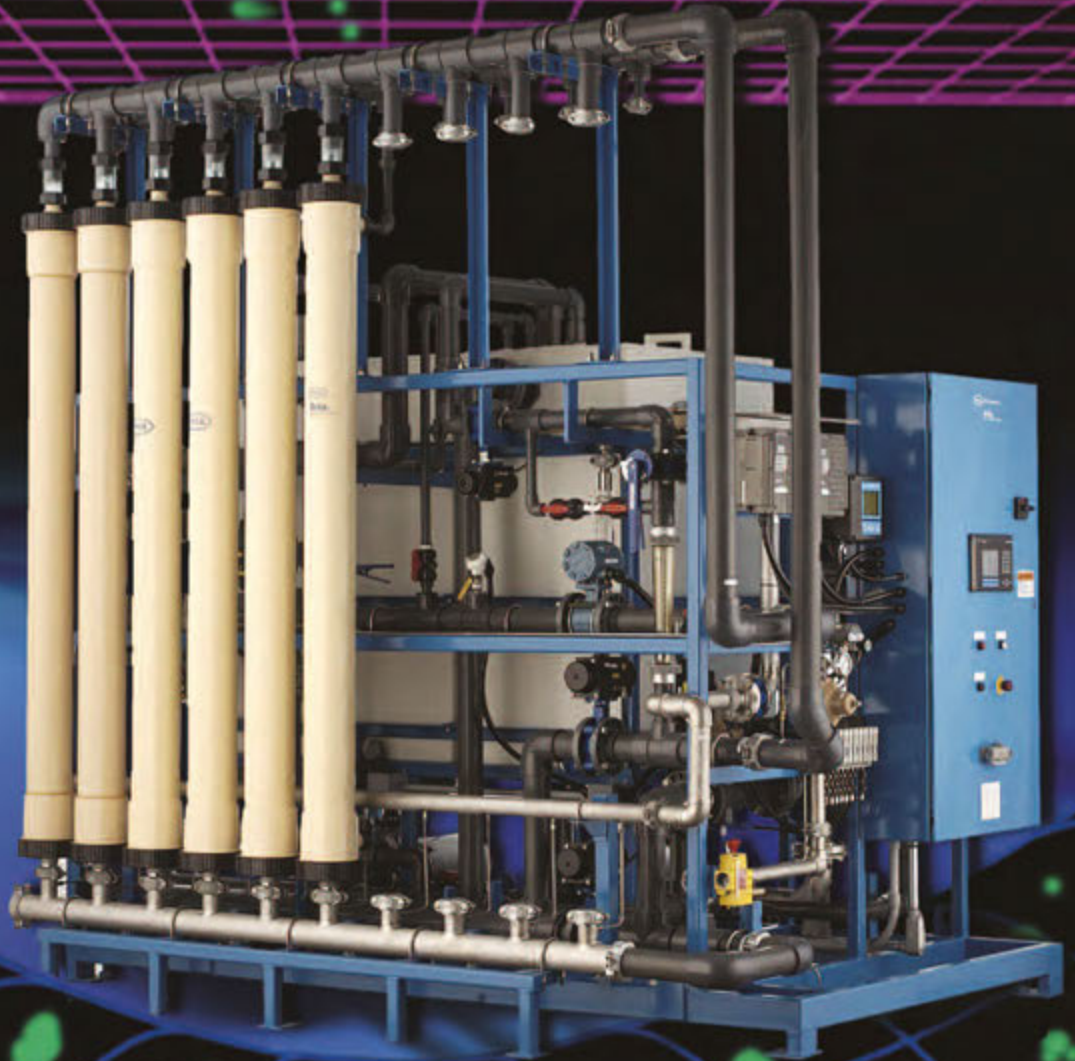




Pall Corporation

Pall Aria™
AP Series
Packaged
Water
Treatment
Systems



Filtration. Separation. Solution.™

Pall Aria™ AP Series Packaged Water Treatment Systems

Installations

Point Hope, AK

Wainwright, AK

Nuiqsut, AK

Point Lay, AK

Atkasuk, AK

Anchorage, AK

Kaktuvik, AK

Kernville, CA

Burbank, CA

Membrane Filtration for Safe Drinking Water

Pall Aria™ AP water treatment systems are specifically designed to produce drinking water that meets today's stringent standards. The systems use uniquely designed filtration modules in a hollow fiber configuration to remove the following contaminants from surface and ground water sources.

- Suspended solids/turbidity
- Viruses
- Bacteria
- Cysts and oocysts
- Iron and manganese
- Arsenic
- Organics


The Microza¹ hollow fiber membranes are highly permeable, resulting in high water production rates. Each hollow fiber module provides high active surface area of up to 538 ft². Pall's dedication to a simplified process and control design has produced a family of systems that are characterized by:

- Tough, hollow fiber membranes with long service life
- Operator-friendly controls
- Simple surface water treatment without coagulation
- Unique air scrub and flush operation
- High efficiency and low waste
- Excellent compatibility with chlorine and common treatment chemicals
- Minimal cost of operation
- Easy installation using modular skids
- Compact system footprint
- Full system NSF 61 listing
- ISO 9001 certified manufacturing
- ETV certified for surface water treatment rule

Site testing confirmed Pall Aria AP systems meet or exceed US EPA standards for safe drinking water. The system is also the first to receive 'full system' certification in accordance with ANSI/NSF 61 specifications.

¹ Microza is a registered trademark of Asahi Kasei Corp., Ltd.





Membrane filtration is a pressure driven process that uses a semipermeable (porous) membrane to separate particulate matter from soluble components in the carrier fluid, such as water. In Pall Aria AP systems, microfiltration or ultrafiltration membranes act much like a very fine sieve to retain particulate matter, while water and its soluble components pass through the membrane as filtrate, or filtered water. The retained solids are concentrated in a waste stream that is discharged from the membrane system. The pore size of the membrane and the integrity of the sealing mechanism controls the fraction of the particulate matter that is removed. Microza membranes, with their fine pore size and absolute seal, remove virtually all of the fine matter, such as silica, bacteria, and parasite cysts.



Pall Aria AP Systems - Overview

Installations

Forestville, CA

Avon, CO

Pinellas Park, FL

Hobart, NY

Youngs River, OR

Beverly Beach Park, OR

Bullards Beach, OR

Astoria, OR

Hite Marina, UT

Transforming Water from Any Source to Match Your Requirements

Pall Aria AP water treatment systems are used to filter ground and surface waters for drinking water supply and industrial uses, and secondary wastewater effluent for reuse.

Ground Water

- Lowers turbidity and removes microbial pathogens from ground water under the influence of surface water.
- Removes iron and manganese with oxidation.
- Removes arsenic with coagulation.

Surface Water

- Lowers turbidity and removes microbial pathogens from raw water drawn from rivers, streams, lakes, and reservoirs.
- Removes organics with coagulation to improve disinfection by-products rule compliance, taste, and odor.

Secondary Wastewater Effluent

- Removes suspended solids and reduces SDI prior to RO treatment for reuse.
- Removes bacteria and other pathogens and suspended solids to produce water suitable for landscape irrigation and similar reuse applications.

Pall Membrane Microbial and Particulate Removal

Contaminants	Typical Removal ²	
	Microfiltration (MF)	Ultrafiltration (UF)
Giardia	>6 log	>6 log
Cryptosporidium	>6 log	>6 log
MS2 Coliphage or bacteriophage	0.5 – 2.5 log ³	4.5 – 6 log ³
Turbidity	<0.1 ntu	<0.1 ntu

² Based on third party testing.

³ Virus removal varies depending on coagulation process upstream of system.



Pall Aria AP Systems - Specifications

Packaged for Fast, Easy Installation

Pall Aria AP water treatment systems are highly flexible production-scale membrane filtration packages, designed to filter a wide range of feed streams. Standard systems are available in the following skid-mounted configurations.

Standard System Specifications

Model Number	Maximum Number of Modules	Filtered Water Capacity (gpm [m ³ /hr])	Dimensions (L x W x H : ft [m])	
			Shipped ⁴	Installed
AP-1	2	3-25 [0.7-5.7]	6.1 x 2.8 x 6.5 [1.9 x 0.9 x 2.0]	6 x 2.8 x 9.8 ⁷
AP-2	8	10-50 [2.3-11.4]	8.1 x 2.8 x 6.5 [2.5 x 0.9 x 2.0]	8 x 4.1 x 9.9 ⁷
AP-3	10	25-150 [5.7-34.1]	8.2 x 5.7 x 7.5 [2.5 x 1.7 x 2.3]	9.5 x 6.9 x 10.3 ⁷
AP-3x	20	25-150 [5.7-34.1]	8.2 x 5.7 x 7.5 [2.5 x 1.7 x 2.3] ^{5,6}	8.8 x 18.6 x 10.8 ⁵
AP-4	36	50-350 [11.4-79.5]	10 x 6.8 x 7.7 [3 x 2.1 x 2.3] ^{5,6}	10.8 x 20.8 x 10.8 ⁵
AP-6	60	200-850 [45.4-193.2]	10 x 6 x 6.8 [3 x 1.8 x 2.1] ^{5,6,8}	19.1 x 17 x 10.8 ^{5,8}

⁴ Crating: Add 0.5 ft [0.15 m] to each dimension.

⁵ Module rack is off the skid.

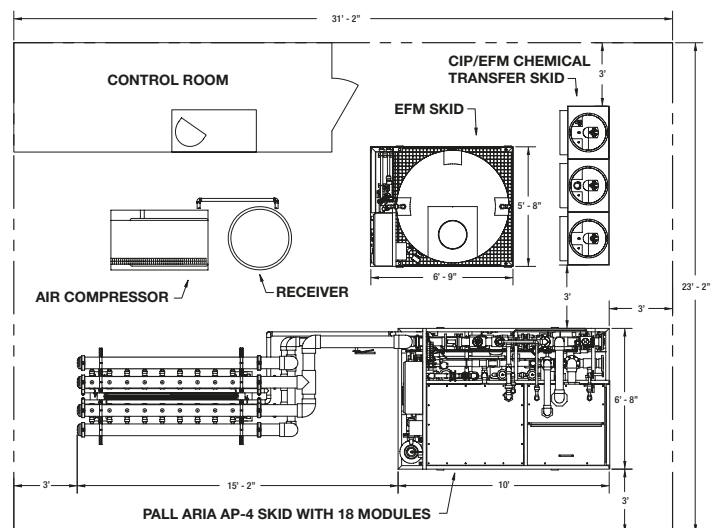
⁶ Module rack shipped as crated parts kit.

⁷ Control skid with attached module rack.

⁸ Two freestanding tanks 5'6" W x 7'6" H, shipped separately for each skid.

Optional and Auxiliary Equipment

- Modem for remote access
- Auto dialer for alarms
- PC for operator interface terminal and data acquisition
- Feed or filtrate turbidimeters
- Oxidant dosing systems
- Air compressor systems
- Enhanced Flux Maintenance (EFM) systems to reduce system costs
- Disinfectant dosing systems
- Coagulant and clean-in-place (CIP) chemical
- Storage dosing systems
- Filtrate particle counter



Typical treatment plant layout for 500,000 gallons per day

Auxiliary equipment to improve treatment capabilities is available on separate skids, which are equipped with distributed controls that can be integrated into a master control system to provide optimal, automatic integrated system operation.

Installations

Basalt, UT

Lake Powell UT

Stoney Creek, VA

Ashford, WA

Meeteetse, WY

Point of Rocks, WY

Manati, Puerto Rico

Burleigh Falls, Canada

Bruce Mines, Canada

Panel Ray, Mexico

Standard Components

A standard Pall Aria AP packaged system consists of 1 to 60 membrane modules, one feed/CIP tank and pump, one reverse filtration tank and pump, manual and automatic valves, flow meter, pressure and temperature sensors, PLC control, control panel, and a painted carbon steel frame. Other items can be added on request. Separate auxiliary skids are available for compressed air and chemical feed/pre-oxidation.

- Painted carbon steel frame
- 316 SST pumps with TEFC motors and VFDs
- PVC and stainless steel piping
- Butterfly valves (manual and air operated)
- PE tanks with level control
- PLC controls and software
- Instrumentation (digital and 4-20 ma analog signal)
- NEMA-4 electrical enclosures

Operating Conditions

- Maximum inlet pressure: 3 bar (44 psi)
- Maximum operating temperature: 40°C (104°F)
- Minimum operating temperature: 1°C (33°F)

Utility Requirements

Electrical Connection

AP 1:	1 ph	230v	50 A
AP 2:	1 ph	230v	30 A or
	3 ph	230v	25 A or
	3 ph	460v	15 A
AP 3/3x:	3 ph	230v	40 A or
	3 ph	460v	25 A
AP 4:	3 ph	460v	40 A
AP 6:	3 ph	460v	70 A

Other voltage can be accommodated, if required. Water supply for CIP: 25-35°C (75-95°F)



Module cutaway showing hollow fibers

Microza Hollow Fiber Microfiltration Module⁹

- Membrane material: PVDF
- Pore rating: 0.1 micron (μm)
- Fiber OD/ID: 1.3 mm/0.7 mm
- Active filter area: 538 ft²
- Module size: 6" diameter x 79" long
- Housing: ABS
- Gasket: EPDM
- Potting material: Urethane

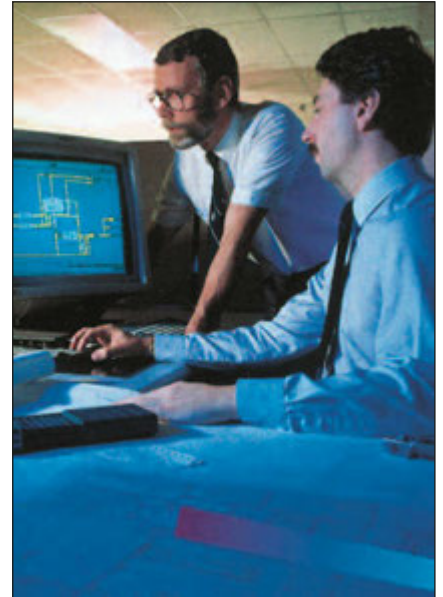
⁹ Ultrafilters also available

NSF System Listing

Pall's family of hollow fiber membrane systems were the first "full systems" to be listed in accordance with ANSI/NSF 61 specifications. The Pall Aria AP system is manufactured from NSF-approved materials and meets all requirements for potable water service.

ISO 9000 Certification

Pall's North American manufacturing, engineering, sales, and marketing operations have received ISO 9001 registration from Lloyd's Register of Quality Assurance Limited. ISO 9001, which also covers design and development functions, represents the highest, most comprehensive level of ISO 9000 certification. The quality system and procedures are regularly audited to assure compliance and proper record keeping before the certification is renewed.



Pall R&D team members

Pall Aria AP Systems - Operations

Clean Water, Clean System

Filtration (Normal Production)

Feed water enters the bottom of the module and is distributed uniformly to the outside of the fibers. Since it is under pressure, the water passes through the hollow fiber membranes, and filtered water exits through the top of the module. Under normal conditions, all of the feed water flows through the membranes and exits as filtered water. Depending on the feed quality, a small amount of the feed water may be circulated past the outside of the hollow fibers. This flow prevents the accumulation of foulants and debris on the surface of the membrane and helps to evenly distribute flow through the membrane fibers.

Flux Maintenance (FM)

As water is filtered, rejected particulate accumulates in the module on the surface of the membrane fiber. The effect is a flow restriction in the module, resulting in an increase in transmembrane pressure (TMP). FM is a two-step process, consisting of simultaneous air scrubbing (AS) and reverse filtration (RF), followed by flushing with feed or filtered water. This is a mechanical process to remove the debris from the module and reduce the rate of overall increase in transmembrane pressure.

Flux maintenance is initiated at a preset interval of water throughput or, as a secondary trigger, by a preset time interval. The air valve opens and air is injected at low pressure into the feed side of the module. At the same time, filtered water that has been collected in the RF tank is pumped in the reverse direction through the module and out through the main system drain. Air and RF flow are then stopped. At this point, most, if not all, accumulated debris in the module has been swept to drain.

To complete the cycle, a flush is performed by circulating feed or filtrate, depending on raw water quality, at high velocity from the feed/RF tank along the outside and then the inside of the membrane fibers. This last flow of liquid is directed through the excess recirculation port of the module to drain. This further dislodges and removes debris from the module that was captured by the membrane fibers.

Pall Aria AP systems perform this fully automated cycle every 20 - 120 minutes, interrupting forward flow for about 1.5 - 2 minutes.



Enhanced Flux Maintenance (EFM)

To ensure maximum efficiency and lowest total cost of ownership, Pall developed an enhanced cleaning technique to keep the membranes free of fouling materials. EFM is a fully automated process that uses water with mild chemical solutions to significantly reduce TMP. A reduction in TMP decreases pumping energy and results in fewer modules, which in turn scales down the system footprint and lowers facility heating and cooling costs.

The highly crystalline polyvinylidene fluoride (PVDF) hollow fiber membranes that are part of every Pall Aria AP system make EFM possible. These fibers are exceptionally strong and chemically resistant, with a life of 10+ years, even with daily EFM. When changes in water conditions make EFM unnecessary, the on-board control system disables it, increasing efficiency of the Pall Aria AP system.



Chemical Clean-in-Place (CIP)

Backwash and EFM are designed to remove particulate matter and foulants. In most applications, it will occasionally be necessary to execute a complete CIP process. The CIP process is a two-step protocol using a caustic solution with chlorine and an acidic solution. This process will return the modules to nearly new condition and can be performed hundreds of times over the life of the modules.

Since CIP operation is infrequent, the process is semi-automated. The cleaning and rinse cycles are programmed for manual initiation and require minimal operator intervention.



Pall Aria AP-4 System



Pretreatment Requirements

Pall Aria AP water treatment systems provide reliable, low maintenance performance. A 400 μm strainer is included on the feed water line to prevent debris from clogging small passages in the system.

Enclosures

A heated structure is required where freezing temperatures are expected. A roof may be required in other areas to prevent damage from sunlight and high temperatures.

A pre-engineered metal, concrete, or wood frame building is acceptable and can be designed to address many aesthetic concerns.

Seismic Design

The skid can be modified for use in Seismic Zone 4 areas (highest hazard). An anchoring plan will be furnished upon request.

CIP Conditions

Pall recommends that all chemicals for treatment and CIP be purchased in solution form. Water for CIP should be heated to 31-38°C (90-100°F). Contact Pall to obtain the recommended CIP procedures and specifications for chemicals.

Wastewater Disposal

The FM wastewater and CIP and EFM wastes can be discharged to a sanitary sewer, if available. In areas without sanitary sewers, the FM wastewater can be discharged to a settling pond to remove suspended solids.

The clarified supernatant may be discharged to a local receiving stream or recycled to the plant feed water. Pilot testing may be required before recycling the supernatant. If sanitary sewers are unavailable, CIP and EFM wastes should be combined and neutralized prior to collection and disposal by a waste hauler. These wastes can be disposed of like septic system sludge. The customer is responsible for contacting the local regulatory agencies and obtaining the appropriate permits and approvals before initiating any discharge of process wastewater.

Contact Us for Support or Information

Remote online monitoring of system performance by Pall water specialists and membrane maintenance contracts are available from Pall. Contact your local Pall representative or Pall Corporation to obtain more information.





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WP-300e

Produced in the USA

August 2011