

GAS DETECTION IN SEMICONDUCTOR MANUFACTURING FACILITY MANAGERS & ENGINEERS GUIDE



Honeywell

TABLE OF CONTENTS

What To Know Before Choosing a Partner

Part I: The Evolution of Semiconductor Manufacturing

Understanding the Role of Semiconductors in Manufacturing

Semiconductor Manufacturing Trends

Part II: Understanding Gas Detection in Semiconductor Manufacturing

Why Gas Detection Matters

Gas Detection Challenges in Fabrication Facilities

Key Considerations for Reliable Gas Detection

Part III: Choosing a Semiconductor Manufacturing Detection Partner

Specifying Gas Detection Solutions

The Honeywell Gas Detection Ecosystem

Honeywell Resources and Support

Looking Ahead

WHAT TO KNOW BEFORE CHOOSING A PARTNER

Semiconductor fabrication facilities (fabs) are among the most complex and demanding industrial environments, requiring systems that meet stringent safety codes, ultra-high-purity standards and continuous, 24/7 operational reliability.

Within these environments, gas detection plays a critical role. Semiconductor manufacturing relies on toxic, flammable and asphyxiant gases used across fabrication and research processes. Even minor detection failures can put workers at risk, damage high-value tools, disrupt tightly controlled processes or trigger downtime.

Drawing on our extensive experience working closely with semiconductor manufacturers, this guide is designed to support facility managers and engineers in navigating the partner selection process to help provide reliable, safe and efficient gas detection in modern fabs.



PART I: THE EVOLUTION OF SEMICONDUCTOR MANUFACTURING

Semiconductor fabs operate at the intersection of extreme precision, high capital investment and rigorous regulatory oversight. For managers and engineers, the fundamentals are well understood. What continues to evolve are the operational pressures — driving higher yields, tighter process control and improved energy efficiency in increasingly complex environments.

As device architectures advance and regulatory and sustainability requirements intensify, fab operators are expected to make technology and infrastructure decisions that deliver measurable performance today while supporting long-term scalability, underscoring the importance of choosing a reliable, integrated and future-ready system that balances operational performance with long-term resilience.

THE ROLE OF SEMICONDUCTORS IN MANUFACTURING

Within a semiconductor fab, the systems that control automation, power and data are foundational to maintaining stable and predictable operations. As production requirements grow more demanding, these systems must deliver high reliability, precise control and efficient energy performance to protect yield, maximize uptime and support future expansion. Our solutions are designed to integrate seamlessly into fab environments, helping reduce operational risk while enabling flexibility and scalability as manufacturing needs evolve.

SEMICONDUCTOR MANUFACTURING TRENDS

This industry is driven by the need to balance continuous operations, advanced technology adoption and increasing safety and compliance demands. Key trends shaping semiconductor manufacturing today include:

- **Advanced process nodes and materials** are driving increased use of hazardous gases
- **Larger, more complex fabs** with distributed operations and global footprints
- **Workforce challenges**, including skill gaps and technician shortages
- **Stricter regulatory and EHS requirements** across regions
- **Pressure to maximize ROI on capital expenditures** while minimizing downtime
- **Increased digitalization and automation** to support continuous operations

PART II: UNDERSTANDING GAS DETECTION IN SEMICONDUCTOR MANUFACTURING



WHY GAS DETECTION MATTERS

Semiconductor manufacturing relies on a wide range of chemicals and process gases, many of which are flammable, toxic or asphyxiant. Even small leaks can pose serious risks to personnel, equipment and production continuity. Effective gas detection is essential not only for safety compliance but also for preventing costly downtime, protecting sensitive equipment and maintaining product quality in highly controlled fab environments.

GAS DETECTION CHALLENGES IN FABRICATION FACILITIES

Semiconductor fabs are highly complex environments where even small gas leaks can have serious consequences. Detection systems must operate seamlessly without disrupting production while providing reliable, real-time alerts.

KEY CHALLENGES INCLUDE:

Complex fab layouts and conditions

Intricate layouts, extremely low permissible exposure limits and interference from other chemicals, humidity and temperature variations make detection difficult.

Toxic gas risk

Fabs use hazardous gases while maintaining extremely high safety and purity standards.

Costly downtime

Even brief interruptions in production result in significant financial losses.

Workforce shortages

Limited staffing reduces the ability to manually inspect, maintain and monitor systems.

OEM sensor requirements

Equipment manufacturers demand ultra-high-purity, highly accurate sensors for mass-flow controllers and process tools.



GAS HAZARDS

Flammable

Hydrogen, silane and ammonia are widely used in semiconductor processes. These gases can ignite or explode if leaked, making rapid detection and automated response critical.

Toxic

Gases like arsine, phosphine and boron trichloride are highly toxic even at very low concentrations. Continuous monitoring promotes worker safety and regulatory compliance.

Asphyxiant

Simple asphyxiants include nitrogen, argon, helium, methane, propane and carbon dioxide. These gases or vapors can cause unconsciousness or death by suffocation.

KEY CONSIDERATIONS OF RELIABLE GAS DETECTION

Reliable gas detection goes beyond simply installing sensors. Effective systems must detect gases at extremely low concentrations; distinguish between similar chemicals to prevent false alarms; integrate seamlessly with ventilation, alarms and automated shutdown protocols; operate reliably in cleanroom environments; and comply with all safety and industry regulations.



Fast & Sensitive

Detect hazardous gases at extremely low concentrations in real time to provide immediate response before conditions become dangerous.



Accurate & Selective

Differentiate target gases from other chemicals and environmental interference to minimize false alarms that could disrupt production.



Fully Integrated

Connect with ventilation systems, alarms and automated shutdown protocols to provide seamless, automated risk mitigation.



Compliant & Certified

Meet industry standards and regulatory requirements for worker safety, environmental control and process integrity.



Durable & Low Maintenance

Operate reliably in cleanroom conditions with minimal downtime and maintenance.



PART III: CHOOSING A SEMICONDUCTOR MANUFACTURING DETECTION PARTNER

As this industry continues to increase in complexity, gas detection strategies must evolve to support safety, operational continuity and long-term performance. Choosing the right partner and approach is critical to aligning detection technologies with fab requirements, integrate seamlessly with existing systems and remain effective as processes and facilities scale.

SPECIFYING GAS DETECTION SOLUTIONS

Selecting the right gas detection solution starts with evaluating the risks associated with your manufacturing processes — flammable, toxic and/or asphyxiant gases. In your consideration, you should evaluate sensor types, sensitivities, placement, integration and local regulatory safety requirements.



Fixed Toxic & Flammable Gas Detection

Stationary sensors continuously monitor fabrication areas, tool enclosures, and critical infrastructure for toxic or flammable gases, providing early warning, automated alarms, ventilation activation and automated shutdowns when hazards are detected.



Portable Gas Detection for Personal Protection

Handheld or wearable devices alert operators in real time to hazardous gases during inspections, maintenance or tool operation. They complement fixed systems by providing flexibility and rapid response to localized hazards or unexpected leaks.



Flame Detection Devices

Specialized sensors detect flames or rapid temperature changes, enabling immediate response to fire hazards in high-risk semiconductor manufacturing areas to help protect personnel, prevent equipment damage and minimize production downtime.



Sensing Solutions for Real-Time Feedback

Advanced sensors deliver continuous, high-precision monitoring of gas levels and environmental conditions, providing actionable insights for process control, operational decision-making and hazard mitigation.



Software Platforms for Monitoring, Analytics and Response

Integrated digital platforms collect and consolidate data from gas detection devices, visualize trends, trigger automated alerts and support incident management, regulatory compliance and operational optimization.

THE HONEYWELL GAS DETECTION ECOSYSTEM

The conditions you operate in demand devices engineered for the highest levels of safety and purity. Every moment of unplanned downtime can cost hundreds of thousands of dollars.¹ These realities require gas detection systems designed to reduce downtime and extend workers' limited capacity.

Our gas detection ecosystem combines advanced devices, sensing solutions and software platforms to deliver a

connected approach to gas safety. Our solutions integrate fixed and portable gas detection, toxic gas monitoring and unified alarms, along with predictive diagnostics to reduce sensor drift, failures and technician workload.

By providing real-time monitoring, accurate sensing and comprehensive support, we help you protect personnel, maintain compliance and optimize operational performance.



HONEYWELL GAS DETECTION SOLUTIONS

Honeywell provides the sensing, safety and control technologies manufacturers need to protect people, optimize performance and modernize operations with confidence.

TYPE		PRODUCTS
FIXED <i>Permanently sited monitors</i>	Comprehensive range of flammable, toxic and asphyxiant gas detectors with options designed to meet the needs of all industries and applications; from low-cost compliance through to high-end solutions that minimize maintenance and maximize equipment uptime.	Midas®S2 Gas Detector: A compact, plug-and-play, fixed single-point gas transmitter with factory-calibrated sensor cartridges, clear display and front-access serviceability, designed for reliable detection of toxic, flammable and oxygen gases Vertex™ Multi-Point: The most advanced Chemcassette® software and optics technologies with up to 72 points of toxic gas detection Vertex™ Edge: Multi-point toxic gas system using Chemcassette® technology VC4 Toxic Gas Monitor: A colorimetric, four-point continuous gas monitoring system using Chemcassette® technology to provide highly accurate, interference-free ppb-level toxic gas detection with fast response, low maintenance and cost-effective operation ACM 150G2 Gas Monitoring System: A centralized FTIR-based gas monitoring system that detects up to 15 gases across 40 points with low detection limits, advanced HMI, self-diagnostics and flexible communications XNX™ Universal Gas Transmitter: Universal transmitter for multiple gas types; flexible and configurable for a range of gas sensor technologies
PORTABLE <i>Spot-reading detectors</i>	Wide variety of portable, on-the-go devices designed to meet the application monitoring needs of diverse industries, from low-cost, disposable compliance units to functionality-rich, high-specification devices.	SPM Flex: Extractive Single point SPM Flex gas detector based on Chemcassette® technology 4 Series: Industry standard to detect oxygen and toxic gases, carbon dioxide and hydrocarbons BW™ Solo: Lightweight, single-gas detector with Bluetooth connectivity, real-time monitoring and easy serviceability
FLAME <i>Flame detectors</i>	Designed to identify flames or rapid temperature changes in high-risk environments. Flame detection devices protect personnel, prevent equipment damage and minimize production downtime by providing immediate alerts and automated responses.	FS24X: Triple IR flame detector using Honeywell's WideBand IR™ infrared technology to detect hydrocarbon fires
SOFTWARE <i>Digital detection solutions</i>	Integrated digital platforms that collect, consolidate and analyze data from gas detection devices. Software solutions enable real-time monitoring, automated alerts, compliance reporting and operational optimization, promoting safety and efficiency across the facility.	Experion GMS: Real-time toxic gas monitoring with advanced alarms, centralized SCADA visibility, predictive analytics and high reliability to enhance safety and compliance Safety Suite: Comprehensive safety applications that enhance remote and emergency response with connected devices, analytics and automation

GAS DETECTION OUTCOMES

Effective gas detection delivers more than compliance — it provides tangible benefits for both safety and operations.



Life Safety and Security

Continuous monitoring of toxic, flammable and oxygen-deficient gases enhances worker protection and prevents hazardous incidents. Rapid alerts and automated responses help mitigate risk before it impacts personnel or equipment.



Operational Efficiency

Reliable detection improves production performance by helping reduce false alarms, minimizing downtime and providing actionable real-time insights. The result is higher uptime, better process stability and smoother, more efficient operations.

HONEYWELL RESOURCES AND SUPPORT

At Honeywell, we provide a single-source solution for gas detection products, technical service and ongoing support. With deep expertise in semiconductor gas detection, our team of application specialist engineers can quickly assess your needs and recommend solutions that meet your specific requirements.

Our comprehensive support network includes engineering, training certifications and flexible service packages for your business. This network is designed to provide efficient assistance to help you maximize uptime and keep operations running smoothly. We work closely with industry partners and customers to design products that meet real-world requirements, supported by world-class service throughout the full product lifecycle from initial inquiry through long-term maintenance.

LOOKING AHEAD

Implementing gas detection in your site requires deep industry expertise, collaborative support and a focus on future-ready operations. As the right partner, we deliver more than individual products by providing a connected ecosystem that promotes safety, efficiency and long-term operational success.

We bring this together through integrated, interoperable detection systems and dedicated support teams that work with engineers and facility managers to build safer and more resilient semiconductor fabs. From initial risk assessment through ongoing maintenance, our end-to-end support helps optimize systems for process continuity, regulatory compliance and operational efficiency, keeping your facility prepared for evolving demands.



1. Silicon Semiconductor, "[Advanced fabs require more innovative facility services for efficiency, reliability and resiliency](#)," Joseph Cestari and Neha Dhingra, June 5, 2025.

For more information
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