



Pall Corporation



**P**ower  
**P**urity  
**P**erformance



Aria<sup>SM</sup> Membrane Filtration System



## Working to Make Water Pure

Water is an integral part of more products and industrial processes than any other liquid. Less than one percent of the world's water is suitable for use in products or for drinking. Industrial users compete with residential users for that clean water resource, be it supplied by municipalities or drawn from surface or groundwater sources.

Every water source has a certain degree of contamination. Surface waters can contain particles, protozoa and pathogens. Groundwater may contain corrosive metals and salts. Municipal water may contain treatment chemicals as well as all of the contaminants mentioned above. Intake water quality will vary widely depending on water source, upstream treatment, plant demand and season.

Water scarcity and source variability puts water dependent manufacturers at risk. That risk is magnified with market pressures from consumers and competition and regulatory pressures from government. Quality Control professionals and Facilities Engineers are challenged to remove the water risks, meet stringent water quality standards and reduce the total cost of operations.

The total cost of water includes more than just a single unit treatment process. Chemical consumption, energy use, downtime, labor time, factory space, as well as production and waste solids generation are all costs that must be factored into the equation. The technology solution must also be a commercial solution.

One membrane technology has proven its value in over 150 installations. It has consistently been the difference between highly variable, contaminated feed water and reliable intake water supply at a consistently high quality.

*That technology is the Pall Aria<sup>(SM)</sup> Membrane Water Treatment System.*



## Aria<sup>(SM)</sup> – Working for You

Pall's Aria<sup>(SM)</sup> water treatment systems are designed and built to produce water of a quality that meets the most stringent standards for process and potability.

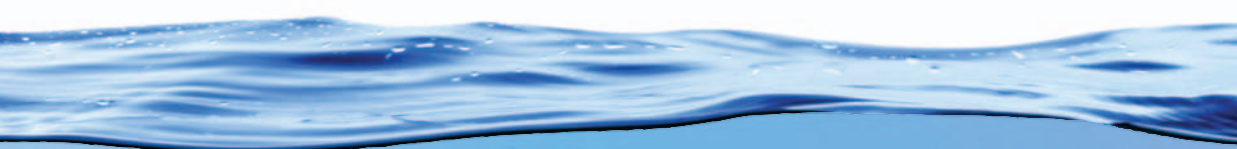
### Designed for Real Life

- Long Service Life Membranes
- Compact Add-On Modules
- Low Cost, Automated Operation

### Built for Performance

- Maximum Production & System Run Time
- Maximum Flux and Recovery
- Minimum Waste

Site testing confirms Pall Aria<sup>(SM)</sup> Systems meet or exceed EPA and FDA standards for safe drinking and process water.





## Working to Remove Feed Water Variability

Aria<sup>(SM)</sup> membrane systems remove the variability characteristic of different water sources. Predictable water quality means water that is free of particles and pathogens. Integrity and performance means you can depend upon a protected water supply suitable for people, products and downstream processes.

### Municipal Water

#### Removes:

- Flocculant and coagulant chemicals
- Fine particles, minimizing turbidity
- Bacteria, cysts, oocysts and spores
- Oxidized, precipitated iron and manganese
- Oxidized, coagulated Arsenic

### Ground Water

#### Removes:

- Fine and colloidal particles, minimizing turbidity
- Microbial pathogens from well water under the influence of surface water
- Oxidized, precipitated Iron and Manganese
- Oxidized, coagulated Arsenic

### Surface Water

#### Removes:

- Fine and colloidal particles minimizing turbidity
- Bacteria, cysts and oocysts drawn from rivers, streams, lakes and reservoirs
- Organics (with coagulation) to achieve DBP compliance

### Feed Water Guidance for Aria Systems

| Design Parameter       | Municipal Water  | Ground Water   | Ground Water                                    | Surface Water  | Surface Water  |
|------------------------|--|--|---|--|--|
| Water Type             | Tap Water  | Under influence of Surface Water   | Iron, Manganese, Arsenic                        | Low TOC, Turbidity                                       | High TOC, Turbidity                                      |
| Contaminants Removed   | Treatment Chemicals, Turbidity, Microbial, Fe, Mn, As                            | Turbidity and Microbial  | Iron, Manganese, Arsenic                        | Turbidity and Microbial                                  | Treatment Chemicals, Turbidity, Microbial, Fe, Mn, As    |
| Pretreatment Required  | None to oxidation, precipitation & coagulation                                   | None   | Oxidation & either precipitation or coagulation | Strainer   | Strainer, Oxidation or coagulation                       |
| Filtered Water Quality | Turbidity < 0.1 NTU; no detectable protozoan or bacteria; Fe, Mn, As < 0.05 mg/L | Turbidity < 0.1 NTU; no detectable protozoan or bacteria; Fe, Mn, As < 0.05 mg/L | Turbidity < 0.1 NTU, Fe, Mn, As < 0.05 mg/L     | Turbidity < 0.1 NTU; no detectable protozoan or bacteria | Turbidity < 0.1 NTU; no detectable protozoan or bacteria |





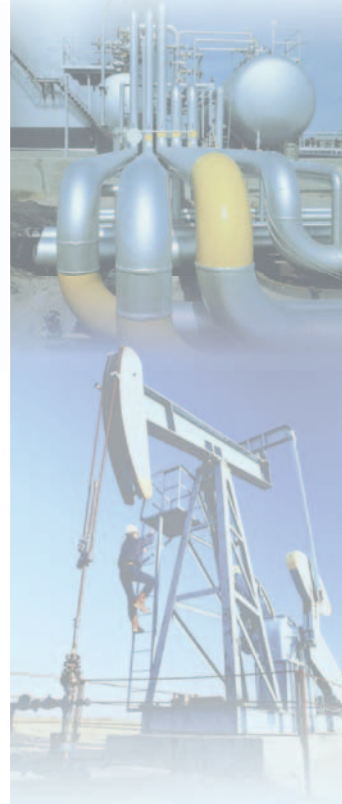
## Working to Remove Contamination

The Aria<sup>(SM)</sup> system is a pressure driven process that uses a semi-permeable (porous) membrane to separate particulate matter from soluble components in the carrier fluid. The pore size of the membrane controls the fraction of the particulate matter that is removed. Membranes having a smaller pore size remove more of the very fine matter, such as silica, bacteria, and parasitic cysts. Aria systems can be outfitted with either microfiltration or ultrafiltration membranes that retain particulate matter, while the fluid (e.g., water) and its soluble components pass through the membrane as filtrate, or filtered water. The retained solids, in concentrated form, are discharged from the membrane system as a waste stream.

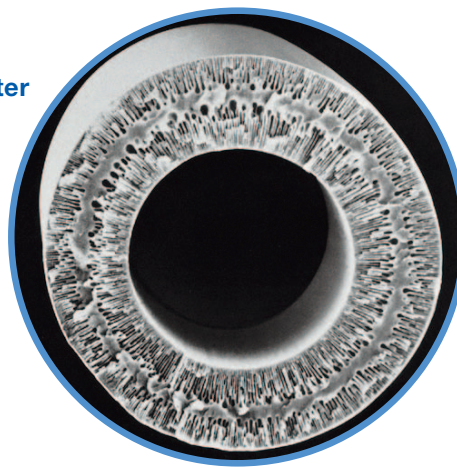
### Pall Membrane Microbial and Particulate Removal

| Contaminant                    | Typical Removal* |                 |
|--------------------------------|------------------|-----------------|
|                                | Microfiltration  | Ultrafiltration |
| Turbidity                      | To <0.1 NTU      | To <0.1 NTU     |
| <i>Giardia lamblia</i>         | > 6 log          | > 6 log         |
| <i>Cryptosporidium</i>         | > 6 log          | > 6 log         |
| <i>Escherichia coli</i>        | > 6 log          | > 6 log         |
| Bacillus Spores                | > 6 log          | > 6 log         |
| MS2 Coliphage or Bacteriophage | 0.5 – 2.5 log**  | 4.5 – 6 log     |

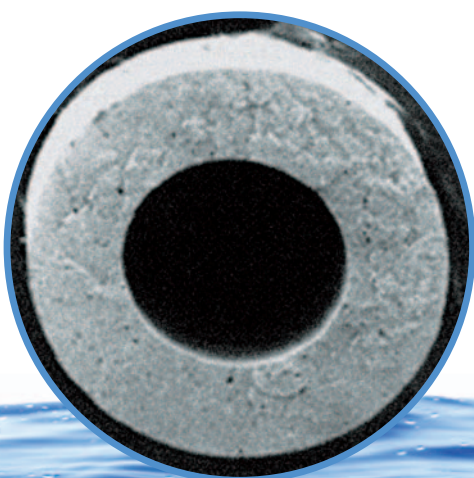
\*Based on third party testing. \*\* Virus removal varies depending on coagulation process upstream of system.



Ultra Filter



Micro Filter





## Working to make every drop count

Wherever water supply is scarce, investment in pure water is critical to plant operations and profitability. Transforming wastewater effluent into a reusable resource for direct reuse in cooling and heat transfer systems maximizes return. Pall Aria Quality water treatment ensures the optimal performance of nanofiltration, reverse osmosis and ion exchange systems by supplying drinking water quality feedwater. Pall Aria<sup>(SM)</sup> systems cost effectively remove bacteria and fine particles from salt water as well as biological plant and physical chemical plant effluents to help you combat water scarcity and maximize return on every water dollar invested.

### Salt Water

#### Removes:

- Colloidal particles minimizing Silt Density Index (SDI 2)
- Bacteria, cysts, oocysts and spores drawn from oceans, seas and brackish wells
- Natural Organic Matter (with and without coagulation)

### Wastewater Reclamation

#### Removes:

- Bacteria, Protozoans and spores found in biological effluent
- Fine and colloidal particles minimizing Silt Density Index (SDI 2)



## Working and Growing with your Company

Pall Aria<sup>(SM)</sup> systems are modular in design, allowing their owners to match treatment capacity with the demands of their process. Each system package contains a list of essential components supporting from 1 to 60 hollow fiber membrane modules depending on design flow. Optional components including pre-treatment skids, compressed air supply and extra monitoring instrumentation can be added on request. Auxiliary equipment, available on separate skids, is equipped with distributed controls that can be integrated into the main control system on the filtration skid to provide optimal, automatic system operation.

| Model Number | Maximum Number of Modules* | Typical Filtered Water Capacity Gpm [m3/hr]* | Dimensions: L x W x H – ft [m]        |
|--------------|----------------------------|--|---------------------------------------|
|              |                            |  | Installed                             |
| AP-1         | 2                          | 3-25 [1-6]                                   | 6 x 2.8 x 9.7 [1.8 x 0.9 x 3]         |
| AP-2         | 8                          | 10-50 [2.3-12]                               | 8 x 4.1 x 9.9 [2.5 x 1.3 x 3]         |
| AP-3         | 10                         | 25-175 [6-40]                                | 10 x 6.9 x 10.3 [3.1 x 2.1 x 3.2]     |
| AP-3x        | 20                         | 25-175 [6-40]                                | (1) 22.9 x 5.7 x 10.8 [7 x 1.8 x 3.3] |
| AP-4         | 36                         | 65-350 [15-80]                               | (1) 24 x 6.8 x 10.8 [7.4 x 2.1 x 3.3] |
| AP-6         | 60                         | 200-700 [45-160]                             | (1) 27 x 17 x 10.8 [8.3 x 5.2 x 3.3]  |

### Operating Conditions

| Maximum Inlet Pressure: | Maximum Temperature: | Minimum Temperature: |
|-------------------------|----------------------|----------------------|
| 44psi [3 bar]           | 104F [40C]           | 33F [1C]             |

\* Number of modules and flow ranges shown in table are based upon the use of microfiltration modules.  
 Note: The numbers shown in this table reference the standard Aria unit with plastic pipe construction.  
 Capacities and dimensions for stainless steel versions can be supplied upon customer request.

#### Standard Equipment & Process

- Membrane modules
- Automated Flux Maintenance
- Automatic & manual valves
- Automatic integrity test
- Automatic backwash pre-filter
- Flow, pressure & temperature monitoring
- Feed CIP tank & pump
- Reverse Filtration tank & pump
- PLC controls & trending

#### Optional Equipment

- Remote Access Modem
- Automated Enhanced Flux Maintenance (EFM) System
- Dedicated Data Recorder
- Operator Interface & Data Acquisition PC
- Feed or Filtrate Turbidimeters
- Air Compressor Systems
- Dosing Systems – Oxidant, Coagulant & Disinfectant
- CIP Storage & Dosing Systems
- Alarm Auto Dialer



## Pall SS Aria System for Sanitary Applications

In order to satisfy the design and operating requirements of some specialized water applications, Pall offers a stainless steel version of the Aria AP membrane treatment system. The variability in plant feed water due to particles and bacteria is eliminated by our membrane separation ensuring the optimal performance of any downstream treatment processes and, in many cases, protecting customer products and processes. These membrane filtration systems are custom designed to meet the plant piping, electrical and equipment specifications of the customer.



Each stainless steel Aria system employs hollow fiber, microfiltration and ultrafiltration membranes that provide the same excellent treated water quality as the standard Aria AP systems. Automated membrane integrity test, flux maintenance, enhanced flux maintenance, simultaneous air-scrub-reverse-filtration are all key performance functions included in the SS Aria systems. In addition, each membrane system including modules and components can be subjected to caustic, oxidant and acidic solutions commonly utilized in sanitary applications.

Pall Corporation will tailor the stainless steel system configuration and component materials to meet 3A or other industry or customer design specifications for hygienic and sanitary use in biopharmaceutical, food & beverage and other sensitive industrial sectors. Each Aria membrane filtration system is subjected to ISO 9001 quality assurance procedures for design and manufacturing such that it meets the highest standards for materials and performance.







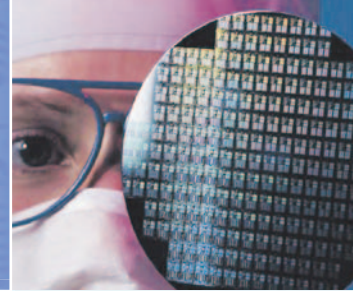
## Aria Process and Operation

### Production (Forward Filtration)

Feed water enters the bottom of the module and is distributed uniformly to the outside of the hollow fibers. Depending on feed water quality, a small amount of the feed may be circulated outside of the hollow fibers. This small cross flow prevents accumulation of membrane fouling material and debris on the surface of the membrane or within the module. The water, being under pressure, passes through to the core of the hollow fiber membranes. Filtered water flows from the fiber cores to the top of the module where it is conveyed by a filtrate header to distribution or other downstream processes.

### Flux Maintenance

As water is filtered, rejected particulate may accumulate on the membrane fiber's surface or within the membrane module. A flow restriction may occur, resulting in an increase in pressure across the membrane, commonly known as trans-membrane pressure (TMP). The Aria<sup>(SM)</sup> system is designed with an automated flux maintenance procedure that will be initiated upon reaching a trigger TMP or according to a timer, depending on the customer preference.





## Aria<sup>(SM)</sup> Process and Operation

The flux maintenance procedure comprises simultaneous Air Scrubbing and Reverse Filtration followed by Forward Flush. Air Scrub (AS) involves the injection of air at low pressure into the feed side of the module. This dislodges debris from the fiber bundle and within the module. Simultaneously, clean filtrate that has been collected in the Reverse Filtration (RF) tank is pumped in the reverse direction through the hollow fibers. A forward flush of feed water sweeps the dirt, debris, air and water from the shell side of the module out of the filtration system to drain. This fully automated cycle is included in every Aria<sup>(SM)</sup> System and serves to prevent the membranes from building up fouling material, maintain operating pressures at low levels and keep the Aria system producing clean water.

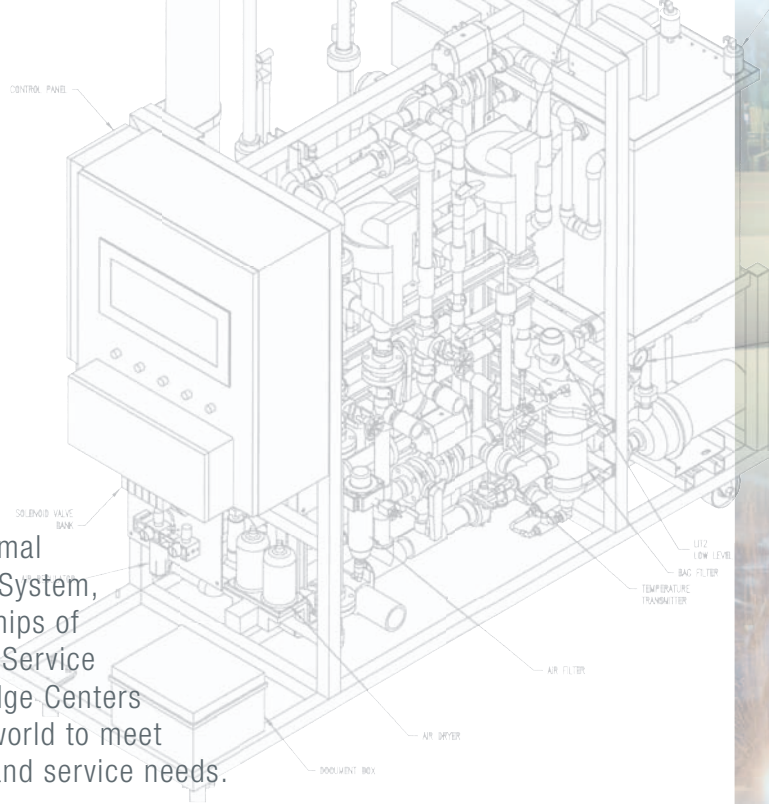
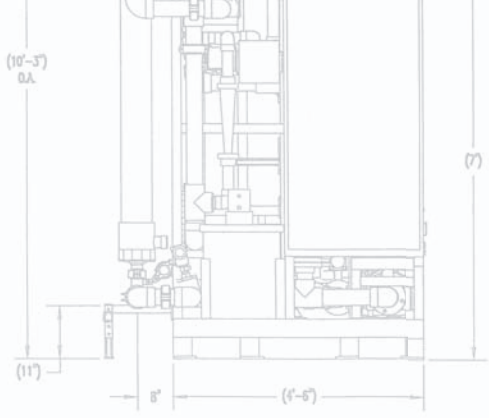
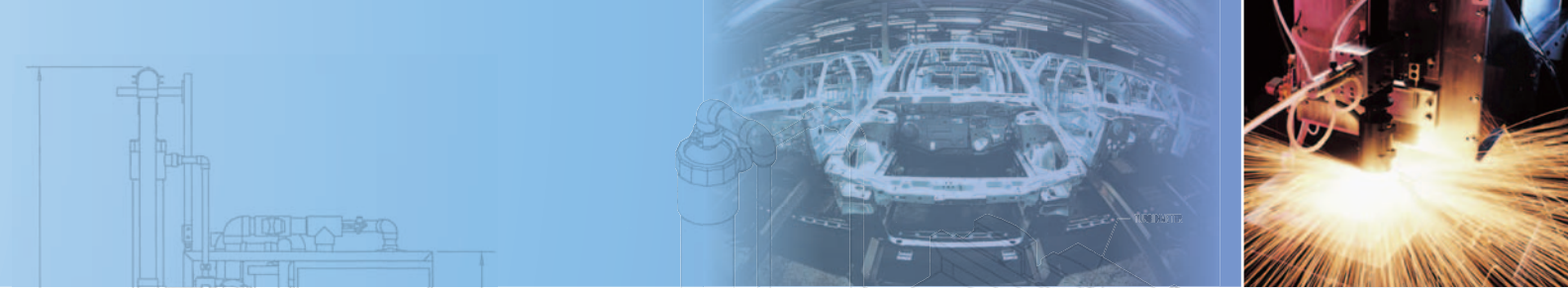
### Enhanced Flux Maintenance (EFM)

Depending upon the feed stream, difficult fouling materials may build up on the membrane or within the module. In order to maximize treated water production and system efficiency at a low cost, Pall Corporation developed the Enhanced Flux Maintenance (EFM) technique. EFM is a patent pending, fully automated process that uses hot water with mild chemical solutions tailored to specific foulants that may be present in the application. Using EFM results in a smaller system footprint, a lower average transmembrane pressure and reduced pumping energy costs. The hollow fiber used in the Aria system has demonstrated that it can be subjected to thousands of EFM cycles with no reduction in service life. The Aria control system also allows seamless integration of EFM into the treatment process where warranted by feed conditions.

### Chemical Clean In Place (CIP)

Depending upon feed water quality, an occasional CIP process may be necessary. The Aria CIP process is a 2 step protocol using first a caustic with oxidant solution and then acidic solutions. This process will return the modules to "nearly new" condition and can be performed hundreds of times over the life of the modules. Due to the low frequency of CIP cleanings, the process is designed for semi-automated operation. The rinse cycles are programmed for manual initiation. This process requires the operator to "setup" the system for CIP by turning 5 manual valves.





## Service & Support

In order to maintain the optimal performance of your Aria<sup>(SM)</sup> System, Pall offers ongoing partnerships of service and assistance. Pall Service Specialists and Pall Knowledge Centers are located throughout the world to meet our customer's application and service needs.

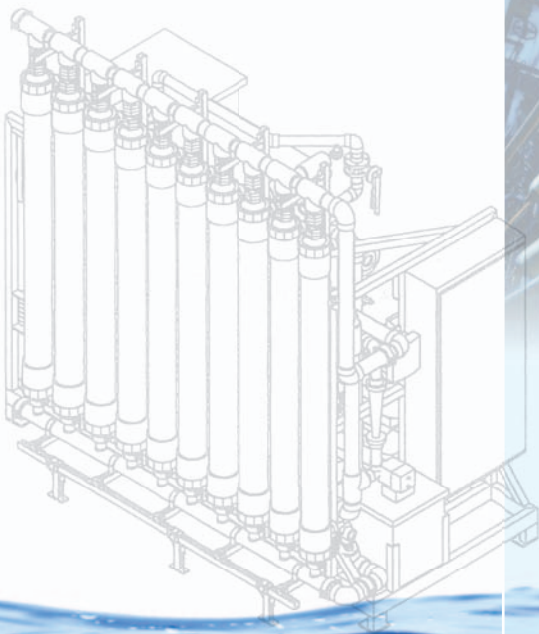
Online remote (via modem) monitoring of Aria system performance by Pall Membrane Service specialists is a feature frequently utilized by our customers.

This ensures that water dependent production processes are vigilantly monitored and process challenges are anticipated.

Several membrane maintenance contract packages are available from Pall.

They range from continuous services to monthly and quarterly inspections and interaction with your staff.

Contact your local Pall representative to obtain more information.





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*Filtration. Separation. Solution.<sup>SM</sup>*

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