wet etch and clean

process control «» particulate control «»

© purity «» flow rate
Wet Etch and Clean (WEC) processes touch wafers more than any single application in the semiconductor fab. WEC processes modify and clean the wafer surface with a critical influence to meet the demanding yield requirements of an effective fab. These processes utilize the most aggressive chemistries: strong acids, oxidizers, solvents, high temperatures and highly concentrated substances. The process materials and parameters must be controlled to levels other industries cannot achieve in terms of repeatability and consistency. Entegris provides the solutions to succeed under these extreme conditions.

Creating a material advantage.
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Entegris provides innovative materials science-enabled solutions for applications across key semiconductor processes to help chip makers solve manufacturing challenges, enhance yield and gain sustainable competitive advantage.

**bulk chemical**
As wafer sizes continue to increase and line widths shrink, purity requirements become more stringent and precise. Chemical blending becomes more critical. Whether it's transport or storage, mixing or dispense, Entegris has solutions to meet bulk chemical handling needs.

**chemical mechanical planarization**
From filtration, liquid and slurry handling, Entegris products enable the CMP process.

**wet etch and clean**
Ultrapure liquids and gases are purified, protected and transported with Entegris filters, purifiers, valves, fittings and sensing and control products.

**wafer handling**
Entegris provides wafer handling products to protect and transport prime wafers, wafers being processed, finished wafers, bare die and packaged devices. Products include wafer carriers, wafer shippers, mask and reticle carriers, bare die trays, horizontal wafer shippers, chip trays and film frame shippers.

**photolithography**
Entegris' broad product line enables lithography processing with gas filters and diffusers, purifiers and purifier systems, wafer and reticle handling, liquid filtration, purification and control.

With 2,800 employees worldwide, Entegris thrives on the challenge to meet our customers' expectations through a global network of service, technology, manufacturing and applications support teams, all built upon a tradition of product and process innovation.

**lab capabilities**
- Analytical Services
  - Airborne molecular contamination
  - Surface contamination
  - Applications support
  - Root-cause analysis
- Product Testing
  - Performance testing
  - Particle testing
  - Electrostatic charge
  - Vibration
  - Flow rate optimization
  - Applied statistics
  - Safety and industry standardization
  - DOT and UN regulations
  - CE marking
- Material Science
  - New material development
  - Material characterization
  - Material selection
  - Material incoming inspection
  - Applications support
The technology roadmaps to produce the next generation of semiconductor devices and microelectronics are presenting unprecedented technological challenges, as well as ever increasing pressure to improve yields and productivity. As the leading provider of contamination control products and services to the global semiconductor and microelectronics industry, Entegris is using a wide array of analytical and materials science expertise to develop comprehensive solutions to contamination issues in the fab.

**ITRS**

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>DRAM ½ Pitch (nm)</td>
<td>45</td>
<td>32</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>Critical Particle Size (nm)</td>
<td>20</td>
<td>15</td>
<td>10</td>
<td>5</td>
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<tr>
<td>Critical Metal ions (ppt)</td>
<td>1000</td>
<td>1000</td>
<td>100</td>
<td>TBD</td>
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<tr>
<td>Molecular Contaminants</td>
<td>Surface</td>
<td>Airborne</td>
<td>Airborne</td>
<td>Airborne</td>
</tr>
</tbody>
</table>

**Industry**

- **Lithography**
  - 193 nm Immersion Lithography
  - EUV
- **Wafer Size**
  - 300 mm
  - 450 mm

**Entegris Technologies**

- **Liquid and Gas Filtration and Purification**
  - Continuous Improvement
    - Filtration products: smaller pore size, higher flow, higher retention
    - Purification products: volatile organics, AMC, moisture
- **Wafer Handling**
  - Advanced 300 mm Microenvironment Control
  - 450 mm prototypes
- **Mask Handling**
  - Carriers to prevent reticle haze
  - EUV mask carriers
- **Fluid Handling**
  - Components for a wider range of process conditions, precise real-time sensing and control
- **Coatings**
  - New coating technologies for components used in next generation semiconductor processing

Electronics that are smaller, faster, cheaper and more functional.

**Close to our customers**

Direct sales and local support gives us the opportunity to achieve customer intimacy.

Customer intimacy helps us better understand our customers’ needs through direct feedback and roadmap sharing.

By aligning our material science, engineering and R&D initiatives, we can develop indispensable contamination control solutions to solve our customers’ roadmap challenges.

**Application and Process Knowledge**

- We Develop Relevant Final Solution
- We Listen
- We Respond with Prototypes

**Customer View**

Entegris as solutions provider

**Customer Enters**

Problem-solving relationship

**Direct Engagement**

- Relevant, Trusted Technology Partner

**Expand Applications Excellence**

- Customer views
- Entegris as solutions provider

**Customer Shares**

- Sensitive product roadmap information

**Pilot Capability**

- at Most Sites

**Entegris Milestones**

- 1966: Founded as Fluoroware, Inc.
- 2000: Begins trading under the ENTG symbol on NASDAQ
- 2005: Merges with Mykrolis Corporation, a leading provider of liquid filtration and gas purification products and systems
- 2006: Expands manufacturing facility in Kulim, Malaysia
- 2007: Acquires Surmet Corporation’s high-purity semiconductor coatings business
- 2008: Acquires Poco Graphite, a fluid handling component manufacturer, in Kangwon-do, Korea
- 2011: Opens manufacturing facility in Hsinchu, Taiwan
- 2012: Opens the Advanced Technology Center, manufacturing for 450 mm and EUV, in Colorado Springs, CO.
  - Acquires Entegris Precision Technology, a HDPE drum blowmolding facility, in Yangmei, Taiwan
  - Opens new facility to provide specialized silicon and diamond-like coatings in Lyon, France
For over 40 years, Entegris has been at the forefront of providing comprehensive microcontamination control solutions – with products and services that surround key processes such as wet etch and clean, lithography, CMP and wafer handling.

Our expertise in material science and contamination control enables our customers to meet the demands of the market by reducing costs, enhancing yields, increasing productivity, and improving process control.

The following pages highlight 22 products designed to solve your fab challenges by providing best-in-class purification, materials management and process control solutions.>>>

**WET ETCH AND CLEAN**

**ENTEGRIS INC.**
liquid contamination control solutions

Developed from Mykrolis® microcontamination technologies, Entegris liquid contamination control solutions are specifically designed for filtration of chemicals used in data storage processes and ensure higher flow rate, particle retention and longer lifetime, leading to higher productivity and lower cost of ownership.

chemical compatibility guide

- Good Compatibility
- Possible: Usage is Application Specific
- Not Compatible

<table>
<thead>
<tr>
<th>CHEMICAL NAME</th>
<th>Microgard</th>
<th>Guardian DEV/Plus</th>
<th>Intercept</th>
<th>Guardian EOD</th>
<th>Fluorogard AF</th>
<th>QuickChange</th>
<th>Isrotect</th>
<th>Metal Ion Purifier</th>
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</thead>
<tbody>
<tr>
<td>Acetic Acid (glacial)</td>
<td>▲ ▲ ▲ ▲ ▲</td>
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<td>Ammonium Hydroxide</td>
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<td>Hydrazinic Acid</td>
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<td>Hydrogen Peroxide</td>
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<tr>
<td>Sulfuric Acid (98%)</td>
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<td>Acetone</td>
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<td>Ethyl Lactate</td>
<td>● ● ● ● ●</td>
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<td>Ethylene Glycol</td>
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<tr>
<td>Mineral Spirits</td>
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<td>PEGMA (Propylene Glycol)</td>
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<td>Tertamethylammonium Hydroxide (TMAH) 25%</td>
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<td>TMAH 2.0%</td>
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<tr>
<td>WAFER CLEANING</td>
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<tr>
<td>DHF (Dilute Hydrofluoric Acid)</td>
<td>● ● ● ● ●</td>
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<tr>
<td>SPM (Sulfuric Acid 98% + Hydrogen Peroxide @120°C)</td>
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<td>SC1 (@ 40-90°C)</td>
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<td>SC2 (@ 25-30°C)</td>
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<tr>
<td>DI Water Rinse @ 20°C</td>
<td>● ● ● ● ●</td>
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<tr>
<td>DI Water Rinse @ 80°C</td>
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<td>IPA (Isopropyl Alcohol) @ 20°C</td>
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<td>ETCHING</td>
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<tr>
<td>Silicon Etch (HF + Acetic Acid + HNO₃)</td>
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<tr>
<td>Buffered Oxyde Etch (HF + NH₄F + H₂O)</td>
<td>● ● ● ● ●</td>
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<tr>
<td>Nitride Etch (Phosphoric Acid 85% @120-160°C)</td>
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<tr>
<td>Aluminium Etch (H₂PO₄ + HNO₃ + Acetic + H₂O)</td>
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<td>CU PLATING</td>
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<tr>
<td>Copper Sulfate + Sulfuric Acid</td>
<td>● ● ● ● ●</td>
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<tr>
<td>Citric Acid</td>
<td>● ● ● ● ●</td>
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</tr>
</tbody>
</table>

- Recommended product
- 1: Protego LTX
- 2: Protego HTX
- 3: Protego Plus IPA
Torrento Filter Family

20 nm and 15 nm retention with ultra-high flow rate performance. The new standard for nondewetting Teflon® filters.

• Torrento filters provide high-yield, rapid bath cleanup cycles, extended filter life, fast changeouts and cleanliness - all in a prewet package for ease-of-use.

• Torrento ATE/AT3 cartridges and disposable filters are designed for recirculation bath applications, while Torrento 1500/3000 disposable are useful for single wafer processing.

• Torrento 1500/3000 are only available in 15 nm retention with maximum operating temperature to 95°C.

Optimized for leading-edge recirculated bath processes like SPM, SC1, SC2, DHF, etc. in process technology nodes 45 nm.

FEATURE ADVANTAGE BENEFIT

Ground breaking new high-flow Teflon membrane technology

• 20 nm and 15 nm particle removal with highest retention efficiency

• Exceptional flow performance without compromising retention

• Highly uniform pore size distribution insures high retention of small particles and long life

• Minimized particle-related wafer defects through optimal bath cleanup

• Increased OEE through reduced process cycle time

• Lower COO and increased OEE through extended filter lifetime

New device construction with more surface area in each filter

• Lower flow resistance

• Higher flow

• Extended lifetime

• Lifetime exceeds closest competitor by 20 percent in SPM process chemistry

• Reduced overall maintenance and replacement costs related to wet bench pumps as the low filter resistance design reduces pump strokes—reducing wear and tear

Maintains industry proven and reliable nondewetting technology

• No risk related to membrane technology

• Maintains advantages of QuickChange technology

• Fast qualification and rapid ROI

• Low COO and high OEE through fast installation/qualification, stable performance, long life

Available in cartridge and disposable formats

• Maximize installation flexibility

• Seamless installation in existing tools

performance

Torrento’s revolutionary membrane technology provides improved retention at exceptional flow rates.

• High-flux membrane for high-flow recirculating applications

• Advanced particle retention to 15 nm

• High cleanliness performance during startup and product use

Tailored by application needs

<table>
<thead>
<tr>
<th>Product</th>
<th>Torrento ATE 20 nm</th>
<th>Torrento AT3 15 nm</th>
<th>Torrento Plus AT3 15 nm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application</td>
<td>Recirculation, bulk, viscous chemistries</td>
<td>Single pass, recirculation, bulk</td>
<td>Recirculation, viscous chemistries</td>
</tr>
<tr>
<td>Membrane material</td>
<td>Advanced PTFE - modified</td>
<td>Advanced PTFE - modified</td>
<td>Advanced PTFE - modified</td>
</tr>
<tr>
<td>Support materials</td>
<td>Standard PFA</td>
<td>Standard PFA</td>
<td>Improved PFA</td>
</tr>
<tr>
<td>Media area</td>
<td>2 m²</td>
<td>3 m²</td>
<td>3 m²</td>
</tr>
<tr>
<td>Filter footprint</td>
<td>Standard cartridge and disposable</td>
<td>Standard cartridge and disposable</td>
<td>Standard disposable only</td>
</tr>
<tr>
<td>Flow rate 0.2 Kg/cm²</td>
<td>23 L/min</td>
<td>22 L/min</td>
<td>17 L/min</td>
</tr>
<tr>
<td>Temperature rating</td>
<td>180°C</td>
<td>180°C</td>
<td>180°C</td>
</tr>
<tr>
<td>Metal cleanliness options</td>
<td>&lt;10 µg/device STD, &lt;3 µg/device UCM</td>
<td>Cartridge &lt;25 µg/device STD, Disposable &lt;10 µg/device STD, Disposable &lt;3 µg/device UCM</td>
<td></td>
</tr>
</tbody>
</table>

Proven performance

41 nm LLS versus Filter Rating and Bath Life

Torrento 3000 15 nm in SC1 (NH₄OH/H₂O₂) on DNS SU 3100

* For Industrial Use Only. Not for use in food, drug, cosmetic or medical devices manufacturing, processing or packaging operations.
QuickChange ATE chemical filters enable rapid nano-particle removal via low pressure drop and high chemical flow rates.

- High flow, long-life prewet filter that delivers yield enabling particle protection, ease-of-use and rapid changeouts
- Reliable nondewetting membrane technology

**Performance**

QuickChange ATE chemical filters do not lose performance due to dewetting.

- QuickChange nondewetting filters do not dewet
- Entegris' nondewetting filter membrane delivers yield enabling performance by providing consistent retention and flow properties

**Customer Evaluation:**

QuickChange ATM reduces wafer defects

- RCA cleaning station (SC1 and SC2) at a device maker
- QuickChange ATX 100 nm and ATM 50 nm were installed on both a SC1 and SC2 baths

- Graph indicates a significant reduction of defects on wafers together with an improved flow rate after the installation of a QuickChange ATM 50 nm

**Frequently Asked Questions**

**How long does my filter remain wet?**

QuickChange filters stay wet even when exposed to air or outgassing chemicals. This assures stable performance and long life even in strongly out-gassing applications.

**What are the membrane areas of QuickChange ATM and ATE?**

QuickChange ATE provides 35 percent more flow at 30 nm single pass retention when compared to the industry standard ATM configuration under equivalent pressure conditions.

---

**Table: Feature, Advantage, Benefit**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Advantage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nondewetting PTFE* membrane with prewet packaging</td>
<td>Eliminates prewetting and flushing cycles</td>
<td>Higher yields and longer life through consistent filter performance</td>
</tr>
<tr>
<td></td>
<td>High purity, ultra-clean, ready-to-use filter</td>
<td>Increased tool time and decreased COO through longer filter life</td>
</tr>
<tr>
<td></td>
<td>Consistent flow performance in outgassing chemistries</td>
<td>Decreased COO through reduced work/chemical consumption</td>
</tr>
<tr>
<td>High membrane surface area</td>
<td>ATE design incorporates 35% more membrane than ATM</td>
<td>Minimized particle-related wafer defects through optimal bath cleanup</td>
</tr>
<tr>
<td></td>
<td>Lower flow resistance</td>
<td>Increased OEE through reduced process cycle time</td>
</tr>
<tr>
<td></td>
<td>Higher flow</td>
<td>Lower C0D and increases OEE through extended filter lifetime</td>
</tr>
<tr>
<td></td>
<td>Extended lifetime</td>
<td>Reduced overall maintenance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reduced replacement costs related to wet bench pumps through reducing wear and tear</td>
</tr>
<tr>
<td>High retention</td>
<td>Smaller particle removal, 30 nm</td>
<td>Cleaner device, higher yield needed for advanced technology nodes</td>
</tr>
<tr>
<td>Industry proven and reliable nondewetting technology</td>
<td>No risk related to membrane technology</td>
<td>Fast, risk-free qualification and rapid ROI</td>
</tr>
<tr>
<td>Low metal extractables</td>
<td>Reduction in qualification time, ensures ultra-clean processing, low risks of metallic contamination of wafer</td>
<td>Higher yield and wafer throughput</td>
</tr>
</tbody>
</table>

* For Industrial Use Only. Not for use in food, drug, cosmetic or medical devices manufacturing, processing or packaging operations.
QuickChange Plus 1500/3000 Filters

Nondewetting membrane technology in a low-profile prewet disposable filter that delivers protection, ease-of-use, rapid changeout and safety for smaller volume applications.

- Superior filtration efficiency and flow rate provided by a nondewetting pleated membrane
- Highest retention rating with capability down to 30 nm
- Unmatched purity and safety ideal for critical applications
- Optimized for aggressive chemicals like SC1, SC2, SPM and all hot temperature chemicals.

The QuickChange Plus is the next generation of the QuickChange 1500 and 3000 filters.

- QuickChange ATM membrane
- New membrane improves retention and flow rate

QuickChange Plus 1500 and 3000 will replace QuickChange 1500 and 3000.

**FEATURE** | **ADVANTAGE** | **BENEFIT**
--- | --- | ---
Nondewetting PTFE* membrane filter prewet and packaged in high-purity DI water | • Eliminates prewetting and flushing cycles. Eliminates chemical usage while reducing system downtime during filter changeouts. Saves time, greatly increases equipment uptime | • Higher yields and increased overall equipment efficiency • Increased OEE through reduced process cycle time
O-ring free design | • High-purity connections avoid potential sources of contamination | • Minimized particle-related wafer defects through optimal bath temperature control • Both fluid streams remain separate
Available in retention ratings of 30 nm, 50 nm and 100 nm | • Provides excellent small particle retention to ensure minimal particles remain on wafer surface | • Safe and ultra clean, higher yield, needed for advanced technology nodes • Increase OEE through reduced particle contamination
Compact, easy-to-install design | • Allows quick installation and minimizes downtime while limiting the handling of hazardous chemicals during installation and disposal | • Requires less space for changeout. Minimizes downtime and simplifies changeout

**Note:** QuickChange Plus 1500 and 3000 will replace QuickChange 1500 and 3000.

* For Industrial Use Only. Not for use in food, drug, cosmetic or medical devices manufacturing, processing or packaging operations.

**frequency asked questions**

**What are the chemical compatibility recommendations?**

QuickChange Plus disposable filters are recommended for use with aqueous-based chemicals at ambient temperatures (including H2SO4, H3PO4, HNO3, HF, HCl, BOE, NH4F, H2O2, TMAH, NH4OH, and ozonated water) and elevated temperature applications (including SC1, SC2, piranha etch, and metal etch).

**What are the available retention ratings?**

100 nm, 50 nm and 30 nm

**What connection types are available?**

Flaretek
Super Pillar®
Super type 300 Pillar
Wet Etch and Clean

Intercept Plus HPM Filters

Highest flow hydrophilic UPE membranes with the greatest particle removal for submicron batch baths and single wafer tools.

Intercept is the most advanced UPE liquid microcontamination platform available from Entegris:
• Highest single pass retention
• Dual particle capture mechanism
• The fastest bath cleanup time
• Longest filter lifetime
• Lowest COO

Optimized for acid based process chemicals such as DHF, DHCl, BOE and critical DHF final processes.

Performance
• Intercept removes particles in typical DHF applications by an additional mechanism to sieving: Physisorption
• Particle retention below rated pore size is achieved, enhancing process capability

Customer Evaluation

Intercept 200 nm vs. PTFE* filter 100 nm in DHF
• Intercept reaches much lower particle level in bath and reaches low particle levels immediately after bath changeouts

FEATURE | ADVANTAGE | BENEFIT
---|---|---
Advanced membrane technology | Dual particle capture can improve process performance and reduce on-wafer particle defects | Higher yield and throughput through efficient nanoparticle removal
High flow rate | Reduced bath cleanup time | Increase wafer throughput and yield through faster bath cleanup
Hydrophilic membrane | No prewetting or flush-up required for rapid start-up | Increase tool up-time through fast filter installation/qualification
Universal filter design | One filter fits many applications, Recommended for batch or single wafer tools, All polyethylene cartridge provides clean drop-in replacement for existing filters | Fast ROI through easy implementation

10 nm, 20 nm and 30 nm sieving retention ratings available | Highest single pass retention at rated pore size | Higher yield and throughput through efficient nanoparticle removal

Comparison of Particle Counts in 0.46% HF (One Bath Lifetime)

*Particle Control for Advanced Wet Process*, Parekh et al., European Semiconductor May 2004

* For Industrial Use Only: Not for use in food, drug, cosmetic or medical devices manufacturing, processing or packaging operations.
Guardian ECD Cartridge Filters

Guardian ECD (Etch-Clean-Deposition) is constructed of hydrophilic, high-flow polysulfone membrane with high purity HDPE supports.

- High flow and bath recirculation performance
- Excellent particle removal in single pass and recirculating applications
- Retention range from 30 nm to 0.1 µm
- Membrane is non-interactive with typical metal deposition additives

> Ideal for dilute and low temperature acids and bases used in WEC processes. Highly effective in nickel & copper plating applications.

### Guardian ECD Cartridge Filters

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<td>Improved chemistry cleanliness</td>
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<tr>
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<td>30 nm retention</td>
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| Proprietary non-interactive polysulfone membrane | Stable additives concentration over time | Metal Plating specific: 
- Enhanced process consistency |

### Guardian ECD Performance

**Asymmetric PS membrane:**
- Longer life time
- More stable flow in high loading applications like copper plating and post CMP cleans

**Inert surface modification:**
- Concentrations of additives in Cu ECP processes do not change over time

#### Frequently Asked Questions

**How does Guardian ECD help improve process performance for electrolytic deposition applications?**
- Enhanced additives concentration stability over time due to low adsorption of plating additives by the membrane
- Improved process stability
- Longer life time due to asymmetric membrane design

**What are the wet etch and wet clean chemicals compatible with Guardian ECD?**
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More stable flow/Larger life

![Asymmetric Membrane Diagram]

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Microgard Plus LE Cartridge Filters

Microgard Plus patented UPE membrane shows the highest retention efficiency of any membrane. It offers low surfactant binding and spontaneous wettability in solvents.

- High retention efficiency of up to 99.999% at rated particle size
- Removal of microbubbles and gels
- Low pressure drop
- Low leaching of ionic/metallic contamination from filter

Optimized for solvent filtration, filtration of photochemicals, photoresist stripping at temperatures below 60°C.

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<tr>
<td>3 nm and 5 nm asymmetric UPE Membrane</td>
<td>3 nm retention for the tightest membrane technology available in the industry</td>
<td>Reduce defects</td>
</tr>
<tr>
<td></td>
<td>Asymmetric membrane increases flow and reduces pressure drop</td>
<td>Increase throughput</td>
</tr>
<tr>
<td>All-polyethylene construction</td>
<td>Entegris' proprietary cleaning technology insures the lowest levels of organic and metal extractables</td>
<td>Eliminate the potential for the filter to be a source of contamination to your process</td>
</tr>
<tr>
<td>Special cleaning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Superior wettability with solvents</td>
<td>Eliminates prewetting</td>
<td>Stable performance</td>
</tr>
<tr>
<td></td>
<td>Provides more consistent filtration</td>
<td>Reduces chemical usage while reducing system downtime</td>
</tr>
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**UPE vs. PTFE Membrane Particle Count Comparison**

**frequently asked questions**

**Why does Microgard Plus provide superior downstream cleanliness?**

Microgard Plus filters are extensively cleaned during manufacturing and are entirely constructed from high-density and ultrahigh molecular weight polyethylene, providing them better initial cleanliness and lower extractables than filters constructed from polypropylene, polysulfone, polyethersulfone or nylon.

**Why does Microgard Plus hold back gels more effectively than PTFE filters?**

The string and node structure of PTFE allows gels to pass through easily. The sponge-like structure of UPE prevents gels from passing through the membrane and additionally provides higher loading capacity.
Protego Plus metal ion purifiers deliver ultimate protection from metal ion contamination in critical cleaning applications.

- Multi-metal ion removal in a single pass
- Available in a variety of purifier designs
- Protego IPA Purifiers are specially designed to remove metal ions for IPA Dryer process with 15 nm particle retention.
- Protego Plus LTX products are designed for low-temperature DI water applications from ambient to 60°C; while HTX products for critical application to 80°C.

Optimized for solvent filtration, filtration of photochemicals, photoresist stripping at temperatures below 60°C.

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<td>Purifier technology with PES and UPE membrane filtration</td>
<td>Single device for ease of use</td>
<td>Metal purification and &gt;99.9% particle retention efficiency</td>
</tr>
<tr>
<td>Exceptional coverage of ion exchange groups</td>
<td>High multi-element removal rate</td>
<td>Excellent removal of broad spectrum of metals for improved device yield performance in DI Water</td>
</tr>
<tr>
<td>New Grafted Membrane technology</td>
<td>Greater stability at higher temperatures</td>
<td>Extended service life</td>
</tr>
<tr>
<td>Improved product cleanliness</td>
<td>Faster resistivity/TOC flush-up</td>
<td>Fast tool start up and less tool idle time</td>
</tr>
<tr>
<td>Cross-linked Ion Exchange technology</td>
<td>Improved stability of IEC technology</td>
<td>Increased process lifetime</td>
</tr>
</tbody>
</table>

How do Protego Plus purifiers remove metal ions?

Protego Plus purifiers utilize ion exchange functional groups that are cross-link grafted on to a substrate membrane. These ion exchange groups reduce metal cations by up to 99.9% efficiency and the cross-linking ensures lower extractables and shedding in the process.

Are Protego Plus purifiers also filters?

Yes. Protego Plus purifiers have capability to remove metals cations while also having tight filter retention as an all-in-one purifier/filter. Different retentions are available for DIW to meet all fab process needs.
Wafergard MAX In-line Teflon Gas Filters

A superior particulate filtration for ultrapure gas applications.
- Targets a wide flow range up to at least 1000 slpm
- Exceptionally low pressure differential
- Ozone compatibility
- Attractive pricing
- Multiple performance options
- Small footprint for on-tool efficiency
- Increased warranty (dependent on performance option)

Optimized for high flow and low delta pressure applications.

**FEATURE** | **ADVANTAGE** | **BENEFIT**
--- | --- | ---
High flow | • Lower pressure drop | • Efficiently save time and costs
Smaller footprint | • Easier implementation | • Easy to implement and install
Incoming gas minimizes process defects | • Higher removal efficiency | • Remove particles greater than 0.003 µm (99.99999996%)
All PTFE/PFA filter cartridge | • Excellent compatibility with high-purity gases, including nitrogen and CDA | • High corrosive tolerance for o-ring seal less
Pre-conditioned | • Fast startup (Silver only) | • Fast dry down (Silver only)
Available in VCR, Swagelok and butt weld fittings | • Many kind of fitting variation | • Meet a variety of needs

**performance**

**Wafergard MAX In-line 1/4” Fittings**

<table>
<thead>
<tr>
<th>SLPM Flow Rate @ 23°C (73°F)</th>
<th>Differential Pressure (bar)</th>
<th>Differential Pressure (psid)</th>
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<tbody>
<tr>
<td>0</td>
<td>0.0</td>
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<tr>
<td>100</td>
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<td>3.0</td>
</tr>
<tr>
<td>200</td>
<td>0.4</td>
<td>6.0</td>
</tr>
<tr>
<td>300</td>
<td>0.6</td>
<td>9.0</td>
</tr>
<tr>
<td>400</td>
<td>0.8</td>
<td>12.0</td>
</tr>
<tr>
<td>500</td>
<td>1.0</td>
<td>15.0</td>
</tr>
<tr>
<td>600</td>
<td>1.2</td>
<td>18.0</td>
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**Wafergard MAX In-line 1/2” Fittings**

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**frequently asked questions**

**What are the key critical design that constitute a good and clean filter?**

Good filter design should avoid the moving parts in its flow path, e.g. springs fitting, dead trap, O-ring seals as such design will induce or generate particular indirectly. Good surface finish help to increase the throughput by having the quick start-up (lower dry down time) and pro-long filter life cycle (prevention of residual gas entrapment).

**How do you determine flow rate and pressure drop in gas filter?**

Good filter should be able to strike a balance between good filtration efficiency (high retention value, e.g. 9 LRV) and a good range of flow rate that still retain its good differential pressure value (e.g. lower pressure drop) and clean in the way that it does not out-gas particulate and molecular contaminants.

* For Industrial Use Only. Not for use in food, drug, cosmetic or medical devices manufacturing, processing or packaging operations.
AMC Tool Top Filters

A unique chemistry removes critical contaminants at a low pressure drop for the production tools.
- High removal efficiency >95%
- Removes critical acids, bases and organics from the fab ambient to reduce contamination risk
- Long life
- Removes a comprehensive array of AMCs in a single filter cell

Optimized for process tool Airborne Molecular Contamination control.
Entegris AMC tool-top filters provide AMC protection for all semiconductor process tools including: wafer metrology, reticle inspection, ALD, EPI, diffusion, CVD, PVD, wet etch, wafer clean, dry etch and CMP.

**FEATURE** | **ADVANTAGE** | **BENEFIT**
---|---|---
High removal efficiency (>95%) | Removes critical acids, bases and organics from the fab ambient | Reduces contamination risk
Proprietary chemistry developed with key scanner manufacturers | Protects optics and process | Qualified by leading fabs
High surface area | Low pressure drop | Reduces energy requirements and cost
Optimized blend of treated, untreated activated carbons and ion-exchange media | Balanced mix to match lifetimes for all contaminant classes | Provides targeted contaminant removal
Data driven See it. Control it. methodology | Clearly identifies critical AMC levels in customer’s facility | Provides tailored, application specific filtration solutions
Product backed by Entegris OEM certified, ISO 17025 accredited laboratory services | Product performance windows are clearly defined | Provides assurance that all performance claims are verified with supporting data
Available in a range of sizes to satisfy various installation requirements, including tool-top, fan filter unit, tool interface or in-tool housing in all equipment front-end modules (EFEM) and process modules | Field tested and proven | Easy to implement and install

**performance**
Filter lifetime estimate: actual filter life is determined by measuring the fab’s chemical challenge concentration, downstream quality and testing of returned filters.

**frequently asked questions**
How do I choose the correct filter for my application?
Our recommendation is based on different parameters such as: AMC targeted, flow rate, maximum pressure drop acceptance, mechanical dimension and expected lifetime.

How do we determine filter lifetime?
Entegris provides on site and post mortem analysis to optimize filter changeouts.
The Spectra™ FOUP is a 25+1 capacity front opening unified pod (FOUP) that provides high-performance wafer transport, optimum automation integration and low cost of ownership for your facility.

- High-strength assembly
- Wafers retained against shock and vibration
- Meets all applicable SEMI® standards
- Uses STAT-PRO® 3000 carbon-filled PEEK material at all wafer contact points
- One piece molded shell
- Optional configuration available for a conductive shell to increase protection
- Microenvironment control

Optimized for below 45 nm processing.

Microenvironment Protection Solution

Purging with inert gas will remove moisture and oxygen during or between critical process steps. Etching and deposition steps are prime examples.

- Reduces corrosion and hazing issues
- Improve yield
- Improve queue processing time
- Helps control environmental contamination due to:
  - Outside contamination (atmosphere)
  - Outgassing of the wafers
  - Outgassing of the FOUP (humidity)

Performance

Microenvironment control: a system approach

- Entegris Barrier Material (EBM) to improve purge duration, quicker purge down time and less absorption/desorption of outgassing from wafers
- Snorkel purge option to rapidly purge down to low moisture and oxygen levels while directing airflow between the wafers
- Clarilite® Wafer for maintaining low moisture or oxygen conditions for extensive time frames

Challenges in wafer microenvironment control

- \( \text{O}_2 \) & \( \text{H}_2\text{O} \) control

- Various shell colors for segregation
- Colored inserts on handles
- License plate
- Molded-in bar code
- Print-on-demand labels
- Laser marking

Why 25+1 slots instead of 257

- One slot can be used for a test or monitor wafer
Design provides reliable service for UHP applications where space is limited and high flow is required.

- Designed for high flow chemical distribution applications
- Unique design allows for higher flow in a small footprint
- Wide range of repair kits available
- Available with a variety of connection options including PrimeLock, Flaretek, PureBond®, and Super 300 Type Pillar.
- Vacuum rated
- Optimized for wet etch and clean applications: SC1, SC2, SPM, H₂SO₄, and H₃PO₄.

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<td>Extremely robust and reliable</td>
<td>Increases tool and valve uptime</td>
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<td>¾&quot; Integra has unique internal radius</td>
<td>Excellent chemical resistance</td>
<td></td>
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<tr>
<td>Innovative diaphragm design</td>
<td>Enables a fully swept flow path in a small footprint</td>
<td>Increases flow efficiency</td>
</tr>
<tr>
<td>No external metal parts</td>
<td>Maintains chemical integrity</td>
<td>Higher yields and wafer throughput</td>
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<td>Repair kits available</td>
<td>Field serviceable</td>
<td>Increases equipment uptime</td>
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<tr>
<td>1&quot; and 1¼&quot; Integra valves have no touch bellows diaphragm design</td>
<td>Minimizes particle generation</td>
<td>Increases cleanliness and valve reliability</td>
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<td>Port Connection</td>
<td>Flow Factor Cv</td>
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<tr>
<td>¾&quot; Flaretek, PrimeLock</td>
<td>6.7</td>
<td>95.7</td>
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<td>¾&quot; PureBond</td>
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<td>117.7</td>
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<td>140.0</td>
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<td>149</td>
</tr>
<tr>
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<td>12.4</td>
<td>177.1</td>
</tr>
<tr>
<td>1&quot; PureBond</td>
<td>13.6</td>
<td>194.2</td>
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### Internal radius for ¾" Integra:

- Eliminates sharp inside corners
- Optimizes the outer radius of the swept flow path
- Eliminates dead spots
- Decreases pressure drop, thereby increasing flow with a smaller footprint

### Frequently asked questions

**What configurations are available?**

- 2-way and sampling configurations
- Pneumatic valve with normally open and normally closed designs available with remote sensing option
- Multi-turn manual valve with optional safety lock out tag out

**What are the pressure and temperature ratings for Integra ¾/4" and 1" valves?**

- **¾" DS12 valves**
  - Forward and backward pressure rating up to 552 kPa (80 PSIG) at 180°C
- **¾" DH12 valves**
  - Forward and backward pressure rating up to 552 kPa (80 PSIG) at room temperature
  - Forward and backward pressure rating up to 207 kPa (30 PSIG) at 165°C
- **1" DS16 and 1¼" DS20 valves**
  - Forward and backward pressure rating up to 552 kPa (80 PSIG) at room temperature
  - Forward and backward pressure rating up to 276 kPa (40 PSIG) at 93°C
CR4, CR8 and CH8 Manual and Pneumatic Valves

Corrosion Resistant (CR4, CR8 and CH8) is the next generation valve specifically designed for corrosive environments.

- Modular design – manifoldable
- Small footprint
- High-temperature capability
- High-purity corrosive chemical handling
- CR4 is ideal for low flow wet etch and clean applications and high temperature corrosive chemical handling.
- CR8/CH8 is ideal for mid flow wet etch and clean, low volume bulk chemical delivery and high-temperature applications.

### performance

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>ADVANTAGE</th>
<th>BENEFIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modular design</td>
<td>Ease of assembly</td>
<td>Improves serviceability</td>
</tr>
<tr>
<td></td>
<td>Easily configured into custom manifolds</td>
<td>Allows tool manufacturer to optimize space</td>
</tr>
<tr>
<td></td>
<td>Compact footprint</td>
<td></td>
</tr>
<tr>
<td>High-temperature capability</td>
<td>Solves variety of critical issues including photoresist stripping</td>
<td>Improves yield</td>
</tr>
<tr>
<td>Vented actuator design</td>
<td>Able to withstand corrosive environments</td>
<td>Improves reliability</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Extends product lifetime</td>
</tr>
<tr>
<td>Variety of end connections</td>
<td>Versatility and ease in system design</td>
<td>Improves cost of ownership</td>
</tr>
<tr>
<td>Available in 3-way configurations</td>
<td>Three-ported directional valve design</td>
<td>Enables simplification of system design</td>
</tr>
</tbody>
</table>

### CR4, CR8/CH8 performance continued

<table>
<thead>
<tr>
<th></th>
<th>CR4</th>
<th>CR8/CH8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orifice</td>
<td>1/4&quot;</td>
<td>1/2&quot;</td>
</tr>
<tr>
<td>Media temperature range</td>
<td>21°C - 160°C</td>
<td>CR8: 21°C - 130°C</td>
</tr>
<tr>
<td></td>
<td>CR8: 21°C - 180°C</td>
<td></td>
</tr>
<tr>
<td>Inlet/outlet pressure rating at RT</td>
<td>CR4: 80 PSIG / 40 PSIG</td>
<td>CR4 HP: 80 PSIG</td>
</tr>
<tr>
<td>Cv</td>
<td>0.29 - 0.84</td>
<td>2.4 - 3.4</td>
</tr>
<tr>
<td>Reliability</td>
<td>Tested over 2.1 million cycles</td>
<td>Tested over 4 million cycles</td>
</tr>
</tbody>
</table>

### frequently asked questions

**What configurations are available?**
- Pneumatic, toggle or multi-turn actuators
- ¼" to ¾" ports size
- Flaretek, PureBond, Pillar S300 or PrimeLock connections
- Options for position indicators, restricted open and close, LOTO etc...

**Is there a 3-way CR valve available?**
Yes, it is available ¼" to ¾" pneumatically actuated.

**Are all CR valves actuators manifoldable?**
Yes, all 2-way and 3-way valve types with all actuator configurations can be manifolded.

**When should I choose CH8 vs CR8?**
When temperature exceeds 130°C (226°F), CH8 should be selected. CH8 can support up to 180°C (365°F).

**Why should I use CR4 instead of SG4?**
- CR4 has no exposed metal hardware and will be more resistant to corrosive environments.
- Higher temperature capabilities compared to SG4 series
- Improve ease of field reparation
- CR4 is a direct replacement for SG4
Flaret 90° Sweep Elbows

Flaret 90° elbow with optimized radius eliminates sharp corners to dramatically reduce pressure drop and increase flow. Manufactured from 100% virgin HP PFA material.

- No dead spots
- Increases flow rate in same footprint as standard elbows
- Decreases fluid turbulence for CMP chemical health
- Optimized for high volume bulk chemical distribution and CMP slurry applications.

**FEATURE** | **ADVANTAGE** | **BENEFIT**
--- | --- | ---
Optimized 90° radius | Reduces total system pressure drop | Increases overall equipment lifetime
 | Increases flow | Improves yield
 | Reduces fluid shear | Improves yield by reducing large particles on wafers
 | Reduces dead volume | Maintains chemical integrity
 | Decreases turbulence | Maintains chemical integrity

**performance**
- 60% lower pressure drop through the fitting compared to the standard 90° elbow
- Smallest footprint sweep available, making it practical for OEM tools
- Reduced footprint design saves assembly time

Achieve better results than standard 90° elbows
- Standard 90° elbow burst pressure: 644 PSIG (average)
- Sweep 90° elbow burst pressure: 825 PSIG (average)

**frequently asked questions**

**What fitting sizes and accessories are available?**
- Fitting sizes: ½”, ⅝” and 1”
- Spacesaver or PureBond connections available
- FlareLock® II, PVDF, PFA, CPFA nut available

**What are the pressure and temperature ratings?**
Pressure and temperature ratings are the same as a standard 90° 90° elbow fitting. Visit www.entegrisfluidhandling.com for additional information.

**How can I find the appropriate fitting?**
You can generate fitting part numbers based on your specifications and search the extensive online catalog on:
- The web at www.entegrisfluidhandling.com
- The mobile selection tool at: m.entegrisfluidhandling.com

**Flow Pattern Comparison**
Standard vs. Sweep Elbow at 5 GPM

Frequently asked questions:

- What fitting sizes and accessories are available?
- What are the pressure and temperature ratings?
- How can I find the appropriate fitting?
PrimeLock Fittings

The simplest, cleanest and most robust PFA fitting on the market.
- PrimeLock fittings ensure leak-free performance in the most demanding chemical applications
- Easy to assemble, heat is not required
- The audible and visible indicator allows users to verify the proper makeup of the connection
- Broad range of sizes and configurations: ¼” to 1¼” elbows, unions, reducers, caps, tees, minimum tube unions and adapters
- Expanded on a wide range of Entegris products: Chemlock® filter housing, Torrento 15 nm liquid filter, NT pressure transducers, CR4 ¼” and CR8 ½” series valves and Integra ⅛”, ¼” and 1¼” series valves.

Ideal for high purity, corrosive chemical handling, low surface tension chemistries and high-temperature applications.

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>ADVANTAGE</th>
<th>BENEFIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease of assembly</td>
<td>• Audible and visual indication of proper</td>
<td>• Consistent and repeatable fitting makeup</td>
</tr>
<tr>
<td></td>
<td>fitting makeup</td>
<td></td>
</tr>
<tr>
<td>PFA wetted surfaces</td>
<td>• Broad chemical compatibility</td>
<td>• Simplifies product selection</td>
</tr>
<tr>
<td>Robust thread design</td>
<td>• Three backup seals</td>
<td>• Consistent leak-free connection</td>
</tr>
<tr>
<td></td>
<td>• No cross threading</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Quick makeup</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Increased sealing forces</td>
<td></td>
</tr>
<tr>
<td>Unique seal design</td>
<td>• Nonwetted insert eliminates multiple</td>
<td>• Improved process</td>
</tr>
<tr>
<td></td>
<td>entrapment, leak points and flow</td>
<td></td>
</tr>
<tr>
<td></td>
<td>interruptions</td>
<td></td>
</tr>
<tr>
<td>Capable of 200°C (392°F)</td>
<td>• Simplifies product selection</td>
<td>• Lower design cost</td>
</tr>
<tr>
<td>temperature rating, all sizes</td>
<td>temperature rating</td>
<td></td>
</tr>
<tr>
<td>No heat required to flare tubing</td>
<td>• Reduces operator variability</td>
<td>• Saves time and money</td>
</tr>
</tbody>
</table>

performance

The unique seal design removes the insert from the flow stream
- Reduces entrapment
- Reduces leak points
- Eliminates flow interruptions

PrimeLock fittings are compatible with high-temperature chemical processes:
- At temperatures up to 200°C at 40 psi
- At room temperatures it is rated to 120 psi

frequently asked questions

When should I use PrimeLock fittings?
PrimeLock fittings can be used in high-purity, corrosive chemical handling, semiconductor applications, solar, LED, flat panel display and with low surface tension chemistries. Also, used in high-temperature applications up to 200°C.

Is the pressure vs. temperature rating depend on the size?
No, same specification for all sizes ¼” through 1¼”

How can I find the appropriate fitting?
You can generate fitting part numbers based on your specifications and search the extensive online catalog on:
- The web at www.entegrisfluidhandling.com
- The mobile selection tool at: m.entegrisfluidhandling.com

![PrimeLock Cross-section](image)

![Pressure vs. Temperature Rating](image)

Scan QR Code

Fittings mobile selection tool
Microenvironment Transport Solutions

Wide range of microenvironment products for transport and protection of critical wafers during wet applications.

- Designed to fit your equipment needs
- Wide range of materials to allow chemical compatibility
- Strong technical support to enable customized solutions
- Large variety of optional products (tweezers, lab products, etc.)
- Optimized for WEC, hot temperature applications.

**frequently asked questions**

**What materials are available for these solutions?**
- High-purity process wafer carrier material
- Translucent perfluoroalkoxy (PFA)

**What are the temperature limits?**
- Continuous use (process enhancement): 165°C
- Continuous use (traditional): 180°C
- Wafer insertion: 250°C

**What identification options are available?**
- Laser marking
- Hot stamping
- Barcoding
- Alphanumeric ID tag
- RF ID tag

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>BENEFIT</th>
</tr>
</thead>
</table>
| **A200** | • Chemical resistant PFA material  
• Industry standard equipment interface (H-bar)  
• Quick and even solution coverage and drainage  
• Reduces surface area, volume and mass enables smaller tank sizes  
• Design minimizes chemical carry over and reduces wafer masking  
• Reduces PFA wafer supports  
• Rail features (notches) for accurate location on equipment  |
| **A192** | • Enables high purity during wet processing  
• Enables automation during processing  
• Enables more repeatable wafer access, higher temperature processing and longer useful lifetime  
• Enables easy interfacing with tools  |

*Process enhancement cassette

PEC* 300 mm

* Process enhancement cassette
High-purity flow-through conductivity sensor for highly accurate measurement of chemical conductivity in wet applications.

- All PFA electrodeless conductivity sensor – rated up 140°C
- High sensitivity, wide rangeability
- On-Line sensor and analyzer diagnostics communicate real-time measurement faults with history event log
- Selection of tubing line sizes: 1/2", 3/4", or 1"
- Rapid temperature compensation

Optimized for aggressive chemicals used during wet etch and clean (HF, HCl, NaOH, KOH, NH4OH, TMAH) and for diluted to high concentration binary process solutions.

**FEATURE** | **ADVANTAGE** | **BENEFIT**
--- | --- | ---
The only all PFA material flow-through electrodeless conductivity sensor | • Compatible with typical semiconductor process chemistries | • Decreases particle contamination and improves yield
The NT model 8800 uses multiple Toroid sensors | • Reduces signal to noise with a better signal resolution — Highly accurate — Expanded measurement range | • Increases measurement accuracy
Temperature compensating | • Real-time conductivity measurement corrected for temperature | • Increases lab efficiency for process verification
Unique in-situ precision calibration method | • Isolates personnel from aggressive process solutions during calibration | • Increases tool uptime with maintenance safety and process accuracy

**performance**
Works with typical semiconductor etching solutions such as hydrofluoric acid (HF), hydrochloric acid (HCl), nitric acid (HNO₃), sulfuric acid (H₂SO₄), etc.

**application overview**
The NT nonintrusive conductivity sensor, model 8800:
- Allows in-situ chemical measurement
- Conductivity monitoring for wet benches and chemical delivery systems
- Supports up to 3 sets of application configurations. Remote range and application switching using PLC compatible contact inputs
- Simple to use, calibration plug and in-line calibration method eliminates personnel safety issues

**Graph:**
- Conductivity of HF concentration by weight
  - PPM | µS | Wt. %
  - 100 | 630 | 0.01
  - 300 | 1490 | 0.03
  - 1000 | 2420 | 0.1
  - 3000 | 5100 | 0.3
  - 11700 | 1
  - 34700 | 3
  - 62000 | 5
  - 118000 | 20
NT High-Temperature Flowmeter, Model 4401

NT high-temperature flowmeter, model 4401 is designed for use in ultrapure, high-temperature applications. Incorporates same pressure sensor technology as the NT electronic flowmeter, model 4400.

- Effectively handles process temperatures up to 180°C (365°F)
- No moving part to generate particles
- Nonmetallic sensing technology for reliable measurement
- Flow ranges up to 0 - 120 l/min
- Easy installation in any orientation
- Same response time as proven NT model 4400

Ideal to obtain valuable and critical diagnostic information which is used to monitor and control high-temperature, aggressive chemical processes in wet etch and clean applications, precision blending and metering.

**FEATURE** | **ADVANTAGE** | **BENEFIT**
--- | --- | ---
PFA, PTFE and other high-purity fluoropolymer wetted surfaces | • Compatible with highly corrosive wet etch and clean processes  
 • Resistant to harsh chemical environments and external spraysdowns | • Improves yield  
 • Lower cost of ownership through increased tool uptime
No moving parts | • Does not generate particles  
 • Provides repeatable and reliable measurements | • Improves yields  
 • Improves throughput
Nonmetallic sensing technology | • Does not generate contamination | • Improves yields  
 • Lower cost of ownership through extended service time
Pressure output included | • Eliminate needs for additional instrumentation | • Lower overall tool cost  
 • Improves process control
Easy to retrofit and upgrade existing applications | • Adds flow and pressure measurement capability for high-temperature applications | • Improves process control on existing platforms

**performance**

- **Process temperature**: 10°C - 180°C (50°F - 356°F) (consult factory for specific application support and expanded capabilities)
- **Operating pressure**: 0 - 414 kPa (0-60 PSIG)
- **Flow measurement accuracy**: ±1% full scale > 20-100% of full scale flow range  
 ±2.5% full scale 10-20% of full scale flow range
- **Pressure measurement accuracy**: ±1% of full scale includes combined effects of linearity, hysteresis and repeatability

**frequently asked questions**

When should I use NT high-temperature flowmeter, model 4401 vs. NT electronic flowmeter model 4400?

NT model 4401 is recommended when process temperature is above 65°C (149°F).

When should I use a PFA vs. CTFE sensor interface?

- PFA should be used for solvents, select chemicals or if sensor module temperature could go above 40°C during purging.
- CTFE should be used for most aqueous chemical solutions and select solvents. The sensor module temperature must be maintained below 40°C during purging.

Please refer to chemical compatibility chart for sensing and control products:

How do I select a suitable flow range for a given chemical?

Please use our web based calculator to apply viscosity and density correction for all flowmeters:
http://www.entegrisfluidhandling.com/VDT/
NT Integrated Flow Controllers, Model 6510 and 6520

NT integrated flow controllers, model 6510 and 6520 are designed for critical dispense applications, chemical blending, on-demand chemical mixing applications.

- PTFE wetted surface for high-purity applications
- No moving parts offers reduced contamination potential
- Nonmetallic sensing technology based on differential pressure provides reliable measurement
- Compact design

NT model 6510 is ideal for aggressive chemical applications where accurate dispense or dosing is needed.

NT model 6520 is ideal for high-flow applications such as bulk delivery or tool liquid dispense.

### FEATURE

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>ADVANTAGE</th>
<th>BENEFIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTFE and other high-purity fluoropolymer wetted surfaces</td>
<td>• Corrosion resistant</td>
<td>• Maintains high purity process</td>
</tr>
<tr>
<td>Pressure output included</td>
<td>• Eliminates needs for additional instrumentation</td>
<td>• Improves metrology • Improves process control • Lowers cost</td>
</tr>
<tr>
<td>Compact footprint</td>
<td>• Easy for field installs and OEM designs with limited space</td>
<td>• Upgrades older equipment • Allows tool manufacturers to optimize space</td>
</tr>
<tr>
<td>Discrete alarm output</td>
<td>• Improved diagnostics</td>
<td>• Increases tool uptime by improved systems troubleshooting</td>
</tr>
</tbody>
</table>

### Performance

Enhancements to valve motor and diaphragm provide improved flow control, added safety and contamination protection.

<table>
<thead>
<tr>
<th></th>
<th>6510</th>
<th>6520</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor interface</td>
<td>CTFE, PFA</td>
<td>CTFE, PFA</td>
</tr>
<tr>
<td>Flow range</td>
<td>0-15 mL/min to 0-1250 mL/min</td>
<td>0-2.5 L/min to 0-40 L/min</td>
</tr>
<tr>
<td>Flow measurement accuracy</td>
<td>±1% full scale &gt;20-100% of full scale flow range</td>
<td>±2.5% full scale 10-20% of full scale flow range</td>
</tr>
<tr>
<td>Repeatability</td>
<td>±0.5% full scale &gt;20-100% of full scale flow range</td>
<td>±1% full scale 10-20% of full scale flow range</td>
</tr>
<tr>
<td>Pressure measurement</td>
<td>0-414 Kpa (0-60 PSIG)</td>
<td></td>
</tr>
<tr>
<td>Pressure accuracy</td>
<td>±1% of full scale</td>
<td></td>
</tr>
<tr>
<td>Process temperature</td>
<td>10 – 65°C (50 -149°F)</td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>852 cm³ (smallest IFC on the market)</td>
<td>1744 cm³</td>
</tr>
</tbody>
</table>

### Frequently Asked Questions

**What are the NT Integrated Flow Controller requirements?**
- Line pressure must be at least 10 PSIG
- Sizing for flow control: target flow (nominal flow) should be within 35 - 90% of a flow controller’s flow range
- Maximum working pressure: 60 PSIG

**Do bubbles affect pressure/flow measurement?**
No, NT Integrated flow controllers combine differential pressure based flowmeter and leading edge control valve to create a closed loop flow controller.

**What types of sensor interfaces are available?**
CTFE, PFA or CTFE (hydrofluoric acid compatible).

**How do I choose the right interface for my application?**
- CTFE should be used for most aqueous chemical solutions and select solvents
- PFA should be used for solvents, select chemicals and process temperatures above 40°C
- CTFE (Hydrofluoric acid compatible) should be used for HF applications

Please refer to chemical compatibility chart for sensing and control products:
pHasor X Heat Exchanger

Preserves absolute fluid purity with maximum heat control and transfer
- Ideal where fluid temperature control is desired
- The device is fully bonded without o-rings
- Constructed from 100% PFA
- Very low trace ionic metals: <10 µg/unit
- Optimized for low and high temperature aqueous applications like SC1, SC2, SPM, aggressive acids and bases.

**FEATURE** | **ADVANTAGE** | **BENEFIT**
--- | --- | ---
Large contact surface area from 0.3 m² to 0.8 m² | • Maximizes heat transfer and heat control during critical etching steps | • Higher yields and increased overall equipment efficiency
• Increased OEE through reduced process cycle time
O-ring free design | • Eliminates maintenance and material compatibility concerns while maintaining seal integrity and fluid purity | • Minimized particle-related wafer defects through optimal bath temperature control
• Both fluid streams remain separate
All PFA shell construction | • Provides excellent chemical compatibility and ensures chemical cleanliness and ultimate safety | • Safe and ultraclean, higher yield, needed for advanced technology nodes
• Increases OEE through reduced particle contamination
Compact, easy-to-install design | • Allows a controlled process fluid temperature with a low pressure drop over the fluid paths | • Increases equipment space savings

**frequently asked questions**

**What configurations are offered?**

PHX03 (0.3 m²) and PHX08 (0.8 m²) are offered to meet a variety of needs.

**What is the maximum heat transfer efficiency?**

- This efficiency has been rated between 4–12 L/min at 20 PSI line pressure
- The maximum heat transfer has been measured at 620–800 w/m² °K (110–140 BTU/hr. ft² °F)
NT Pressure Transducers

Provide accurate and reliable inert pressure measurements.

Measure gas or liquid pressure, allowing you to monitor process conditions for increased safety and system performance.

- No moving parts or fill fluids help reduce contamination potential
- Nonmetallic sensing technology provides reliable measurement
- Compact design
- Dymension manifold mountable
- Kalrez®, PTFE, Sapphire, PFA and CTFE

- Optimized for aggressive chemical applications.

**performance**

- Provides reliable pressure measurement where manual gauges only provide approximate pressure results
- Pressure transducers can help determine filter lifetime where critical contamination control is needed

**frequently asked questions**

Where can I use NT pressure transducers?

- System diagnostics
- System pressure monitoring for tool queuing
- Pressure at chemical distribution modules, valve manifold boxes and point-of-use
- Differential pressure in filtration systems
- Integrated into custom valve manifolds

Can NT pressure transducers, model 4100 be used in high-temperature applications?

Yes, contact Entegris for more information.

How long can model 4150 and 4250 survive 49% Hydrofluoric acid (HF) at 23°C?

Estimated 10 years.

How do I choose the right interface material for my application on pressure transducers, model 4100 and 4210?

- CTFE should be used for most aqueous chemical solutions and select solvents
- PFA should be used for solvents, select chemicals and process temperatures above 40°C.

For hydrofluoric acid applications, contact Entegris for more information.

Please refer to chemical compatibility chart for sensing and control products: http://www.entegris.com/Resources/assets/3960-2602-0912.pdf
Customized fluid control that optimizes space saving inside equipment, provides low cost of ownership and allows a wide range of valve types.

- Customized distribution manifold
- Modular method of mounting valves to a manifold block
- Optimized flow path
- Replaceable parts on the manifold (fittings)
- Interchangeable valves

Optimized for wet etch and clean applications and VMB replacement in chemical distribution.

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>ADVANTAGE</th>
<th>BENEFIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface mounted valves</td>
<td>Repairable</td>
<td>Increased equipment uptime</td>
</tr>
<tr>
<td>Low dead volume designs</td>
<td>Reduces internal volume</td>
<td>Efficient chemical flush out</td>
</tr>
<tr>
<td>Complex flow path and control in a single component</td>
<td>Smaller footprint</td>
<td>Lower cost of ownership (COO)</td>
</tr>
<tr>
<td>Integrated mixing</td>
<td>Reduces flow volume to mix point</td>
<td>Faster chemical mix response time</td>
</tr>
</tbody>
</table>

Media temperatures up to 160°C
- Media pressures to 80 PSI
- PFA and PTFE wetted surfaces for broad chemical compatibility
- Designed using computational fluid dynamics
  - Mixing analysis
  - Flow velocity
  - Pressure drop analysis and optimization

**frequently asked questions**

What is the process and how long does it take to create new manifold designs and prototypes?

- Design system and relevant schematic together with customer
- Perform computational analysis if required
- Manifold price quoted within two days of design freeze
- Drawings sent to customer for approval within 2–5 days
- Quick-turn prototypes completed in 2 weeks

What are the available valve options?

- Normally open/closed actuators
- Restricted actuation valves
- Manual toggle valves
- 3–way valves
- Needle valves
- Suckback valves
- Integrated fixed bypass valves
- 1⁄4”–1” orifice size valves

**Computational Fluid Dynamics**

- Mixing performance analysis
- Mixing analysis
- Flow velocity analysis

**Reduced Footprint**

Discrete component assembly (33 cm)

Equivalent function in a manifold solution (17 cm)
Entegris Analytical Services

Air sampling and analysis
- ASML® and Nikon® approved lab ISO 17025 accredited
- Serving OEM requirements for lens and filter change compliance programs
- Trouble shooting for AMC process and environmental issues
- Assessment of filter performance on track, scanner and HVAC systems
- Baseline studies for new fabs and cleanrooms

- Optimized for the detection of airborne molecular contaminants in air below 100 ppb, ambient and high pressure air analysis, photolithography applications, the validation and calibration of "online" or "continuous" monitors, and materials outgassing studies.

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>ADVANTAGE</th>
<th>BENEFIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-site service use impingers for cations (base) and anions (acids) and Tenax® for organics</td>
<td>Easy implementation on site, customized support</td>
<td>Optimization of airborne molecular control in the fab</td>
</tr>
<tr>
<td>Interstack filter sampling</td>
<td>Enables early warning before filter breakthrough</td>
<td>Preventive maintenance</td>
</tr>
<tr>
<td></td>
<td>33, 66 and 100 percent life control</td>
<td>Filter lifetime optimization</td>
</tr>
<tr>
<td>OEM approved lab, 20+ years experience in the semiconductor industry</td>
<td>Formatted reports in compliance with OEMs</td>
<td>Secure lens protection</td>
</tr>
<tr>
<td>Postmortem filter analysis Reports:</td>
<td>Data interpretation</td>
<td>Filter lifetime optimization</td>
</tr>
<tr>
<td></td>
<td>Removal efficiency</td>
<td>Better understanding of the process</td>
</tr>
<tr>
<td></td>
<td>Remaining capacity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Contaminants removed</td>
<td></td>
</tr>
<tr>
<td>Measurement of low molecular weight silicon organic compounds</td>
<td>Specific measurement of TMS, HMDSO and D3 levels in the photolithobay</td>
<td>Secure lens protection</td>
</tr>
<tr>
<td>ISO 17025 accredited lab</td>
<td>Highest quality and competence standards</td>
<td>Peace of mind for the customer, low failure rates, ease-of-use through trained operators</td>
</tr>
</tbody>
</table>

frequently asked questions
Are the Entegris labs approved by the scanner vendor serving OEM requirements for the lens compliance program?
Yes, Entegris is working with the OEMs and reports ambient and filter outlet analysis of acid, base and organic compounds as per the scanner manufacturer definitions of organics.

Entegris can also perform analysis to calibrate on-line monitoring devices, or to solve specific contamination issues in the fab.
### NORTH AMERICA

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Tel. +86 10 5107 8300  
Fax +86 10 5107 8326

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### Entegris regional customer service centers

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<tr>
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<td>800-763-5820</td>
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