

SEMI S15-0200 (Withdrawn 0707)

SAFETY GUIDELINE FOR THE EVALUATION OF TOXIC AND FLAMMABLE GAS DETECTION SYSTEMS

This safety guideline was technically approved by the global Environmental, Health and Safety Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on April 25, 2007. It was available at www.semi.org in June 2007 and on CD-ROM in July 2007. Originally published February 2000.

NOTICE: This document was balloted and approved for withdrawal in 2007.

1 Purpose

1.1 This guideline provides considerations for the evaluation of fixed gas detection systems used to monitor for safety of plant personnel, product and materials, the local environment and community. It provides an evaluation guide and reference sources appropriate to facilities and equipment where toxic and flammable gases are used and stored in gaseous or liquid form.

2 Scope

2.1 This guideline applies to toxic and flammable gas detection and addresses performance characteristics of gas detection systems.

2.2 It also describes several technologies available for detection of such gases and their performance characteristics.

NOTICE: This safety guideline does not purport to address all of the safety issues associated with its use. It is the responsibility of the users of this safety guideline to establish appropriate safety and health practices and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 This guideline does not include applicable fire and safety code regulations.

3.2 The gases or liquids which should be monitored are not listed.

3.3 This guideline does not suggest the appropriate levels of detectability. Such levels may be determined by reviewing accepted government and non-governmental agency standards, such as those promulgated by ACGIH, USEPA, and USOSHA.

3.4 Process related issues and corrective actions in the case of gas leaks are not discussed in this guideline.

3.5 This guideline makes no recommendation of any specific technology or manufacturer, nor does it provide installation and operation recommendations.

3.6 This guideline provides neither a comprehensive list of all gases, nor recommended areas for monitoring of toxic and flammable gases.

3.7 Not all known analytical methodologies for monitoring of toxic and flammable gases are described in this guideline.

4 Referenced Standards and Documents

4.1 SEMI Standard

SEMI E33 — Specification for Semiconductor Manufacturing Facility Electromagnetic Compatibility

5 Terminology

5.1 Abbreviations and Acronyms

5.1.1 ACGIH — American Conference of Governmental Industrial Hygienists

5.1.2 EMI — Electromagnetic interference

5.1.3 *EU* — European Union

5.1.4 *RFI* — Radio frequency interference

5.1.5 *USEPA* — United States Environmental Protection Agency

5.1.6 *USOSHA* — United States Occupational Safety and Health Administration

5.2 *Definitions*

5.2.1 *challenge gas* — a gas/chemical used to create a response in the gas detection system.

5.2.2 *conditioning* — the necessity to expose a gas/chemical sensor to the target gas/chemical to enable more rapid detection of that gas/chemical.

5.2.3 *fail-safe relay* — an alarm relay that is “fail-safe” returns to a safe operating condition when power is lost.

5.2.4 *filter lag* — relative to gas/chemical sensors, the time delay in the detection of a challenge gas/chemical due to the incorporation of a chemical, mechanical or electrical filter.

5.2.5 *latching* — relative to discrete alarm contacts, the alarm relay will not reset when the alarm condition ceases to exist. The alarm must be manually or remotely reset by operator interface.

5.2.6 *poisoning* — the interaction of a gas/chemical other than the target gas/chemical that temporarily or permanently disables the sensor from reliably detecting the presence of the target gas/chemical, or otherwise renders the device inoperable.

5.2.7 *span drift* — the percentage change in a known calibration point or span of a sensor or gas detection system over time.

5.2.8 *surrogate gas/chemical* — a substitute gas/chemical that is more benign than the gas/chemical it is replacing. This concept is used in the calibration of gas/chemical sensors when a highly toxic or corrosive challenge gas is undesirable. The surrogate gas/chemical will simulate the interaction with the sensor of the gas/chemical for which it is substituted.

5.2.9 *target gas* — the specific gas intended to be detected.

5.2.10 *zero drift* — the percentage change in the zero point or baseline of a sensor or gas detection system over time.

6 *Performance Characteristics*

6.1 The performance characteristics (the test results of which should be reliable and repeatable) are as identified below. These are factors one should consider in the evaluation of a gas detection system (from the point of detection through the output signal) for a specific application. A form for compiling a comparison table is provided as Appendix 1.

6.2 *Accuracy* — What is the stated accuracy of the system? Over what time period will that accuracy be valid (before calibration of the gas detection system is necessary)?

6.3 *Alarms* — What is the range for setting the alarms for each gas detection point? Are the alarms user-adjustable for set and reset time delays, latching or non-latching, normally open or closed, fail-safe or non fail-safe? How many alarm levels are available per detection point? Is there a fail alarm and what conditions will activate that alarm? Are the alarms dedicated to each detection point or are they common to a group of monitoring points?

6.4 *Calibration*

6.4.1 Is calibration required? If so, how often? How is it accomplished? Can it be done away from the point of detection or must it be done on site? What equipment is needed to perform the calibration? Can a surrogate gas be used for calibration? Can the calibration be accomplished by one individual? Is calibration accuracy affected by humidity?

6.4.2 During start-up, how much time must elapse before the gas detection system can be calibrated?

6.5 *Certifications and Classifications* — Does the gas detection system have the necessary performance or safety approvals for the specific application and location (e.g., UL, CE, SEMI S2)?

6.6 *Communications (serial)* — What types of serial communication are available from the gas detection system? What communication protocols are supported? Is it one-way or two-way communication?

6.7 *Conditioning Requirements* — Is the monitoring equipment always ready and able to detect a gas leak or must it be preconditioned on a periodic (regular) basis to ensure response times are achieved?

6.8 *Cost of Ownership* — What is the initial cost for the equipment and installation? What is the long-term cost of ownership of the system (consumables, calibration equipment, and labor)? What is the cost (hardware and installation) to expand the system (additional points of detection) and/or change the gas configuration?

6.9 *Data Archiving* — Are data documentation or data archiving system available as a part of the gas detection system?

6.10 *Diagnostics* — What system diagnostics are included? Can electrical or mechanical failures within the system be detected? Will a fault alarm be activated? Are diagnostics communicated over analog and/or digital outputs? Are faults archived by the gas detection system? Will an inoperative system be identified through a self-activated alarm (fail-safe)? Will the system alert the user that a calibration is required? Are communication outputs supervised?

6.11 *Display* — What local displays are available on the gas detection systems? Where is the display located? Does the display show gas concentration level with engineering units and identify active alarms with signal lights? Are other diagnostic and control functions displayed when activated? Is the display easy to read from a distance?

6.12 *Drift* — What is the zero and span drift over 30, 60, 90, and 180 days? Does the gas detection system compensate for drift?

6.13 *Environmental Conditions* — What are the temperature and relative humidity specifications for the gas detection system for normal operation as well as for storage of consumable parts? Could environmental changes such as quick humidity transients or temperature changes cause the gas detection system to spike or drift into an alarm condition?

6.14 *Equipment Failure* — Is the gas detection system capable of reporting all single point failures that disable detection? What failure mode disables both detection of gas and reporting failure?

6.15 *Expansion Flexibility* — Is the gas detection system capable of expansion to accommodate additional detection points? How easy is it to integrate into the user's system (hardware, installation, programming, etc.)?

6.16 *Extraction Detection Systems*

6.16.1 *Sampling Distance* — What is the maximum sampling distance for the gas detection system? Will all the gas entering the sample line at the point of detection reach the central monitor? What is the sample loss due to the challenge gas absorbing onto the sample tubing walls?

6.16.2 *Sample Cycle Time* — How frequently, if multiple points are sampled, is the same detection point surveyed by the extraction detection system, at the desired alarm level?

6.16.3 *Sample Contamination* — What, if any, is the potential for contamination of the sample line tubing and manifold equipment when multiple gases are monitored within the same extraction system? What combination of gases should be avoided due to chemical interaction on wetted materials?

6.17 *Filter Lag* — Does the gas detection system use any mechanical, chemical or electronic filters (for cross sensitivity, particles, etc.) which could slow the sampling response? If so, what lag time is expected for each gas type?

6.18 *Installation - Wiring Configuration* — How many wires are required per detection point? Can the system be wired in a highway configuration (bus, ring, star, etc.)? Are special barriers or grounds required to ensure no earth loop faults exist?

6.19 *Isolation* — Does the gas detection system require any special electrical isolation or grounding?

6.20 *Limits of Detection*

6.20.1 *Lowest Alarm Level* — What is the lowest alarm level setting for the gas detection system which will not activate due to sensor drift or insufficient signal to noise ratio?

6.20.2 *Limit of Detection* — What is the absolute lowest value that a sensor can detect, for each gas?