



CRITICAL SYSTEMS, INC.

## Gas/Chemical Delivery & Abatement Excellence

- 40 Years of consulting process engineering in manufacturing and R&D.
- UHP systems in semiconductors, optical fibers, photovoltaics and biopharmaceuticals.
- High flow, pressure, and temperature systems associated with aerospace research.
- Taking projects from R&D to production with manufacturing companies.
- Hazardous materials including toxics, highly toxics, pyrophorics, flammables, oxidizers and physical hazards.
- Bulk gas delivery systems.
- Codes and regulatory requirements including IBC, IFC, NFPA, CGA, FDA and USDA.
- Abatement Design Support: Design experience for “safe and sustainable” processes that can move from R&D to High Volume Manufacturing (HVM).
- Designs that eliminate reaction byproducts and potential issues such as condensation of vapors in pumps or pump lines.
- Greenhouse Gas Experience: Design/Build - semiconductor systems covering around 90% of processes that produce greenhouse (GHGs) gases released during various processes.
- Manufacturer of Advanced Abatement Technologies: To limit emissions from manufacturing steps like etching and lithography, and to support a team of people reimagining production methodologies using different chemicals and advanced abatement technologies.
- Support in identifying the “BEST” Abatement Technology for the application, keeping sustainability and fab cost control in mind.

## Manufacturing Capabilities



### Engineering

S2 Certified

#### Develop Submittal

Engineering team develops submittal drawings for customer review and works collaboratively to achieve acceptance.

#### Create Design Package

Packages are developed using engineering designs and customer specifications.

#### Internal Review

The package is fully vetted by the CSI (STAR) Team prior to customer submittal.

### Manufacturing

Innovation

- **Reliability** – Highest level of workmanship, craftsmanship and component and software selection.
- **Safety** - Industry best practices to mitigate hazards prior to system delivery.
- **Process Control** - High tech instruments to monitor and control QA and QC processes.
- **Validation** - Safety function validation to ensure system meets design intent.

### Support

Expert Trouble Shooting

#### Services Offered:

- Site Services
- Long-Term Contract Management
- Field Service (Start up & Training)
- Preventative Maintenance Site Evaluation
- Facility Audit
- Process Line Qualification
- Gas Cylinder safety Training
- Cylinder Change Training

# Gas & Chemical Delivery Builds

## Standard Offerings

- 8 New Control Packages:
  - **Arias IG** - Inert gas controller
  - **Arctic Max** Acetylene/acetone separation
  - **CSM** - Configurable safety monitor
  - **ApX Gateway** - Data monitoring to Modbus/TCP
  - **ARIAS IG Max** - UP 100 replacement
  - **MPG** - Multi-purpose gas controller
  - **Full-Auto VMB**
  - **Semi-Auto VMB**
- Ancillary Tool Support Products:
  - UHP & HP gas sticks for wafer contact
  - General purpose sticks in brass or stainless
  - Complete drawing sets
  - Multiple filter options
  - Full analytical testing
- Controller Capabilities:
  - Manual and automatic switchover systems
  - Semi-auto systems with remote shutdown capabilities
  - Fully automated systems with purge & vent routines
  - Full communication capability via Modbus protocol
- Panel Types:
  - Auto switchover panels
  - Automated panels
  - Manual panels
  - Purge panels
  - New Q-panel design for easy maintenance and operation
    - Lowest wetted surface area in the industry.



## Customized Equipment Builds

- UHP high pressure N2 delivery set systems
- Bulk gas systems, customized to fit specific delivery requirements
- Full conversion of W seal panels to C seal or VCR panel
- Customized builds for any gas or chemical delivery requirements.
- Purification and Filtration Systems:
  - Removal and purification of acetylene delivery systems
  - Customized purifier panels w/ control - w/o control
- Chemical delivery systems (SiCl4 bulk storage and transfer, Cl2 tonners, nat gas booster compressor and distribution, bulk N2 and O2)
- GeCl4 and SiCl4 bulk delivery systems cabinet design with dual 200 lbs. drums using N2 pressure transfer to MOCVD for optical fiber manufacturing
- Variety of high purity gas and liquid chemical delivery systems used for R&D and manufacturing.
- Specialty high flow panel design/build for H2, He, CO, C3H8, NH3.
- Customized, high pressure/High flow gas and liquid delivery systems used for research and development. H2, CO, O2, N2, SiH4, CDA, Jet A, Liquid Anhydrous NH3
  - Pressures range from 100 psig to 6000 psig.
  - Flows range from a few liters per minute to 8700 cfm.
  - Heated air systems up to 1550 °F and 900 psig.
  - Each system design based on the specific requirements of the individual researchers.



## NextGen Equipment Builds

- Multi-tool liquid bubbler systems
- Liquid push systems
- Solid volatilization systems
- Gas recovery systems
- Gas blending systems



# Gas & Chemical Abatement Builds

## Standard Offerings

- Technology to abate toxic and corrosive gas effluent
- Multiple purifier panel designs available
- External vent canister for pigtail purge
- Emergency release scrubbers and multiple canister battery custom systems
- CSI targeted processes: chamber clean, oxidation, deposition, photolithography, etching, doping
- New metal precursors for abatement, thin film advancements:
  - Metal organics - TMA, TMG, TMB
  - Metal nitrides - TiN, NbN, TiAlN
  - Metal halides - TiCl<sub>4</sub>, WF<sub>6</sub>, SnCl<sub>4</sub>, HfCl<sub>4</sub>
  - Hydrides - DMS, MMS
  - Amides - DMA, TDMAT
- Dry Bed Scrubber
  - Single canister or dual canister options
  - Process exhaust or emergency release/high flow scrubbers
    - 50 SLPM to 1000 SLPM for process exhaust
    - 500 to 750 SCFM for individual emergency release canisters
  - Cluster design to support 1000+ scfm
  - Built-in toxic gas monitoring and venturi pump
  - Application specific canister for maximum lifetime
- Wet Scrubber
  - Dedicated chemical inject
  - Flow and counter flow spray nozzles
  - pH monitoring to safely dump to drain and recirculation control
- Thermal Wet Scrubber
  - Three technologies in one: thermal, wet & packed column
  - Up to 400 SLPM to abate a variety of gases



## Customized Offerings

- Configurable Safety Monitor for Toxic Gas Monitoring (TGM)
  - Incorporates many safety features to maximize safety and minimize the risk of hazardous exposure.
  - The alarms include an EGO, a remote EGO (optional), a global shutdown output, and up to 10 individual shutdown outputs.
  - Indicator lights for status and an audible alarm.



## NextGen Abatement Builds

- Continued mitigation of effluent gas stream mixes with customized “dry abatement” systems utilizing a variety of *proprietary blended Media*.
- Magnetically-coupled foreline plasma technology

