

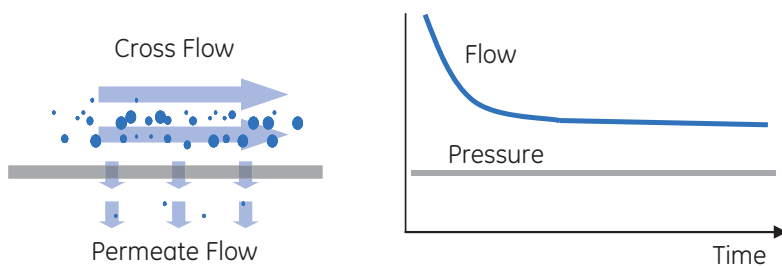
With the addition of normal flow filtration products, GE Healthcare can now deliver filtration solutions and support for integrated bioprocess applications at every step and every scale of the drug development, validation, and manufacturing process.

# ULTA normal flow filters extend our filtration offering **New**

**GE Healthcare's history** in providing cross flow filtration cartridges, cassettes, and systems for the separation and purification of aqueous fluids in the biopharmaceutical industry goes back 25 years. We have now expanded this range to include ULTA™ normal flow filter products.

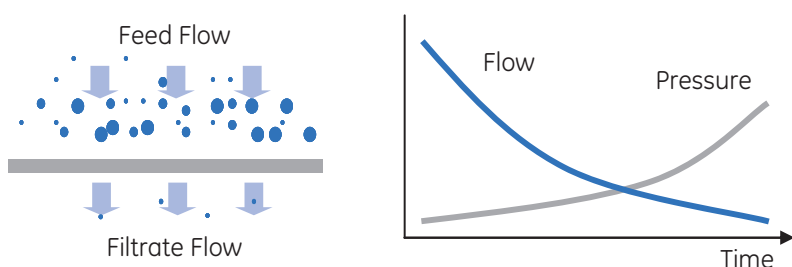
The purification of biological therapeutics generally utilizes cross flow filtration (CFF) or normal ("dead end") flow filtration (NFF) together with chromatographic separation techniques. While both filtration technologies purify bioprocess solutions by removing contaminants with a fixed porous medium, each format has its own particular advantages. Generally normal flow filters are used where clarification and/or bioburden reduction is desired in relatively low solids control streams, protecting or enhancing downstream operations or when final polishing to achieve sterility is demanded. Cross flow filters are best suited for higher solids contents, more viscous feed solutions and/or where concentration or purification of cells or target species is desired. Where there is overlap in function, a GE Healthcare filtration specialist can guide you to the optimum configuration for your specific operation.

## How cross flow membranes work:



The feed stream moves parallel to the membrane surface (Cross Flow) and purified liquid (permeate) passes through the membrane (Permeate). Most of the particulates & aggregates are carried away from the filter surface by the cross flow sweeping action.

## How normal or "Dead End" flow filters work:



The feed stream moves perpendicular to the membrane and purified liquid passes through the membrane (Filtrate). Particulates & aggregates remain behind as "filter cake", reducing flow and/or increasing pressure over time.

## Cross Flow Filtration

GE Healthcare separations cassettes and cartridges are designed for cross flow (tangential flow) operation. Unlike single pass or dead-ended ("normal flow") filtration, cross flow methodology continuously sweeps the membrane surface by recirculating the feed stream across it. Doing so minimizes blinding of the membrane pores and promotes consistent, long-term productivity; it also allows units to be cleaned, stored, and re-used as needed.

As the feed stream is pumped through the cassette or cartridge, the retentate – the materials excluded by the membrane pores – continues through the recirculation loop, while the permeate, including solvent and solutes, is transported through the membrane pores and collected separately.

## Normal Flow Filtration

GE Healthcare now supplies a comprehensive range of normal flow products for increasing process efficiency from early phase product development through to full bioprocess filtration production. Examples of operations that normal flow products perform include:

- **Chromatography column protection** – Reduce bioburden and particulates immediately before chromatography columns
- **Clarification** – A range of prefiltration products providing consistent performance with minimal product loss.
- **Bioburden reduction** – Extensive membrane and depth media products to meet individual application requirements.
- **Liquid sterilization** – Filters incorporating high flow membrane formats minimize filtration system sizes while meeting full validation and integrity test requirements.

Target applications include

# ULTA Normal Flow Filtration range

## Prefiltration

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**ULTA Prime GF** liquid filter cartridges are utilized for the clarification, stabilization and bioburden reduction of aqueous solutions, media and biologicals. These filters have contaminant holding capacity and exhibit exceptional flow performance compared to polypropylene filters. The hydrophilic nature of ULTA Prime GF filter cartridges also makes them more suitable for gravity fed systems.

Target applications include

- Prefiltration of Biopharmaceuticals including tissue culture media and protein solutions
- Biologicals such as Serum and Veterinary vaccines
- Provides optimal protection for final membrane filters
- Ideal for batch or small volume processes



**ULTA Prime PP** liquid filter cartridges are utilized for the clarification and prefiltration in biopharmaceutical applications. The all polypropylene construction ensures a broad range of chemical compatibility making ULTA Prime PP cartridges particularly suitable for the filtration of aggressive and viscous chemicals and solvents.

Target applications include

- Bioburden reduction
- Buffer prefiltration, water, media, and alcohol
- Serum and tissue culture media clarification
- Disposable laboratory prefiltration

## Specialized protection

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**ULTA Prime CG** filter cartridges and capsules are specifically designed for consistently controlling bioburden and particle retention in a variety of pH ranges and feed streams. The pleated polyethersulfone (PES) membrane combined with thermal-bonded construction, in both capsule and cartridge formats, ensures low extractables and quick flush-up devices.

Target applications include

- Column guard – Reduce bioburden and particulates immediately before chromatography columns
- Sterile filter protection – Prefilter solutions upstream of the sterilizing grade filter
- General bioburden control – Log reduction of bacteria when sterility is not required

## Sterilizing grade



**ULTA Pure SG** employs PES membranes to provide sterile filtrate and extremely low protein binding. This single layer PES membrane allows a very low pressure loss for longest life in critical applications.

Target applications include

- Final filtration
- Protein solution sterile filtration
- Sterile media and buffers
- Critical downstream protection



**ULTA Pure HC** cartridge filters have been specifically designed for the effective and economical processing of difficult to filter solutions associated with biopharmaceutical and diagnostics production. The ULTA Pure HC PES membrane features a highly asymmetric membrane prefilter layer, which significantly extends throughput. These cartridge filters are high capacity and fast flowing.

Target applications include

- Serum filtration
- Cell culture media filtration
- Concentrated protein solutions
- Sterile filtration of different streams

## Additional NFF filters

The ULTA range of filters is being expanded and additional products will be available soon. Watch our website for details. The tables below will assist you selecting the best filter technology for your application.

### Guide to selecting NFF or CFF

	NFF	CFF
MF range	x	x
UF range		x
High solids processing		x
Moderate to low solids	x	x
Concentration		x
Disposable	x	*
Recirculation required		x
Clean & reuse		x
Air applications	x	
Aseptic environment	x	x
Sterile application	x	
Integrity testable	x	x
Validation guides	x	x
Self-contained available	x	x
Steam-in-place	x	x
Autoclavable	x	x
Diafiltration		x

\* some models available; contact GEHC

### Range of GEHC NFF Filters:

	Prefilters	Bioburden Reduction†	Sterilizing Grade
Flat Disc			x
Syringe filters		x	x
Capsules	x	x	x
10" Cartridges	x	x	x
20" Cartridges	x	x	x
30" Cartridges	x	x	
Column Guard		x	
0.1µ			x
0.2µ		x	x
0.45µ		x	
0.65µ			
1.0µ	x		
3.0µ	x		
5.0µ	x		
10.0µ	x		
222 Connection	x	x	x
226 Connection	x	x	x

† to 5 Logs

# GE Healthcare and Parker domnick hunter announce distribution and collaboration agreements in biopharmaceutical purification

Companies to serve biopharmaceutical market with advanced microfiltration cartridges and devices.

**Chalfont St. Giles, UK, and Newcastle, UK, February 1 2007**

GE Healthcare and Parker domnick hunter, a division of Parker Hannifin (NYSE:PH) announced today that they have entered into an exclusive agreement for the supply and distribution of products for biopharmaceutical purification. Under the terms of the agreement, GE Healthcare will have exclusive global rights to market a new range of microfiltration cartridges and disposable filters manufactured by domnick hunter. Financial terms were not disclosed.

The new line of disposable filters for liquid filtration applications in biopharmaceutical manufacture will be marketed by GE Healthcare's global sales and marketing organization under the ULTA™ brand. The products increase the range of technologies available for the purification of vaccines, antibodies and other biomolecules.

"This agreement allows us to expand the range of products for biopharmaceutical purification that we are able to offer our customers" said Ann O'Hara, General Manager of Bioprocess for GE Healthcare. "Building on our reputation as a supplier of cutting edge technologies, the ULTA line of normal flow cartridges will be a significant addition to our purification portfolio".

"We developed an outstanding line of cartridge filters with an eye to making significant in-roads into the pharmaceutical market, expanding on our past successes in this area." said Jeff Porter, Managing Director, Process Division, Europe at Parker domnick hunter. "We are very excited about the prospects of this agreement, which enables us to bring our advanced purification technologies to the biopharmaceutical production industry."

Parker domnick hunter will continue to market its own brand of air and gas filters to the biopharmaceutical industry.

Under a separate joint technology development agreement the two companies will collaborate in the development of new technologies for protein purification, drawing from each other's strengths in separation and purification techniques, membrane production manufacturing and market insights.

## About Parker domnick hunter

**Parker domnick hunter's** Process Division provides novel filtration solutions for the many challenges faced by the biopharmaceutical industry. The company combines process engineering expertise with over four decades of experience in filtration systems and includes a team of dedicated pharmaceutical specialists.

Founded in 1963 and acquired by Parker in 2005, **domnick hunter** is an international group of companies dedicated to the provision of high quality filtration, separation and purification products for a wide range of industries and applications.

Excellence in technology and exporting has been recognized by 8 Queen's Awards to Industry. In 1987 domnick hunter became the first UK based filter company to achieve ISO 9001 registration.

**Parker domnick hunter** has trading subsidiaries and associates in 25 countries and ten manufacturing plants. Over 1900 people are employed worldwide with the specialized skills and experience in the development, manufacturing and application of filtration products.

Parker domnick hunter is part of the Parker Hannifin Corporation (Parker), a leading worldwide supplier in motion and control technologies and systems, providing precision engineered solutions for a wide variety of commercial, mobile, industrial and aerospace markets.