

## **TECHNICAL BULLETIN**

### **Overpressure Protection**

#### **Summary**

Overpressure protection is a safety concern with all gas handling equipment. The determination of what level of protection or method is required rests with the owner and operator of the gas handling equipment. This bulletin is intended to inform our customers of the relevant codes, published industry guidelines, identifiable risks, and Matheson policies. Matheson shall not be held liable for the interpretations provided. Matheson's recommendation is that every customer carefully review this document and make a decision appropriate for their installation. Corporate safety policies, local enforceable codes, and outside resources should be consulted as appropriate. The entire gas system must be considered, up to and including the process tool; this is beyond Matheson's normal scope of supply.

#### **Code Summation**

The most commonly adopted or referenced codes for semiconductor manufacturing facilities in the United States are the Uniform Fire Code (UFC) and Uniform Building Code (UBC). These codes are silent about many piping system design requirements including overpressure protection; however, they do make reference to the American National Standards Institute (ANSI) standards. There are also published industry guidelines from Semiconductor Equipment and Materials International (SEMI) that are a valuable reference.

ANSI/ASME B31.3 *Chemical Plant and Petroleum Refinery Piping* is the piping standard that most closely applies to specialty gas piping systems in semiconductor manufacturing facilities. However, there are many standard industry practices that follow the spirit of ANSI/ASME B31.3 but deviate from a literal interpretation of this standard. On the subject of overpressure protection, ANSI/ASME B31.3 states that "provision shall be made to safely contain or relieve any pressure to which the piping may be subjected". Specific requirements elsewhere in the standard only permit the use of a pressure relief valve or a rupture disk. These devices work effectively for chemical plants and petroleum refineries, but generally fall short of the high purity performance requirements of the semiconductor manufacturing industry.

SEMI F13 Guide for Gas Source Equipment is a published industry guideline that suggests two other solutions: transducer pressure sensing tied to a shutdown circuit or the use of secondary regulation with a warning alarm. Standard Semi-Gas Systems are designed to comply with SEMI F13; however, certain elements of the installation may be beyond our scope of supply. Auto-Purge<sup>®</sup> equipment from SGS complies with this guideline (see limitations below), and transducer based manual equipment complies in

most installations. Gauge based manual equipment does not comply with SEMI F13 unless a mechanical relief device is installed.

### **Risk Assessment**

Overpressure events can be caused by a wide variety of scenarios. Good engineering practice and ANSI codes recommend that consideration be given to a component failure, operator error, environmental factors, chemical reactions, and other reasonable factors. For specialty gas systems this generally requires the designer to be concerned with the system being exposed to full cylinder pressure, regardless of the cause.

There are two primary safety issues from the failure of a piping system from overpressurization; the uncontrolled release of hazardous gas and the generation of shrapnel. The provisions of the UFC address the issue of HPM release by locating all valves, fittings, or other potential leak sources inside of an exhausted enclosure with excess flow protection and toxic gas leak detection. The risk of shrapnel is the unique safety concern from an overpressure event on a specialty gas system.

The components used on standard SGS equipment that are not rated for full cylinder pressure include pressure gauges, pressure transducers, low pressure valves, and the low pressure portions of regulators. Of these components, only gauges have been identified to pose a risk of generating shrapnel from an overpressure failure.

### **Matheson Policy**

Matheson's policy regarding overpressure protection requirements depends on the type of equipment being supplied. This policy is intended to comply with SEMI F13 and deviates from a strict, literal interpretation of ANSI B31.3. The final determination of system design requirements rests with the customer. Four classes of equipment are summarized below; deviations from standard Semi-Gas Systems designs must be reviewed on a case-by-case basis.

- Auto-Purge System with Pressure Transducers: Auto-Purge controllers are designed to sense overpressure events and isolate the source of high pressure gas during normal operation; the limitations of these controllers (see below) are considered acceptable. Furthermore, no component failure has been identified as direct safety hazard as a result of over-pressurization. Therefore, the standard Semi-Gas Systems configuration for this type of equipment does not include a pressure relief device. Pressure relief valves are available as an option.
- Auto-Purge System with Pressure Gauges: Auto-Purge controllers are designed to sense overpressure events and isolate the source of high pressure gas during normal operation; the limitations of these controllers (see below) are considered acceptable.

However, pressure gauges do have the potential to cause personal injury in an overpressure event. Therefore, while the standard Semi-Gas Systems configuration

does not include a pressure relief device; the customer shall receive a copy of this bulletin when making decisions about overpressure protection. Pressure relief valves are available as an option.

- Manual Equipment with Pressure Transducers: Typical installations include secondary regulation at either a valve manifold box or the process tool and an LR-300 pressure display or GEMS-Simon type gas management system with configurable alarms to detect overpressures. Furthermore, no component failure has been identified as direct safety hazard as a result of over-pressurization. This type of installation provides the overpressure alarm feature endorsed by SEMI F13 but does not include an active form of protection. The standard Semi-Gas Systems configuration does not include a pressure relief device; the customer shall receive a copy of this bulletin when making decisions about overpressure protection. Pressure relief valves are available as an option.
- Manual Equipment with Pressure Gauges: This type of equipment does not have any form of overpressure protection and shall be supplied with a pressure relief valve as standard practice. Any customer requesting equipment supplied without such a device shall be required to supply written documentation holding Matheson harmless for all consequences of that decision.

*Auto-Purge Controller Limitations: Alarms are deactivated on Auto-Purge controllers in certain operating modes. Overpressure protection is not active during some steps in purge routines and at all times in manual modes of operation. Generally, cylinder pressure is not be present in the manifold during these modes of operation. Some SGS control systems permit alarm set-point adjustment by the user; Matheson strongly recommends that the alarm point never be set higher than 125 psig.*



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