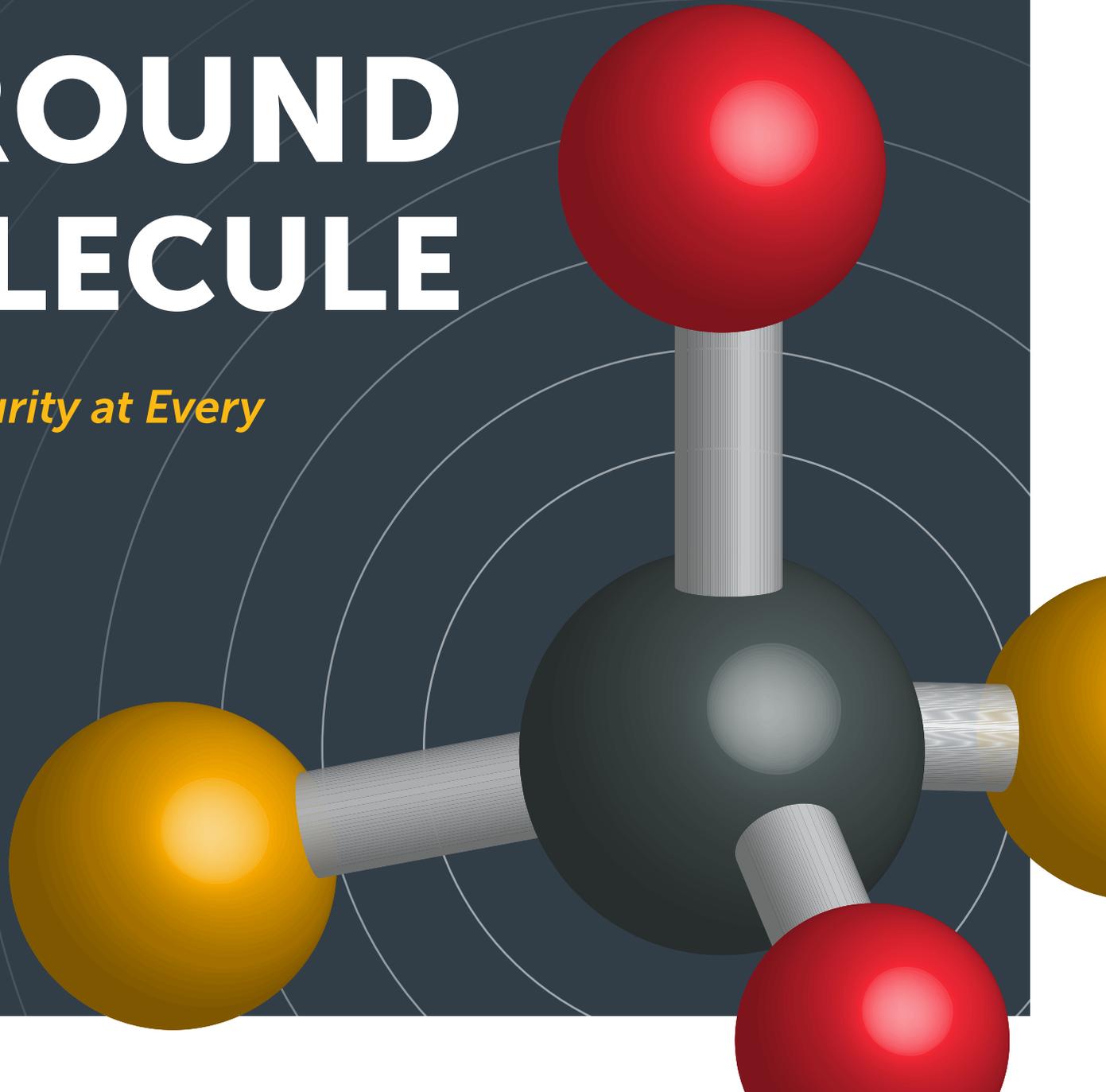


# SURROUND

# THE MOLECULE

*Upholding Gas Purity at Every  
Phase of Delivery*





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**Pure gases power innovation.** From semiconductor chips used to power mobile devices and computers to fuel cells used to power vehicles and buildings, high and ultra high purity gases are at the core of processes used to create and advance these products which the world depends on today.

The challenge lies in upholding process integrity in these precision-driven applications, as they are most susceptible to compromise from even the slightest process inconsistencies. A trace contaminate entering the gas stream poses great risk to end-product quality and yield—meaning that the molecule must be protected.

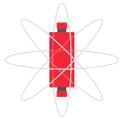
For manufacturing and fabrication plants, this protection must permeate every phase where gases are used and wrap the process from end to end—because while your ability to uphold gas molecule purity starts with the quality of your gas delivery equipment, it certainly does not end there.

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In fact, we consider there to be **8 Rings of Full-Circle Purity**. Each works together in a holistic manner to ensure application gases remain pure, surrounding the molecule with many layers of protection. **Let's explore each ring, and what your gas delivery partner needs to meet the standard.**



# The 8 Rings of Full-Circle Purity



## RING 1

### GAS PURIFICATION

The gas purifier is truly the epicenter of purity, placed within and as part of the larger gas delivery system to eliminate process-harming contaminants at the molecular level. Purification fill materials vary depending on the gases being purified and the impurities that need to be removed, down to as low as the one part per trillion (pptv) level. Therefore your partner should have **the portfolio of purifiers—from heated getters to catalysts for reactive gases to absorbers for moisture and hydrocarbon removal**—needed to flexibly support the breadth of your gas purification requirements, at the volume and flow rates your process requires.



## RING 2

### GAS DELIVERY EQUIPMENT

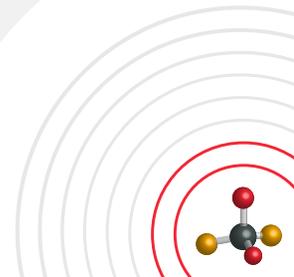
The ability to maintain gas quality is equally dependent on the materials used to construct your gas delivery system's internal components, to **avoid the chance of particle impurities from those components contaminating the gas stream**. The system's surface finish roughness average (Ra) should be low enough to meet the standard for the type of gas it must handle. For example, electro-polished internal components are needed for ultra high purity gas applications. It is also imperative the system be quality- and leak-tested and purged of unwanted moisture, particles, oxygen, and hydrocarbons.

## *It all comes down to* **THE GAS DELIVERY SYSTEM**

To protect your gas molecules from the inside out, you need a complete gas delivery system that is tightly integrated and leaves no room for contaminant infiltration. Working with a single-source provider, who can offer everything from the cabinet to the controller to the purifier, will avoid compatibility issues across components and ensure all elements fit seamlessly together to shield your gas from compromise.



**Applied Energy Systems (AES)' SEMI-GAS® line of ultra high purity gas delivery systems is SEMI S2 certified**, affirming it upholds the most stringent safety and performance standards set forth by SEMI® in semiconductor manufacturing—for example an internal material component finish of 10 Ra maximum.



# The 8 Rings of Full-Circle Purity

## RING 3 LINES OF GAS DELIVERY

Tangential to the gas delivery system but equally important when it comes to gas purity is the process piping that carries the gas from its source to the point of use. This is a critical phase where once-pure gas can pick up contaminants as it flows through the lines. **Process piping therefore must be constructed of material that will not itself leach impurities, and has to be installed in a way that is optimized for the environment in which the gases are being transported.** Ceiling-mounted piping, for example, will have much different installation and maintenance requirements than underground runs, with considerations for connections, quality testing, and leak detection varying.

## RING 4 LIFECYCLE MANAGEMENT OF PURITY

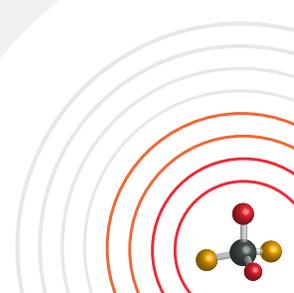
Full-Circle Purity doesn't end once a gas delivery system is constructed, but rather should extend throughout its entire lifecycle. That means **installing, commissioning, and training operators on the gas delivery systems once built**, as well as committing to ongoing maintenance and servicing to ensure integrity does not wane down the line.

### *It all comes down to* **THE GAS DELIVERY PARTNER**

Protecting your gas molecules at every stage of delivery requires a partner with a comprehensive understanding of every phase in the gas handling process. An ideal partner will pair deep equipment expertise with an arsenal of value-added services to ensure gas integrity is upheld after the system is in place, ensuring purity for the long-term.



AES' Applied Services field division acts as a natural extension of our core equipment manufacturing business, offering **analytical testing, equipment commissioning, training, maintenance, and repairs to ensure our gas delivery systems, once in place, are optimized for safety, performance, and purity.**



# The 8 Rings of Full-Circle Purity



## RING 5

### MOLECULE & APPLICATION EXPERTISE

A pure gas for one application can be hazardous for the next. As such, the next ring of Full-Circle Purity requires system engineers to not only understand for *what* application the gas is being utilized, but also *why* a particular gas is ideal for the application. **This knowledge enables gas delivery systems engineers to ensure the intricate nuances of pure gas delivery are upheld without compromising process integrity and system performance.** Accomplishing this requires system engineers to have extensive experience designing gas delivery equipment that caters to myriad gas types and application specifications.



## RING 6

### SAFETY MECHANISMS

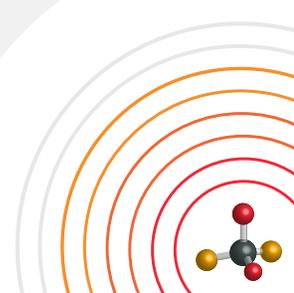
Although systems expertise sets gas delivery equipment up for success, there is always a risk when working with gas molecules that compromise could occur. Systems therefore require built-in mechanisms—such as exhausted enclosures, fire detection sprinkler systems, and local and remote emergency shutdown systems (ESS)—for rapid alerting, **ultimately protecting gas molecules from further contamination and operators from harm.**

## *It all comes down to* **THE GAS DELIVERY FUNDAMENTALS**

A partner that singularly specializes in gas delivery and distribution will inherently have the expertise required to surround the molecule for pure, safe handling. Beyond the gas itself, they will know all the points in the delivery process where purity compromises could occur, and can proactively engineer their equipment to mitigate those impacts and to rapidly alert operators to issues to address if they do arise.



For over 50 years, customers have **trusted AES to deliver the high and ultra high purity gas delivery equipment, services, and solutions** required to uphold purity and integrity across precision-driven applications.



# The 8 Rings of Full-Circle Purity

## RING 7 CUSTOMIZATION

While nitrogen, hydrogen, and oxygen are common process gases, emerging applications can demand unconventional gas types. As a result, standard gas cabinets must be customized to meet unique requirements while preventing contamination of gas molecules. **A partner that follows Full-Circle Purity is able to uphold gas integrity at varying flow rates, temperatures, and pressures based on application demands and gases' unique properties** in order to protect the molecule at every stage.

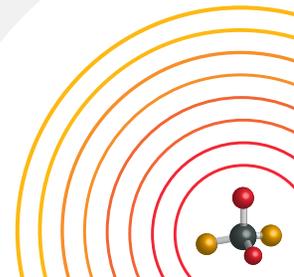
## RING 8 INNOVATION

As technology continues to advance, process gases are increasingly being used in new and innovative ways. Gas delivery systems must also evolve to ensure they are able to uphold increasingly stringent standards for process integrity. An ideal gas delivery partner will have a formal roadmap in place for continual product innovation, adding features to enable Industry 4.0 inter-system communications, increased automation capabilities, and more. **With systems optimized for today's high-tech environments, you can continue to protect gas purity as you meet the production demands of tomorrow.**

### *It all comes down to* **A FUTURE-PROOF GAS DELIVERY SYSTEM**

As technology evolves, it is important that your gas delivery equipment offers advanced monitors and controllers to empower you to keep pace with your industry and application's ever-changing realities.

AES offers **Industry 4.0-ready SEMI-GAS® GigaGuard™ controllers** to enable greater insight and control over your gas delivery equipment.



# Surround the Molecule with AES

At AES, we're supporting industry leaders with the high and ultra high purity gas delivery systems required to ensure process integrity at every stage of manufacturing. Trusted by Tier 1 leaders around the world, we offer 50 years of gas delivery expertise to meet your most diverse and challenging application requirements.

Through our five core divisions, we're able to uphold the 8 Rings of Full-Circle Purity whether working in standard or highly unique operating environments to ensure the safety, integrity, and precision of your applications.

**LEARN MORE**



**APPLIED ENERGY SYSTEMS**



**ULTRA HIGH PURITY GAS DELIVERY SYSTEMS**



**HIGH PURITY GAS DELIVERY SYSTEMS**



**BULK AND POINT-OF-USE GAS PURIFIER SOLUTIONS**



**COMPREHENSIVE, EXPERT-LED FIELD SERVICES**



**PRECISION WELDING, MARKING, AND QA SERVICES**

**Keep gas purity a top priority with AES.**

Tell us a little about your application requirements, and we will connect you with the best-fit equipment for your needs.

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