment

Risk = (S, F, C)

Risk - product of frequency and consequence release from a gas delivery system

S - defines the potential accidents or release scenarios

F - defines the likelihood or probability of the scenario

C - defines the potential consequences for each scenario

Independent FTA Assessment Ratings

as provided by Omicron Safety and Risk Technologies

	Relative Risk
15 kg, VAC [600 Torr]	**0.0011**
◆ F = 3.54E-5, C = nil, R = 4.04E-5	
15 kg, VAC (100 psig)	**1.0**
◆ F = 4.43E-3, C = 8.2 slpm, R = 3.64E-2	
5 kg, 800 psig (High Pressure)	**12.5**
◆ F = 1.49E-2, C = 30.5 slpm, R = 4.54E-1	
10 kg, 1200 psig (High Pressure)	**19.2**
◆ F = 1.27E-2, C = 55 slpm, R = 6.98E-1	
15 kg, 1600 psig (High Pressure)	**22.6**
◆ F = 1.16E-2, C = 70.8 slpm, R = 8.21E-1	

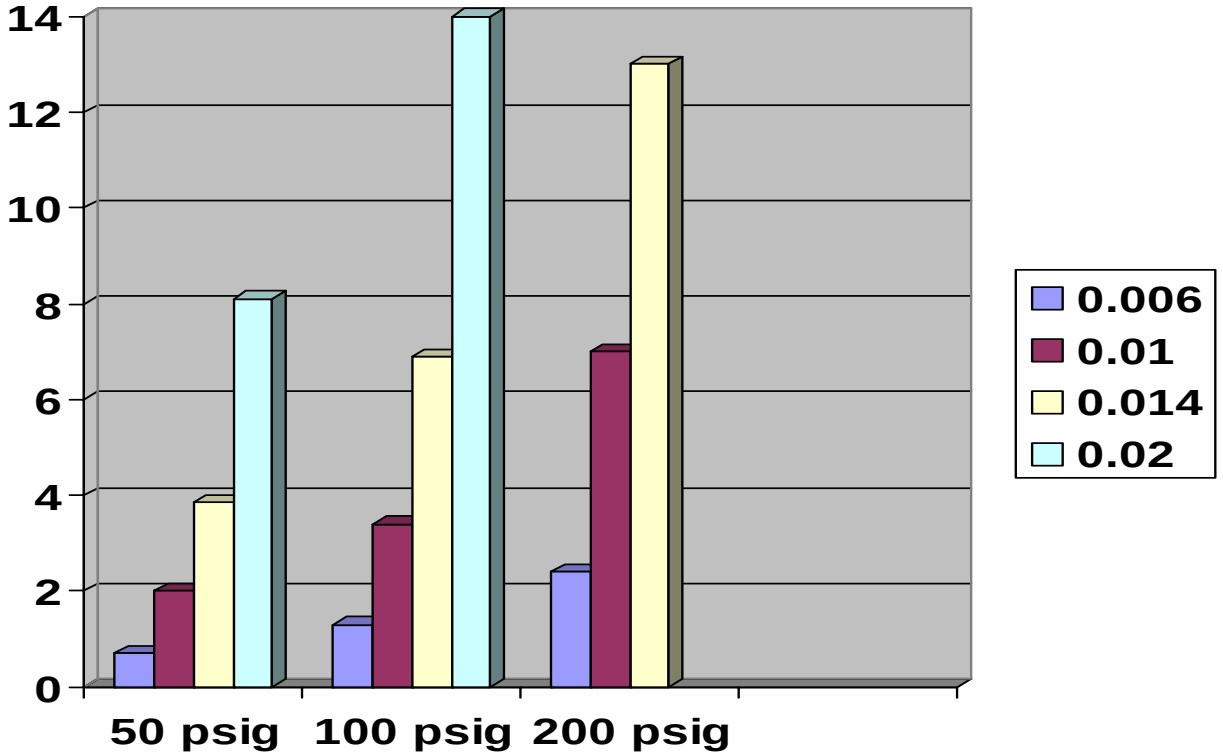
Cylinder Discharge Rate: Pressure/Orifice Driven

High Pressure Silane Cylinder **0.010", (0.25mm)** RFO

	pressure	flow
5 kg fill	800 psig	30.56 SLPM
10 kg fill	1200 psig	55.75 SLPM
15 kg fill	1600 psig	70.75 SLPM

Goal: Match Maximum Delivery Rate with Process Needs

Silane Flow (SLPM) at Reduced Pressure (100 psi) Through Various Orifices



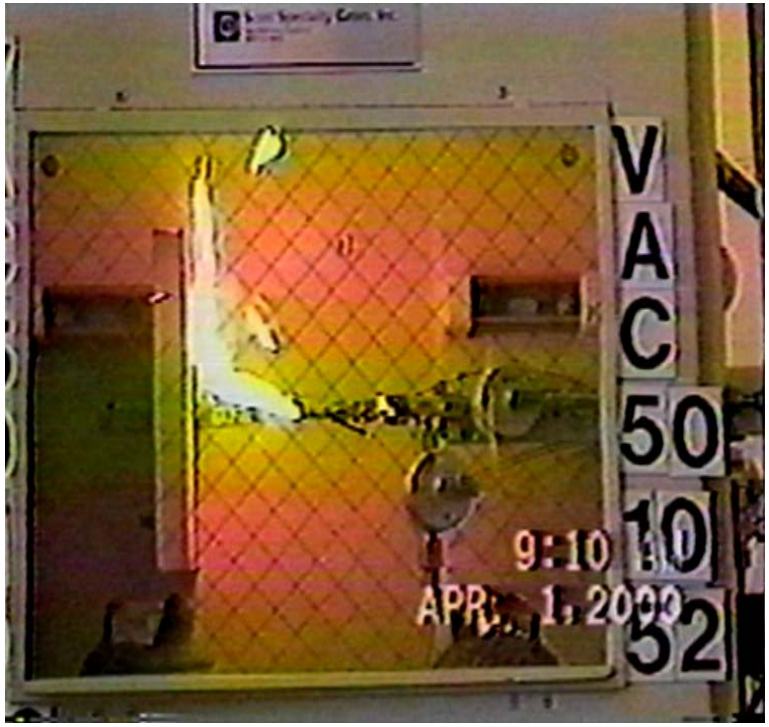
Silane Release Test Observations

conducted at Safety Management Systems, West Jordan, Utah

Goals for Test Program

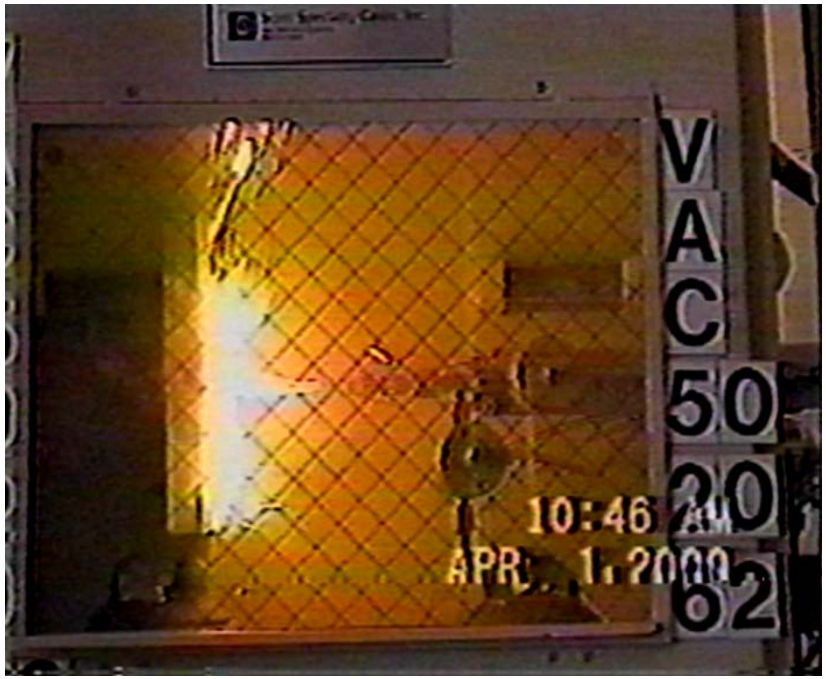
1. Product testing – functionality/reliability
2. Observe auto-ignition characteristics
3. Collect specific data for assessment
4. Document ‘reduced risk’ package technology

0.010” RFO

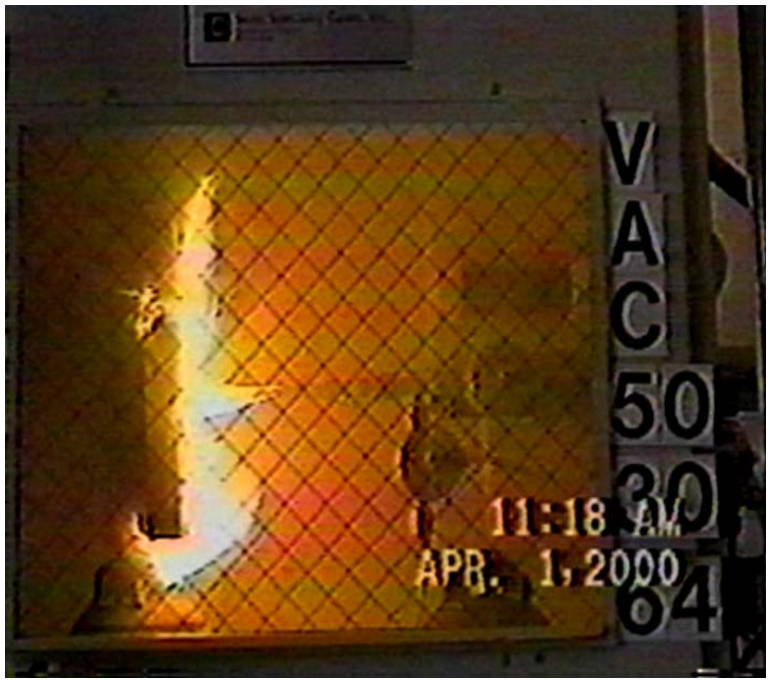


0.014” RFO

0.020” RFO



0.030” RFO



0.040” RFO