CRITICAL PROCESS FILTRATION, INC.

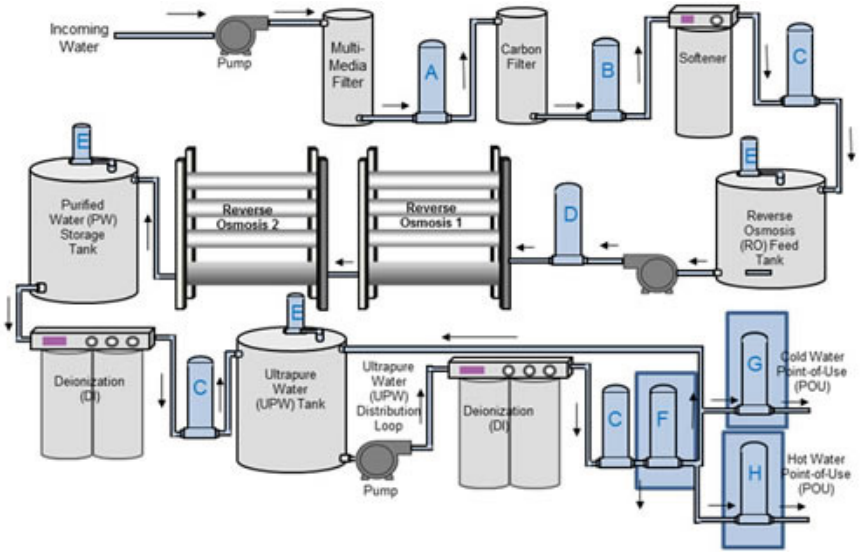
Filters in Electronics and Semiconductor Ultrapure Water Systems – An Overview

The general practice in semiconductor ultrapure water (UPW) system operation is to seal the entire system from the second reverse osmosis unit downstream and not open it for 2 to 3 years. The reason for this is that it takes a long time for a system to 'rinse up' to ultra-purity after it has been opened, and the entire plant must be shut down during that time. Downtime means lost revenue, which can add up quickly in the semiconductor business.

The first RO unit in the system shown in Figure 1 is the equivalent of a prefilter in most other systems. The second RO unit only removes trace contaminants remaining after the first RO unit and the membranes are expected to last for 3 years or more with no cleaning or other maintenance required. With the exception of the pre-RO filters, all of the filters are expected to operate at peak efficiency for the entire time a set of membranes is in place.

Below are brief descriptions of the filters shown in Figure 1. Following that overview is a list of possible filter media for each application.

Figure 1 - Filters in an Electronics/Semiconductor Water System



A - Large Particle Trap Filter
B - Carbon Fines Trap Filter
C - Resin Trap Filter
D - RO Prefilter
E - Tank Vent Filter
F - Loop Filter
G - Cold UPDI Water POU Filter
H - Hot UPDI Water POU Filter

Filtration Steps in Ultrapure Water Treatment

In most cases, the water entering a reverse osmosis (RO) system is filtered to remove larger particles, larger meaning bigger than 1 to 5 microns, depending on the system. Removing these particles prevents premature fouling of the reverse osmosis membranes, which are a critical and expensive component for water treatment. Downstream filtration assures the continued purity of the water as it is recirculated through a distribution loop and as the water is used in various fabrication operations.

The quality of the incoming water determines how much filtration is needed to protect the RO membranes. Figure 1 shows the most complete pre-RO filtration system. Many systems using municipal water will need few of these pre-RO components.

Large Particle Trap Filtration (Housing A)

Systems using well water or other raw, untreated water often use a multi-media filter (sand filter) before the water enters the treatment system. In most cases, water from municipalities does not require this step. The sand filter could release small particles that should be removed before they reach downstream components and clog them or otherwise interfere with their operation.

Carbon Fines Trap (Housing B)

The activated carbon filter shown in the diagram is typically a granular carbon filter that removes chlorine, chloramine, and other dissolved organic materials from the water supply. This protects downstream treatment components, particularly RO membranes, from oxidation. Unfortunately, all carbon filters produce carbon fines, so the trap filters are needed protect downstream equipment.

Resin Trap (Housing C)

There are two resin-based treatment processes illustrated in the system diagram, water softening and deionization. Most pharmaceutical water systems will use these resin based processes. In both cases, the resin beads installed to treat the water will break down over time and introduce resin fines into the water supply. Filters are used to trap the fines and prevent them from harming the processes downstream.

RO Prefiltration (Housing D)

The most important particle filter is the RO prefilter. This filter protects the high pressure RO pump and keeps particles from reaching the RO membranes. Reducing particle loads prevents membrane fouling and performance loss due to particles. Longer membrane life means reduced system cleaning and maintenance expenses as well as lower replacement costs over the life of the system.

Filters in the Distribution Loop

The water in the distribution loop portion of the system is extremely pure and has few particles. The filter shown in the distribution loop in Figure 1 (Housing F) is only an 'insurance policy' against potential system disruption. One potential disruption is bacterial contamination. There may also be particles generated by the simple wear and tear on components like pumps and valves from long term system operation.

Loop filters are usually rated at 0.03 micron or smaller and prevents bacteria or small particles from being sent to sensitive production processes.

Point-of-Use Filters

Point-of-Use filters for either cold water or hot water (Housings G and H) are not usually in the water system but located just before or inside the actual process tools. As with the filters in the distribution loop, these are usually rated 0.03 micron or smaller and capture bacteria or particles just before the water comes in contact with the semiconductor, media or panel components being fabricated.

Figure 2 – Critical Process Filtration's Melt-Blown and Nano-Spun Polyproplyene filters and pleated depth media filters for prefiltration are available in a wide variety of configurations to fit existing housings

Filter Options

The table below shows the various filters available through Critical Process Filtration for applications in ultrapure water systems.

Melt-Blown Polypropylene or Nano-Spun Polypropylene depth filter cartridges are commonly used for RO prefiltration. These products have a high capacity for silt or sediment compared to most depth filter products.

For higher holding capacity and longer filter life in RO prefiltration, pleated polypropylene depth filters may be chosen. They have several times more surface area than melt-blown or nano-spun depth filters and will hold a much higher quantity of sediment or silt. The resulting increased life reduces the need for system maintenance and helps maintain high system uptime. Pleated filters do generally cost more than standard depth filters, but the labor savings from reduced filter change frequency and increased uptime make pleated filters economical in UPW systems.

Critical Process Filtration pleated membrane filters are available for bacteria and particle removal in appropriate pore sizes. The filters are rinsed and dried before packaging for fast rinse-up to ultrapure resistivity and rinse-down to low TOC levels.

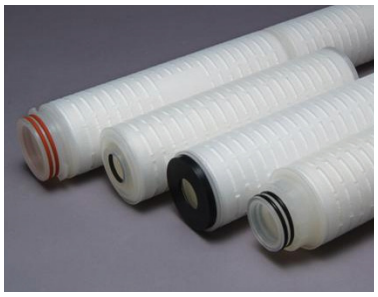


Figure 3 – Critical Process Filtration's Hydrophilic membrane-based filters are used to remove ultrafine particles and bacteria from water.

Contact Critical Process Filtration for assistance in determining the best filter options for your system. Visit our website at www.criticalprocess.com for more information and to access datasheets for all of our products.

Media Options for Filtration in Electronics and Semiconductor Ultrapure Water Systems

Process Area	Filter Application	Filter Function	Critical Process Media*
Ultrapure Water Systems for Electronics/ Semiconductor	Particle Removal and RO Prefiltration	Remove particulates that might prematurely foul membrane or interfere with membrane performance	MB, NS, PD
	Loop Filtration	Remove bacteria and ultrafine particles from water. Charged membrane for removal of some organic contaminants	NC, NM, PS
	Point-of-Use Filtration	Remove ultrafine particles at or in tools just before water use in production	NC, NM, PS

*Media Codes

MB - Polypropylene Melt Blown Media
NS – Nano-Spun Polypropylene Media
NC – Positively Charged Nylon 6,6 Membrane
PD - Polypropylene Pleated Depth Media
NM – Nylon 6,6 Membrane
PS – Polyethersulfone (PES) Membrane

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