CRITICAL PROCESS FILTRATION, INC.

Buying Guide

Filter Options for Process Water Systems

Process Water Systems

Filters are used to protect water treatment processes and final water quality. They prevent possible contaminants from source water entering the system. Filters remove particles that might be generated by parts of the treatment system. They also act as a barrier against environmental microorganisms and remove bacteria and other organisms that might enter the system from a variety of sources.

Source water entering any facility can carry both inorganic particles and microorganisms. Cartridge filters are a cost effective method of controlling these contaminants both as the water enters a facility and as it is processed.

Bacteria, yeasts, molds and other organisms can be found everywhere. They can find their way into the treatment process through raw water, the facility environment, even on system components. Cleaning and operating procedures might reduce the number of organisms, but no cleaning method can prevent environmental organisms from re-entering equipment as soon as the cleaning process is done.

The figure below is a schematic of a multi-step water treatment system. It is not specific to any industry, but does show almost all of the water treatment system components and the filters used in most industries. Following the schematic are brief descriptions of the types of filtration applications and the filters most often used in each.

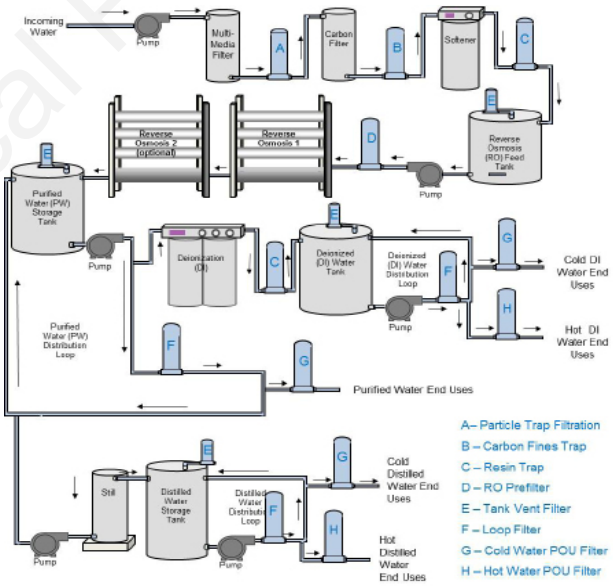


Figure 1: Filtration in Process Water Treatment

Particle Removal & Prefiltration

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 allows the initial treatment steps to perform without interference from particle contaminants. The most important function of particle removal is preventing the premature fouling of the reverse osmosis membranes, which are a critical and expensive component for water treatment.

The quality of the incoming water determines how much filtration is needed to protect the initial treatment components and RO membranes. The figure on the previous page shows a complete system for use with raw water from a well or surface source. Many systems using municipal water will need few of these components. Below is a brief explanation of each particle filter and its function.

Particle 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 source water. This protects downstream treatment components, particularly RO membranes, from oxidation. Unfortunately, all carbon filters release fine carbon particles, so trap filters are needed to protect downstream equipment.

Smaller systems utilize activated carbon block cartridge filters, such as Critical Process Filtration's ACB Activated Carbon Block cartridges, instead of granular carbon beds. Due to their method of construction, carbon block filters do not shed carbon fines after a short initial rinse, making a downstream filter unnecessary.

Resin Trap (Housing C)

The resin-based treatment processes shown in the system diagram are a water softener and a deionization system. Removing hardness ions (calcium, magnesium, etc) helps prevent premature fouling of RO membranes. Removing other ions is a requirement for many high-purity water applications in laboratory, healthcare, pharmaceutical and other facilities. The resin beads installed in softeners and deionization beds 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 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 membranes. Reducing particle loads prevents membrane fouling and membrane performance loss. Longer membrane life means reduced system cleaning and maintenance expenses as well as lower membrane replacement costs over the life of the system.

Particle Filter Options

Standard depth filtration products such as Melt-Blown Polypropylene or Nano-Spun Polypropylene cartridges are commonly used for particle removal. These are products made by forming a thick, self-supporting tube of fibers. The filters are engineered to capture many sizes of particle through the depth of the media, so they will hold a large quantity of silt or sediment before requiring replacement. Yarn wound filters may also utilized in this application, but wound filters often add 'extractable' surfactants to the water just after installation. Additionally, the superior and consistent construction of Melt-Blown or Nano-Spun filters ensures consistent particle removal unmatched by yarn wound filters.

Depending on the type and quantity of particles in the water supply, an economical alternative to standard depth filters may be pleated media filters. Pleated filtration products, such as pleated polypropylene depth filters, have several times more surface area than melt-blown or nano-spun depth filters and may hold a much higher quantity of sediment or silt. Pleated filters do generally cost more, but the increased life in high-particle-load applications and labor savings from reduced filter change frequency often give pleated filters a cost advantage.

Bacteria & Fine Particle Reduction and Removal

The most critical filters in any system are those used for bacteria control. These are shown as housings marked F, G and H in the figure. All of these filters remove microorganisms, but the level of performance required varies considerably between industries.

USP Water Requirements

People unfamiliar with water treatment may be alarmed to hear that the water used to produce pharmaceutical products can contain bacteria. As Table 1 below shows, there are limits for bacteria, but they are not 'zero'. In other words, water used in pharmaceutical production is not required to be 'sterile'. Most operators of pharmaceutical water systems try to keep their systems free of bacteria by controlling potential entry points and installing barriers to the spread of bacteria that might find their way into the system. Filters are an economical barrier that also removes bacteria from the system.

For more on the specific filtration practices for bacteria control in USP water systems, see our Application Guide - "Filtration in Pharmaceutical Water Systems".

Food & Beverage Process Water

Most people don't realize that tap water can contain bacteria, even if the water has been chlorinated. In the vast majority of cases, the bacteria in tap water have no ill effect on anyone using it. However, when that water is used for food processing, the bacteria can be of concern. While they may not cause illness, some bacteria may create off flavors, odors or other characteristics that reduce product quality. Therefore, as with pharmaceutical water systems, operators do their best to keep their water systems bacteria-free using practices to prevent bacteria from entering a system, but also by installing filters to remove bacteria that inevitably find their way into the system..

Semiconductor Ultrapure Water

The water in the distribution loop portion of a semiconductor ultrapure water system extremely pure and has few particles. The filter shown in the distribution loop in the figure (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 prevent bacteria or small particles from being sent to sensitive production processes.

Point-of-Use Filters filters for either cold water or hot water (Housings G and H) are not usually in the water system but located just before or even inside the actual semiconductor manufacturing 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.

General Industrial Process Water

If a process water system is equipped with a chemical treatment option for the water produced, then bacteria filtration may not be needed. However, if the system has no chlorination, ozonation or similar process, then the water is stored and distributed with no chemical protection against bacteria. Any organisms that enter the system, and it is virtually impossible to totally prevent organisms from entering any system, will be viable and may be distributed downstream to all users.

Many waterborne organisms form biofilms which, once established, are extremely difficult to remove. Some systems may be designed and operated with periodic chemical or heat sanitization processes, which can inhibit the formation of biofilms. However, bacteria can still enter through open tank vents, open distribution lines or 'dead legs' and move downstream, possibly interfering with the intended use of the water. Using filters to remove bacteria before the water is moved very far downstream reduces the opportunity for biofilm formation.

Understanding Bacteria Removal Filters

When a filter is supplied as a "bacteria removal" filter, it is expected to remove all bacteria, molds and yeasts so that the resulting water is "bacteria-free". The best filters for bacteria removal are "sterilizing filters" made to pharmaceutical industry standards. Filters designed to remove spoilage organisms in food & beverage processes are also made to very similar standards, but with the unique performance characteristics that help preserve product flavor and appearance. Filters for both industries are usually made with pore size ratings of 0.22 microns. That pore size is smaller than bacteria and other spoilage organisms that might be found in a process water system. Other pore sizes are also used based on the level, type and size of bacteria, but the pore size chosen must remove all bacteria that might be found in the system. No matter the pore size, the filters must be tested and actually proven to remove bacteria of the appropriate size. Documentation of performance is usually required, and is provided in the form of a certificate of compliance inside each filter package. That certificate needs to state that the filter has passed standardized tests proving that it will remove bacteria of the appropriate size.

Tank Vent Filtration

Tank vent filters (housings marked E) are also critical to protecting the quality of the treated water. Vent filters keep particles and bacteria in the facility environment from entering tanks during water storage or when the tanks are emptied (and air is drawn into the tank to replace liquid volume). Almost all tank vent filters that are designed to block bacteria from entering tanks are hydrophobic membrane with 0.22 micron pore size ratings. Other hydrophobic media and other pore sizes may be used if the filter function is only to prevent dust or other inorganic particles from entering a tank.

An important note - water storage tanks are not made to survive vacuum conditions. If the filter chosen creates an air flow restriction that results in too much vacuum as a tank is being emptied, then the tank could implode. Tanks have vacuum ratings, and most can, and should, be ordered with vacuum burst discs to prevent total tank failure. Advance planning can prevent burst discs or tank failure. Work with the filter supplier to install the correct size filter system and avoid excessive vacuum.

Filter Options for Process Water Systems

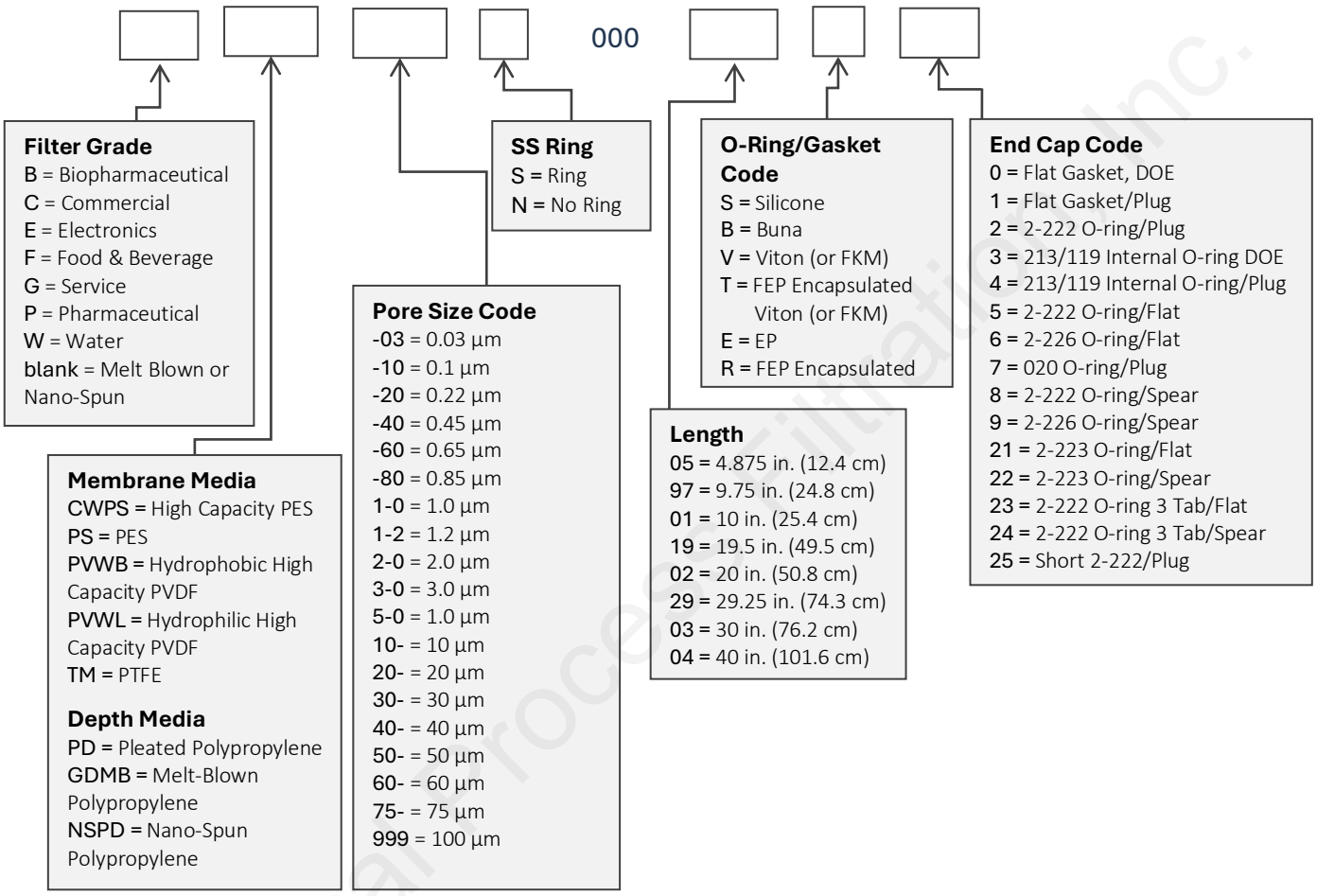
Process Area	Filter Application	Filtration Function	Media **
Sediment and Trap Filtration	Pharmaceutical/Biotech Healthcare/Medical Food & Beverage Electronics/Semiconductor Industrial/Commercial	Removal of larger particles and fractured softener or deionization resin beads before further treatment or use	MB, NS, PD
RO Prefiltration	Pharmaceutical/Biotech Healthcare/Medical Food & Beverage Electronics/Semiconductor Industrial/Commercial	Protect reverse osmosis membranes from premature fouling by removing particles larger than 1 micron in size	MB, NS, PD
Bioburden Reduction	Pharmaceutical/Biotech Healthcare/Medical Food & Beverage	Used in water distribution systems to remove larger organisms and protect final filters that remove all bacteria	PS, NM, NC, PVWL, CWPS
Bacteria Removal, Sterilizing Filtration	Pharmaceutical/Biotech Healthcare/Medical Food & Beverage	Protect the quality of water for the patient, consumer, or end use. Remove all bacteria. May remove viruses and mycoplasma.	PS, NM, NC
Ultra-Fine Particle Removal	Electronics/Semiconductor Industrial/Commercial	Prevent sub-micron particles from reaching processes requiring ultra-pure water, such as semiconductor fabrication.	PS, NM, NC
Tank Vent Filtration	Pharmaceutical/Biotech Food & Beverage Electronics/Semiconductor	Prevent airborne bacteria and fine particles from contaminating process or product water as it is held in tanks	TM, PM, PVWB

**Media Codes		
MB = Polypropylene Melt Blown Media	NS = Nano-Spun Polypropylene Media	PD = Polypropylene Pleated Depth Media
CWPS = High Capacity Polyethersulfone Membrane	PS = Polyethersulfone (PES) Media	PVWB = High Capacity Hydrophobic PVDF Membrane
PVWL = High Capacity Hydrophilic (PVDF) Membrane	NM = Nylon 6,6 Membrane	NC = Positively Charged Nylon 6,6 Membrane
PM = Polypropylene Membrane	TM = PTFE Membrane	

Visit our website or contact us for more application information and to access data sheets on all of our products.

Ordering Information

Cartridge order numbers have several variables from grade to media and pore size to end cap type. For example, Food & Beverage Grade, Polyethersulfone Membrane, 0.22 Micron Rating, with SS Support Ring, 20” Length, Silicone O-Rings, 2-226 O-Ring/Spear End Cap Configuration = FPS-20S00002S9.



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