



Life Sciences

USD 2783

# UpScale<sup>SM</sup> Program Selection Guide

Filtration and Separation Technologies  
to Simplify Process Scale Up



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

# Simplify Scale-Up from Research to Production

Pall recognizes that your finished products are often the result of painstaking research leading to a series of complex manufacturing steps. In various stages of the manufacturing process, direct flow filters, tangential flow filters and chromatography units are used to ensure the quality and safety of all your fluids. Pall offers a broad range of separation and purification products and technologies designed to meet the most stringent requirements of clarification, sterility, purity, and safety.

## Get Biopharm Products to Market Faster

Pall's UpScale Program includes the most comprehensive range of scalable products for direct flow filtration, tangential flow filtration, and chromatography. This allows you to get your biopharmaceuticals to market faster by providing products with the same media and consistent materials of construction for all phases of development, from research and development, to pilot-scale and full-scale production. All of our separation and purification products are designed for use in biopharmaceutical applications and contain materials of construction that are fully compliant with the highest industry standards. These materials contribute to the safety and security that you demand for your products, whether those products are in clinical trials or fully licensed. Simply put, the UpScale Program can simplify scale up to save you time and money.

## Widest Selection of Scalable Technologies

### Direct Flow Filtration

Pall filters are recommended for applications that require optimal flow rates and flexibility in filter medium selection. There are many configurations of Pall filters available, from high-capacity, high-efficiency depth filters for solids removal and clarification to sterilizing-grade and finer membrane filters for microbial removal that can be sized to meet your needs.



### Separation Systems for Bioprocessing

Pall offers the best solutions for biomolecule separation and concentration, including a large range of proprietary tangential flow filtration technologies. These products perform optimally while reducing maintenance and operating costs. Systems are available for feasibility and scale-up testing.

### Purification Systems for Bioprocessing

In addition to a wide range of columns and sorbents, Pall has developed innovative membrane chromatography solutions that allow you to quickly and easily purify biomolecules or remove contaminants at the molecular level using chromatography techniques. These products are available from laboratory and pilot scales to the largest production scale.

### Single-Use Solutions

Many of our products are available in single-use formats that eliminate the need for cleaning and cleaning validation. Pall can assemble them into fully-integrated single-use systems to provide you with extra tools to expedite the validation of your entire process and accelerate time to market.

## The UpScale Program Toolbox



Pall's UpScale Program Toolbox is an attractive, easy-to-use, and easy-to-restock sample cabinet that covers a range of products available through Pall's UpScale

Program. Two versions of the UpScale Program Toolbox are available for your particular application requirements and laboratory needs:

- ▶ UpScale Program Toolbox for Direct Flow Filtration
- ▶ Upscale Program Toolbox for All Technologies

For more information on the UpScale Program Toolbox, request literature USD 2756.

## Purpose of this Selection Guide

This guide proposes filtration and separation tools suitable for many process streams typical to a pharmaceutical manufacturing process. Although not exhaustive, it will help you easily select the best products for your applications. For information on the full product range or for additional technical support, please contact Pall.

Each section of this brochure presents process diagrams and specification charts intended to ease product selection. These colors – blues, greens, reds, and oranges – are used to identify the type of filtration or separation process, for example:

- ▶ Blue – Prefiltration/Clarification
- ▶ Green – Final Filtration (Liquid, Air/Gas, Virus)
- ▶ Red – Tangential Flow Filtration
- ▶ Orange – Chromatography

To further simplify selection, these colors are also used in the design of the UpScale Program Toolboxes.



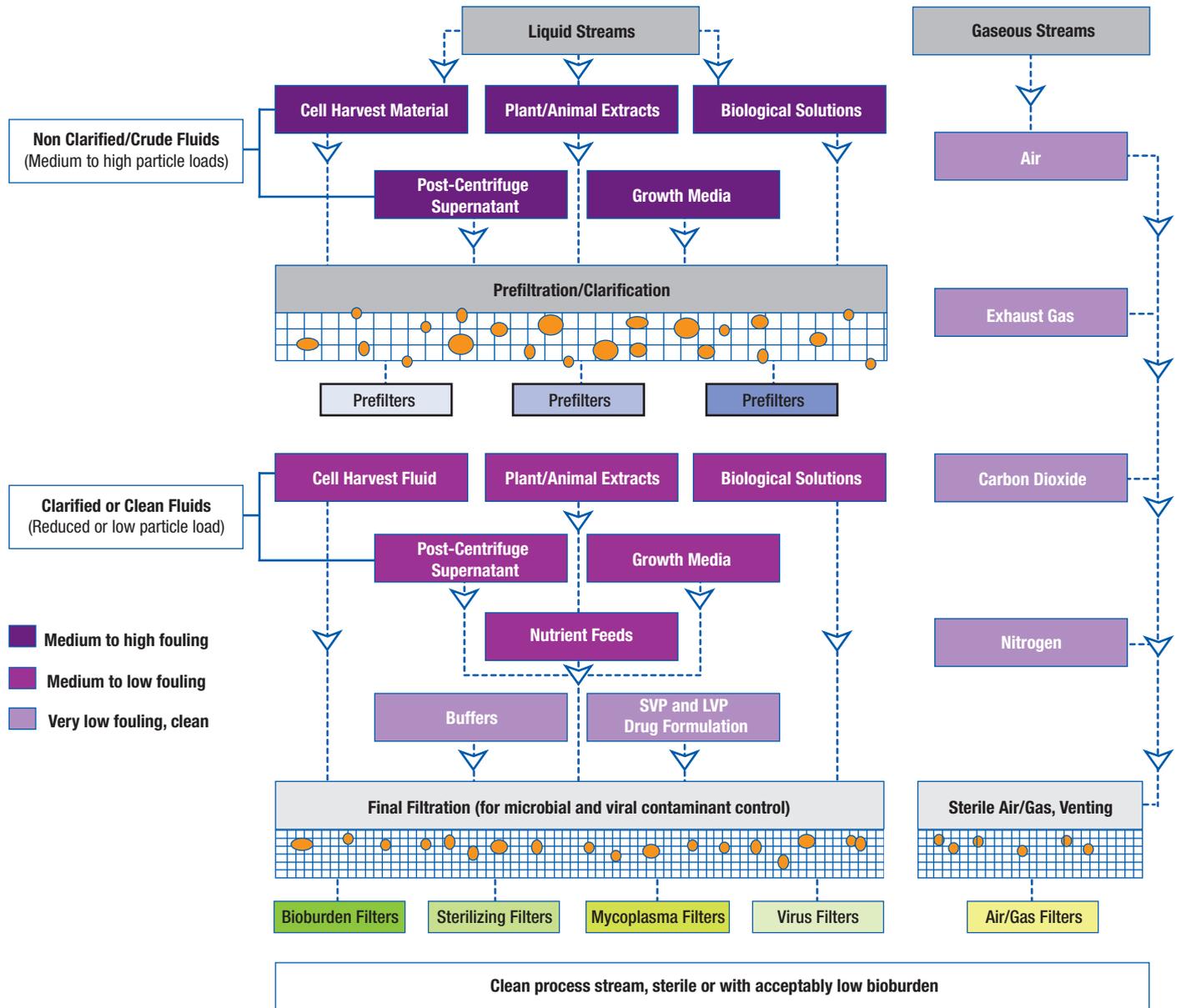
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# Choose the Right UpScale Program Toolbox for Your Application Requirements

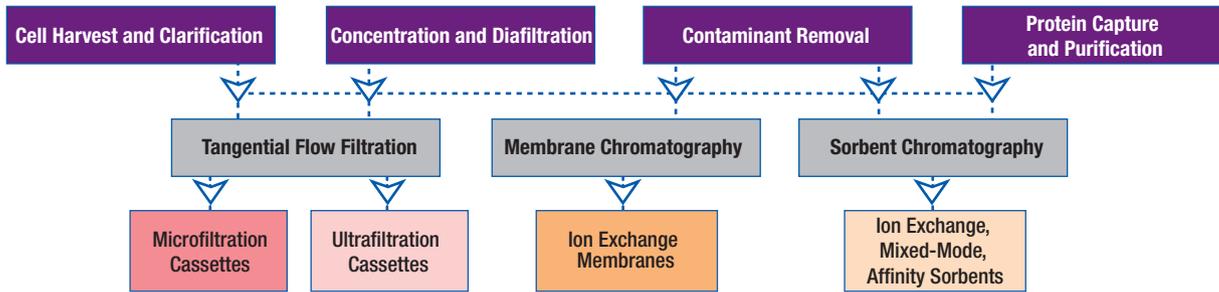
## UpScale Program Toolbox for Direct Flow Filtration

Includes samples for prefiltration/clarification and final or microbial filtration of the following process streams.



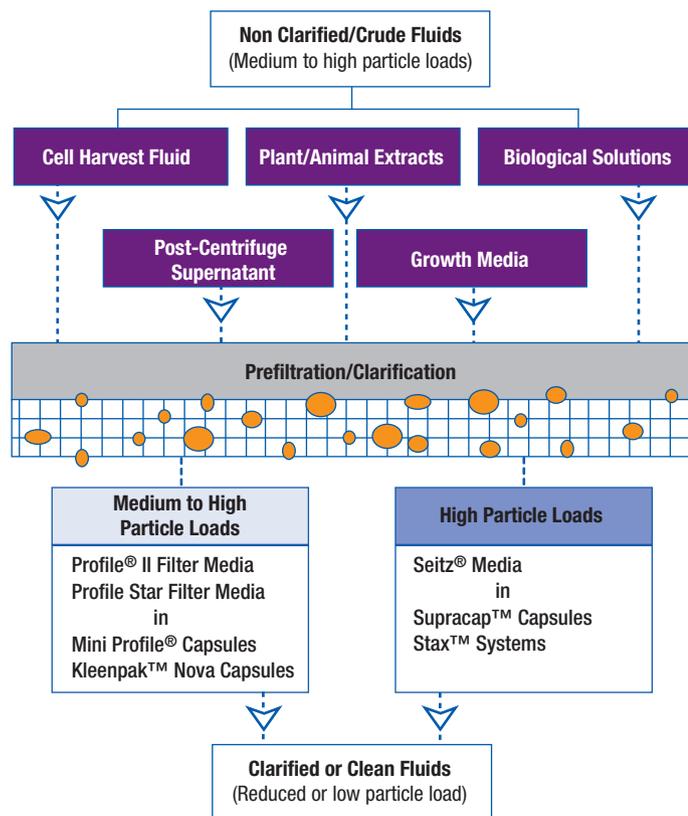
## UpScale Program Toolbox for All Technologies

Includes products from the UpScale Program Toolbox for Direct Flow Filtration plus a sample of products for tangential flow filtration and chromatography.



# Technologies for Prefiltration/Clarification

Pall filters for prefiltration and clarification remove undesirable particulate or cellular solids from process streams and protect more costly downstream final filters, increasing their service life and reducing overall filtration cost. These high performance clarifying filters decrease filtration time, enable high throughputs, and reduce the need for multiple filter change-outs due to premature plugging. Pall prefilter and clarification filter technologies are used to reduce bioburden, remove particulate contaminants, and clarify solutions prior to further downstream processing. Optimized for best performance, they offer the best value in today's pharmaceutical manufacturing marketplace.



Mini Profile Capsule



Kleenpak Nova Capsule

## Mini Profile Prefilter Capsules with Profile® II and Profile Star Media

Features	Profile II Media	Profile Star Media
Capsule Identifier Code (with 13 mm single barb hose inlet/outlet)	BY...P6*	BY...P6*
Filter Type	Clarifying filter or prefilter	Clarifying filter or prefilter
Prefilter Media Material	Polypropylene	Polypropylene
Grade Identifier and Removal Rating	Y005: 0.5 µm	A015: 1.5 µm A050: 5 µm
Filter Media Configuration	Cylindrical depth	Pleated depth
Support/Drainage Layer	No layer	Polypropylene
Cage Material	Polypropylene	Polypropylene
Clean Water Flow Rate per Capsule (100 mbar, 20 °C)	Y005: 0.18 L/min	A015: 3 L/min A030: 5.9 L/min

\*In the table, “...” indicates the section of the product number associated with the filter grade. Example: BYA015P6 for Mini Profile with 1.5 µm rated filter medium.

## Kleenpak Nova Filter Capsules and Cartridges

Mini Profile capsules with Profile II and Profile Star filter media scale up to Kleenpak Nova capsules and AB style filter cartridge configurations for the processing of volumes of fluid > 50 L (depending on fluid properties). Please contact your local sales representative or visit [www.pall.com/biopharm](http://www.pall.com/biopharm) for further information.

Format	Effective Filtration Area
Mini Profile Capsule	Profile II: 42 cm <sup>2</sup> Profile Star: 90 cm <sup>2</sup>
Kleenpak Nova Capsule (N*6 – N*8 <sup>1</sup> ) and AB Style Cartridge (AB1 – AB3)	N*6/AB1: 0.12 m <sup>2</sup> N*7/AB2: 0.24 m <sup>2</sup> N*8/AB3: 0.36 m <sup>2</sup>

<sup>1</sup> \* can be replaced by “P” for inline style (NP6) or “T” for T-style (NT6) inlet/outlet configuration.

## Seitz Depth Filter Media

Code	Media Type	Format	Typical Water Permeability L/min/m <sup>2</sup> at dP 1 bar	Nominal Micron (µm) Rating	Material	Application			
P900	K900P	Single Layer	1980	8.0 – 20.0	Cellulose with filter aids	Cell harvesting and clarification (high viability > 95%) <sup>1</sup>			
P700	K700P		935	6.0 – 15.0					
P250	K250P		535	4.0 – 9.0					
P200	K200P		217	3.0 – 6.0					
P100	K100P		149	1.0 – 3.0					
P080	SUPRA 80P		159	1.0 – 3.0					
P050	KS 50P		93	0.4 – 0.8					
PEK1	SUPRA EK1P		64	0.2 – 0.5					
PEKM	EKMP		41	0.2 – 0.5					
PEKS	EKSP		29	0.1 – 0.3					
PEXX	EKXP		25	0.05 – 0.2					
PDK5	K900 + K100P		Double Layer	151			1.5 – 20.0	Cellulose with filter aids	Cell harvesting and clarification (low viability < 80%) <sup>1</sup>
PDH4	K700 + KS50P			93			0.5 – 15.0		
PDE2	K100P + EKMP	35		0.2 – 3.5					
PDD1	KS50P + EKSP	25		0.1 – 0.85					
PDBX	EKMP + EKXP	14		0.05 – 0.5					
BIO 20 <sup>2</sup>	Bio 20	Single Layer	75	0.4 – 1.0	Cellulose	Cell harvesting and clarification, very low protein adsorption rate			
BIO 10 <sup>2</sup>	Bio 10		30	0.2 – 0.4					

<sup>1</sup> For viabilities > 80%, please contact Pall. <sup>2</sup> Very low level of ash (< 1%) and very low level of heavy metal extractables.

## Supracap Capsules and Stax Systems

Format	Size	Typical Surface Area	Batch Size	Typical Flow Rates
Supracap 60	6 cm ID	26 cm <sup>2</sup>	0 – 1 + L	150 L/m <sup>2</sup> /h
Supracap 100	127 mm (5 in.)	Single layer 0.05 cm <sup>2</sup>	1 – 10 + L	150 L/m <sup>2</sup> /h
	127 mm (5 in.)	Double layer 0.025 cm <sup>2</sup>	1 – 10 + L	150 L/m <sup>2</sup> /h
Supracap 100	254 – 762 mm (10 – 30 in.)	Single layer 0.1 – 0.3 m <sup>2</sup>	10 – 50 + L	150 L/m <sup>2</sup> /h
	254 – 762 mm (10 – 30 in.)	Double layer 0.05 – 0.15 m <sup>2</sup>	10 – 50 + L	150 L/m <sup>2</sup> /h
Stax Pilot-Scale	1 capsule	Single layer 0.5 – 4 m <sup>2</sup>	50 – 200 + L	150 L/m <sup>2</sup> /h
	1 capsule	Double layer 0.25 – 2 m <sup>2</sup>	50 – 200 + L	150 L/m <sup>2</sup> /h
Stax Process-Scale	5 capsules	Single layer 0.5 – 10 m <sup>2</sup>	50 – 1000 + L	150 L/m <sup>2</sup> /h
	5 capsules	Double layer 0.25 – 5 m <sup>2</sup>	50 – 1000 + L	150 L/m <sup>2</sup> /h
Stax Process-Scale	10 capsules	Single layer 0.5 – 20 m <sup>2</sup>	50 – 2000 + L	150 L/m <sup>2</sup> /h
	10 capsules	Double layer 0.25 – 10 m <sup>2</sup>	50 – 2000 + L	150 L/m <sup>2</sup> /h



Supracap 60 Capsule



5 – 30" Supracap 100 Capsule



Stax Pilot-Scale System



Stax Process-Scale System 5 Capsules



Stax Process-Scale System 10 Capsules

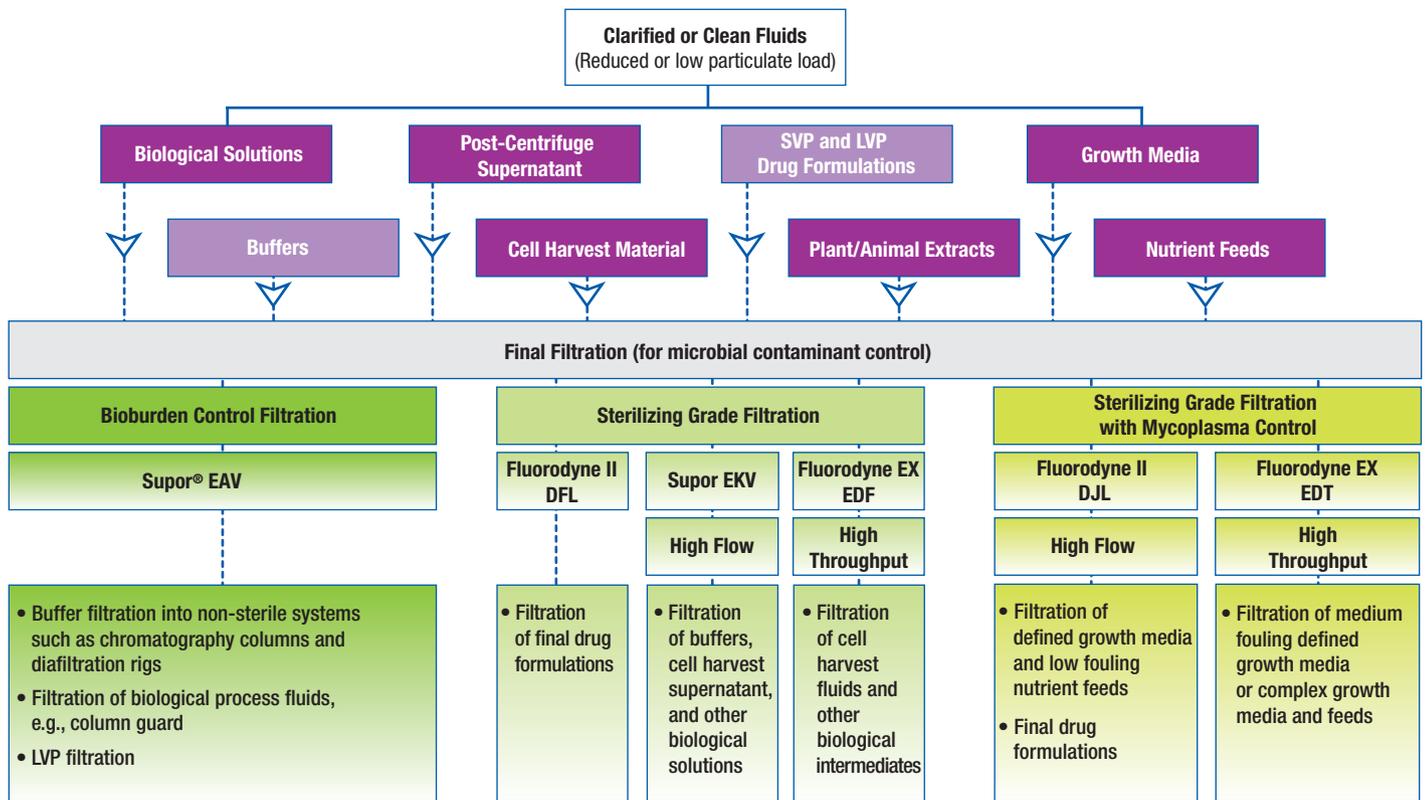
# Technologies for Final Filtration Liquids

Many liquid filtration stages in pharmaceutical R&D, process development, and manufacturing demand the use of a filter that is qualified to produce sterile effluent or reduce bioburden to an acceptably low level. Main applications for microbially-rated filters include buffer filtration, biological process fluid filtration, final drug formulation filtration, growth media filtration, reagent filtration, and water filtration.

Pall offers a wide range of microbially-rated membrane filters for bioburden control, sterility control, mycoplasma, and virus removal. The newest developments featured in the UpScale Program Toolbox deliver the highest flow rate and



throughput performance, and assurance of process safety. Pall microbially-rated capsule filters can be supplied pre-sterilized for easy integration into Allegro™ single-use systems.



Mini Kleenpak Syringe Filter



47 mm Disc



Mini Kleenpak 20 Capsule



Mini Kleenpak Capsule



Kleenpak Capsule

## Microbially-Rated Filters

Filter Type	Bioburden Control		Sterilizing Grade		Mycoplasma Control Grade	
	Supor	Fluorodyne II	Supor	Fluorodyne EX	Fluorodyne II	Fluorodyne EX
Membrane	Supor	Fluorodyne II	Supor	Fluorodyne EX	Fluorodyne II	Fluorodyne EX
Grade Identifier	EAV	DFL	EKV	EDF	DJL	EDT
Membrane Materials	PES (hydrophilic)	PVDF (hydrophilic)	PES (hydrophilic)	PES/PVDF (hydrophilic)	PVDF (hydrophilic)	PES/PVDF (hydrophilic)
Removal Rating	0.2 µm (nominal) LRV <sup>1</sup> > 6 <i>Brevundimonas diminuta</i>	0.2 µm sterile effluent <sup>2</sup>	0.2 µm sterile effluent <sup>2</sup>	0.2 µm sterile effluent <sup>2</sup>	0.1 µm sterile effluent <sup>2</sup> LRV <sup>1</sup> > 8 mycoplasma	0.1 µm sterile effluent <sup>2</sup> LRV <sup>1</sup> > 10 mycoplasma
Membrane Layer(s)	Single layer 0.2 µm asymmetric machV <sup>3</sup>	Double layer 0.2 µm symmetric / 0.2 µm symmetric	Double layer 0.65 µm asymmetric / 0.2 µm symmetric	Double layer 0.2 µm machV <sup>3</sup> asymmetric / PVDF 0.2 µm symmetric	Double layer 0.2 µm symmetric / 0.1 µm symmetric	Triple layer 0.2 µm machV <sup>3</sup> asymmetric / PVDF 2 x 0.1 µm symmetric
Hardware Materials	Polypropylene	Polypropylene	Polypropylene	Polypropylene	Polypropylene	Polypropylene
Clean Water Output (L/m <sup>2</sup> /h) (100 mbar, 20 °C)	1130	785	1250	570	460	170
Mini Kleenpak Syringe (KM2) EFA <sup>4</sup>	2.8 cm <sup>2</sup>	n/a	2.8 cm <sup>2</sup>	2.8 cm <sup>2</sup>	n/a	n/a
47 mm Disc EFA	10 cm <sup>2</sup>	10 cm <sup>2</sup>	10 cm <sup>2</sup>	10 cm <sup>2</sup>	10 cm <sup>2</sup>	10 cm <sup>2</sup>
Mini Kleenpak 20 (KM5) EFA	20 cm <sup>2</sup>	20 cm <sup>2</sup>	20 cm <sup>2</sup>	20 cm <sup>2</sup>	20 cm <sup>2</sup>	n/a
Mini Kleenpak (KA02) EFA	260 cm <sup>2</sup>	200 cm <sup>2</sup>	220 cm <sup>2</sup>	n/a	200 cm <sup>2</sup>	200 cm <sup>2</sup>
Kleenpak (KA1 – KA4) EFA	KA3: 2200 cm <sup>2</sup>	KA1: 400 cm <sup>2</sup> KA2: 800 cm <sup>2</sup> KA3: 1500 cm <sup>2</sup> KA4: 3300 cm <sup>2</sup>	KA1: 375 cm <sup>2</sup> KA2: 750 cm <sup>2</sup> KA3: 1500 cm <sup>2</sup>	KA2 : 750 cm <sup>2</sup>	KA1: 400 cm <sup>2</sup> KA2: 800 cm <sup>2</sup> KA3: 1500 cm <sup>2</sup> KA4: 3300 cm <sup>2</sup>	n/a
Novasip <sup>5</sup> (C05 – C3) EFA	n/a	C3 : 1500 cm <sup>2</sup>	C3: 1500 cm <sup>2</sup>	n/a	C05: 400 cm <sup>2</sup> C3: 1500 cm <sup>2</sup>	n/a
Kleenpak Nova (N*6 – N*8 <sup>6</sup> ) and AB style (AB1 – AB3) EFA	N*6/AB1: 1.06 m <sup>2</sup> N*7/AB2: 2.12 m <sup>2</sup> N*8/AB3: 3.18 m <sup>2</sup>	N*6/AB1: 0.55 m <sup>2</sup> N*7/AB2: 1.1 m <sup>2</sup> N*8/AB3: 1.65 m <sup>2</sup>	N*6/AB1: 0.6 m <sup>2</sup> N*7/AB2: 1.2 m <sup>2</sup> N*8/AB3: 1.8 m <sup>2</sup>	N*6/AB1: 1.1 m <sup>2</sup> N*7/AB2: 2.2 m <sup>2</sup> N*8/AB3: 3.3 m <sup>2</sup>	N*6/AB1: 0.55 m <sup>2</sup> N*7/AB2: 1.1 m <sup>2</sup> N*8/AB3: 1.65 m <sup>2</sup>	N*6/AB1: 0.95 m <sup>2</sup> N*7/AB2: 1.9 m <sup>2</sup> N*8/AB3: 2.85 m <sup>2</sup>

<sup>1</sup> LRV = Log Reduction Value. <sup>2</sup> Sterile effluent for > 10<sup>7</sup> *Brevundimonas diminuta*/cm<sup>2</sup>. <sup>3</sup> Patented machV technology: Asymmetric membranes with variable gradient and markedly higher porosity. <sup>4</sup> EFA = Effective Filtration Area; EFA for disc depends on filter housing used. Please contact Pall for further assistance. <sup>5</sup> Steamable capsule. <sup>6</sup> \* can be replaced by "P" for inline style (NP6) or "T" for T-style (NT6) inlet/outlet configuration. <sup>7</sup> *Acholeplasma laidlawii* at 10<sup>7</sup> cfu/cm<sup>2</sup> membrane EFA.



Novasip™ Capsule



Kleenpak Nova Capsule



AB Style Cartridge

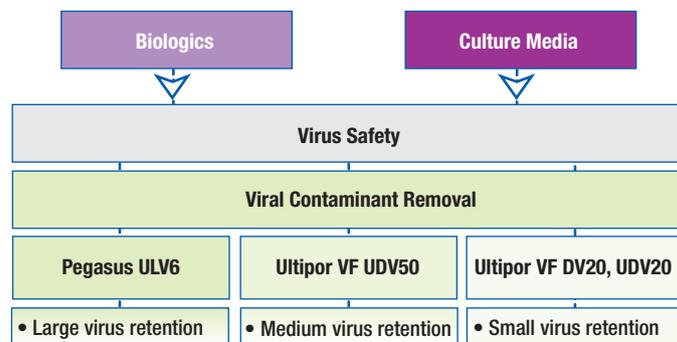
# Technologies for Final Filtration

## Virus

Virus filtration has demonstrated high efficacy for virus removal, and has become a well-accepted orthogonal method for the clearance of infectious viruses in biological fluids. Due to the fine microporous structure of virus filters, however, their performance may be significantly affected by process conditions. Larger batch volumes and higher protein concentrations have led to the development of virus filters with improved performance. Meeting these process challenges also underlines the importance of optimizing large-scale virus filtration.

Pall's product offering for viral clearance from biological fluids consists of membrane technology and chromatography that are both vital elements in ensuring virus safety for therapeutics such as plasma-derivatives, recombinant proteins, or monoclonal antibodies derived from cell cultures.

Ultipor® VF Grade UDV20 and DV50 virus removal filter cartridges, and Pegasus™ Grade LV6 virus removal filter cartridges are robust, reliable, highly efficient and well-established viral reduction technologies due to their efficiency, ease of implementation, and cost-effectiveness.



### Virus Removal Filters

Virus	Para3	PRV	HSV	MuLV	Reo3	BVDV	SV40	PPV	
Size	150 – 300 nm	150 – 300 nm	120 – 220 nm	80 – 110 nm	60 – 80 nm	40 – 70 nm	45 nm	18 – 24 nm	
Filter Type	Large virus retentive filter				Medium virus retentive filter		Small virus retentive filter		Virus prefilter
Membrane	Pegasus				Ultipor VF		Ultipor VF	Ultipor VF	Ultipor VF
Grade Identifier	ULV6				UDV50		UDV20	DV20	DVD
Membrane Materials	PVDF				PVDF		PVDF	PVDF	PVDF
Removal Rating	~70 nm				50 nm		20 nm	20 nm	< 0.1 µm
47 mm Disc EFA <sup>1</sup>	11 cm <sup>2</sup>				11 cm <sup>2</sup>		11 cm <sup>2</sup>	11 cm <sup>2</sup>	11 cm <sup>2</sup>
Minidisc EFA	n/a				n/a		9.6 cm <sup>2</sup>	9.6 cm <sup>2</sup>	n/a
Mini Kleenpak (KA02) EFA	n/a				n/a		n/a	n/a	n/a
Novasip (CLM05) EFA	n/a				n/a		700 cm <sup>2</sup>	700 cm <sup>2</sup>	n/a
Junior (SBF1) EFA	n/a				743 cm <sup>2</sup>		n/a	n/a	n/a
Kleenpak (KA2) EFA	n/a				n/a		n/a	n/a	n/a
Novasip (CL3) <sup>2</sup> EFA	n/a				4000 cm <sup>2</sup>		n/a	n/a	n/a
Kleenpak Nova (N*6 – N*8 <sup>3</sup> ) and AB style (AB1 – AB3) EFA	AB1: 1.65 m <sup>2</sup> AB2: 3.3 m <sup>2</sup> AB3: 4.95 m <sup>2</sup>				N*6/AB1: 1.63 m <sup>2</sup> N*7/AB2: 3.26 m <sup>2</sup> N*8/AB3: 4.89 m <sup>2</sup>		N*6/AB1: 2 m <sup>2</sup> N*7/AB2: 4 m <sup>2</sup> N*8/AB3: 6 m <sup>2</sup>	N*6/AB1: 1 m <sup>2</sup> N*7/AB2: 2 m <sup>2</sup> N*8/AB3: 3 m <sup>2</sup>	N*6/AB1: 0.88 m <sup>2</sup> N*7/AB2: 1.76 m <sup>2</sup> N*8/AB3: 2.64 m <sup>2</sup>

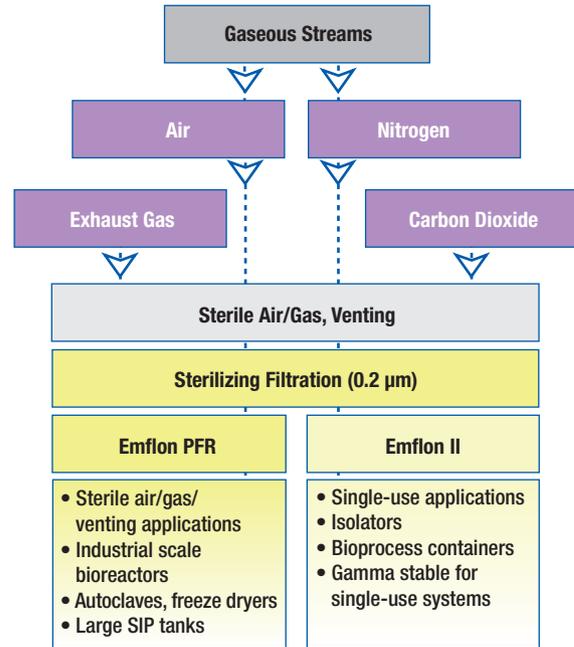
<sup>1</sup> EFA = Effective Filtration Area; EFA for disc depends on filter housing used. Please contact Pall for further assistance. <sup>2</sup> Steamable capsule. <sup>3</sup> \* can be replaced by "P" for inline style (NP6) or "T" for T-style (NT6) inlet/outlet configuration.

# Technologies for Final Filtration

## Air/Gas

Pall filters for pharmaceutical air and gas service are optimized for sterile air or gas filtration to completely remove particles and droplets plus microorganisms like molds, yeasts or bacteria and even viruses and phages. These filters also find wide use in negative-pressure applications such as sterile filtration of vacuum break lines on lyophilizers and autoclaves, and sterile and non-sterile venting of tanks and containers.

Pall air and gas filters can be sized to meet a wide range of flow and pressure drop requirements, from sterile venting in the laboratory to small process flows in pilot operations, from compressed air flows in process scale operations to full scale air supply in large scale aerobic fermentations at ambient or elevated temperatures.



### Microbially-rated Filters for Final Filtration of Air/Gas

Filter Type	Air Sterilizing Filter	Air Sterilizing Filter
Membrane	Emflon PFR	Emflon II
Grade Identifier	PFR	V002
Membrane Materials	PTFE (hydrophobic)	PVDF (hydrophobic)
Removal Rating	Sterile 0.2 µm	Sterile 0.2 µm
Membrane Layers	Double layer 0.2 µm symmetric / 0.2 µm symmetric	Double layer 0.2 µm symmetric / 0.2 µm symmetric
Hardware Materials <sup>1</sup>	Polypropylene	Polypropylene
47 mm Disc EFA <sup>2</sup>	10 cm <sup>2</sup>	10 cm <sup>2</sup>
Mini Kleenpak 20 (KM5) EFA	n/a	20 cm <sup>2</sup>
Mini Kleenpak (KA02) EFA	280 cm <sup>2</sup>	200 cm <sup>2</sup>
Kleenpak (KA1 – KA4) EFA	KA1: 400 cm <sup>2</sup> KA2: 800 cm <sup>2</sup> KA3: 2300 cm <sup>2</sup>	KA1: 500 cm <sup>2</sup> KA2: 1000 cm <sup>2</sup> KA3: 2000 cm <sup>2</sup>
Novasip <sup>3</sup> (C05 – C3) EFA	CM05: 500 cm <sup>2</sup> C2: 1700 cm <sup>2</sup> C3: 2300 cm <sup>2</sup>	n/a
Kleenpak Nova (N*6 – N*8 <sup>4</sup> ) and AB style (AB1 – AB3) EFA	N*6/AB1: 0.8 m <sup>2</sup> N*7/AB2: 1.6 m <sup>2</sup> N*8/AB3: 2.4 m <sup>2</sup>	N*6/AB1: 0.62 m <sup>2</sup> N*7/AB2: 1.24 m <sup>2</sup> N*8/AB3: 1.86 m <sup>2</sup>

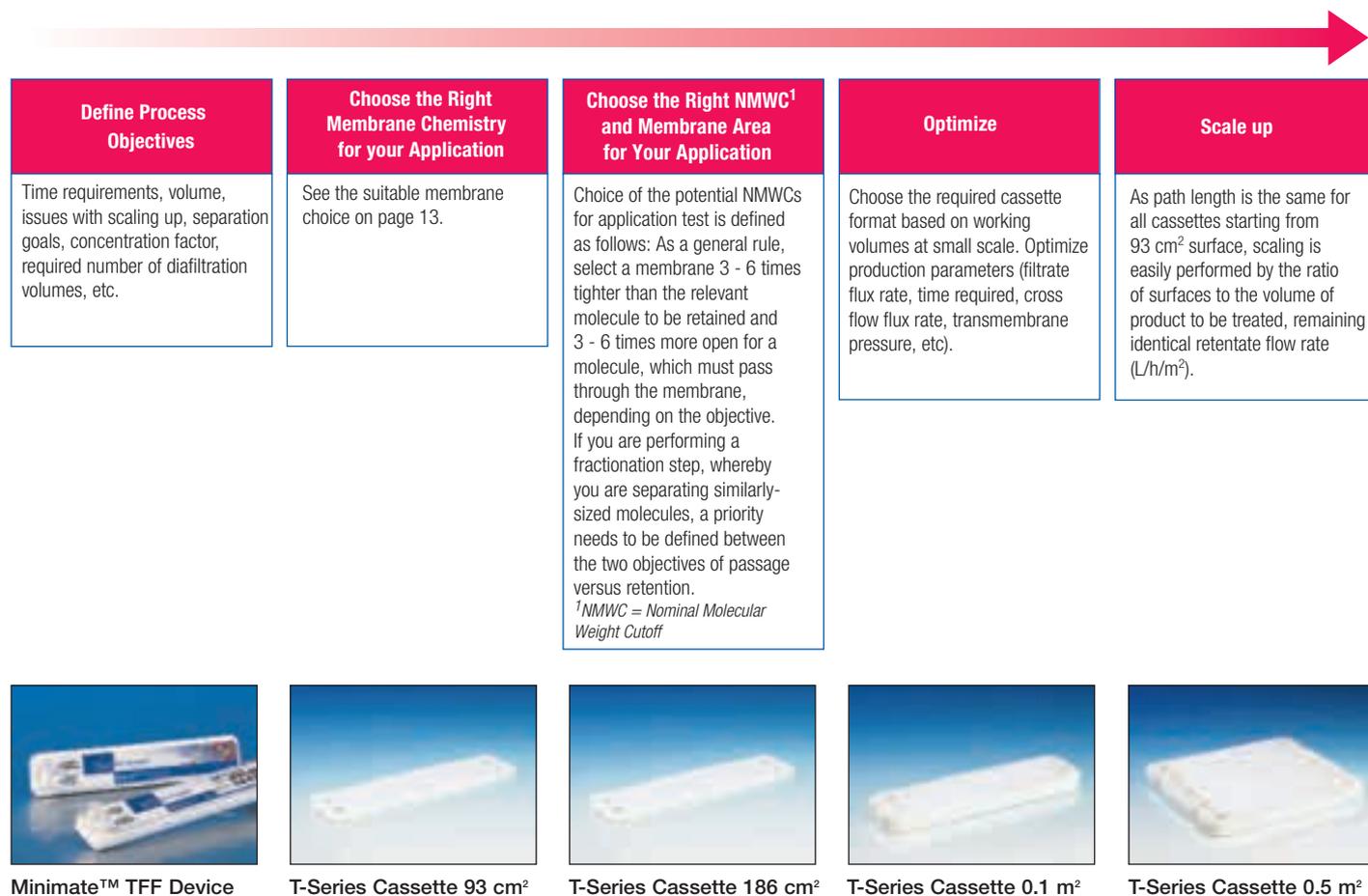
<sup>1</sup> For the Novasip capsules, the capsule bowl is made of polyetherimide, and the capsule head is made of polyetherimide with titanium dioxide. <sup>2</sup> EFA = Effective Filtration Area; EFA for disc depends on filter housing used. Please contact Pall for further assistance.

<sup>3</sup> Steamable capsule. <sup>4</sup> \* can be replaced by "P" for inline style (NP6) or "T" for T-style (NT6) inlet/outlet configuration.

# Technologies for Tangential Flow Filtration



Pall offers industry-leading tangential flow filtration (TFF) technologies to meet the increasing diversity and challenges of biological and biopharmaceutical processes. These products are designed to simplify and streamline your processes while ensuring consistency with the highest possible yields. Pall's TFF products range from single-use capsules to cleanable cassettes, and from standard lab and benchtop systems to fully customizable process systems.



## Microfiltration Cassettes

Membrane	Material	Code	Rating	Application
Supor TFF	Modified polyethersulfone	M20	0.20 µm	Cell harvesting, clarification
		M45	0.45 µm	
		M65	0.65 µm	

## Ultrafiltration Cassettes

Membrane	Material	Code	NMWC (kD)	Application
Omega™	Modified polyethersulfone for low protein adsorption rate	001	1	Concentration and diafiltration of proteins, particles and small molecules
		005	5	
		010	10	
		030	30	
		050	50	
		070	70	
		100	100	
		300	300	
Delta	Regenerated cellulose with high permeate output, very low adsorption rate, easy to clean	010	10	Concentration and diafiltration of proteins, more specifically recommended for recombinant proteins, antibody fragments, antibodies, MAbs
		030	30	

## Available Formats

Formats	Effective Filtration Area (EFA)	Membrane Selection <sup>3</sup>		
		Supor TFF	Omega	Delta
Minimate <sup>1</sup>	50 cm <sup>2</sup>	n/a	OA...C12	n/a
Centramate™ <sup>2</sup>	93 cm <sup>2</sup>	n/a	n/a	DC...T01
Centramate <sup>2</sup>	186 cm <sup>2</sup>	PS...C11P2	OS...T02	DC...T02
Centramate <sup>2</sup>	0.1 m <sup>2</sup>	PS...C11	OS...T12	DC...T12
Centrasette™ <sup>2</sup>	0.5 m <sup>2</sup>	PS...F07	OS...T06	DC...T06
Centrasette (Blocks) <sup>2</sup>	2.5 m <sup>2</sup>	PS...F27	OS...T26	DC...T26

Cross Flux Rate	Production			Cleaning		
	Supor TFF	Omega	Delta	Supor TFF	Omega	Delta
Centramate (L/min/m <sup>2</sup> )	8 – 20	3 – 8	3 – 8	15 – 30	7 – 12	7 – 12
Centrasette (L/min/m <sup>2</sup> )	8 – 20	3 – 8	3 – 8	15 – 30	7 – 12	7 – 12
Minimate (mL/min)	60 – 80	60 – 80	60 – 80	100	100	100

<sup>1</sup> For screening purposes. <sup>2</sup> Specific hardware required, please contact Pall. <sup>3</sup> In the table, “...” indicates the section of the product number associated with the chosen cassette rating/NMWC code.



T-Series Cassette 2.5 m<sup>2</sup>

# Technologies for Chromatography

Pall provides cost-effective and innovative chromatographic purification platforms that support today's demanding applications and productivity goals. They offer exciting new selectivities that address the process challenges of today, true scalability from laboratory to process scale, unique platforms that enhance process economics, and high productivity performance. Fully scalable Mustang® membrane devices are available as either single- or

multiple-use products in easy-to-use, compact designs from 0.18 mL to 5 L. Pall's chromatography sorbents are available in volumes ranging from 5 mL bottles to 20 L drums or larger, for use with appropriately-sized columns and packing stations. Sorbents are also available prepacked into 1 and 5 mL columns for sorbent screening and optimization of conditions of use.

## Mustang Chromatography Membranes

Product	Mode	Chemistry	Material	Dynamic Capacity	Application
Mustang Q	Anion exchange	Quaternary amine	Modified hydrophilic polyethersulfone	50 to 70 mg/mL BSA 20 to 25 mg/mL DNA	Elimination of contaminants, polishing (DNA, HCP, endotoxin, etc.); capture of large molecules (virus, plasmids, etc.)
Mustang E	Mixed-mode	E	Modified hydrophilic polyethersulfone	4 x 10 <sup>6</sup> EU/mL	Optimized for endotoxin retention
Mustang S	Cation exchange	Sulfonic acid	Modified hydrophilic polyethersulfone	60 mg/mL hlgG	Specific capture (baculovirus, etc.)

Formats	Volume of Membrane (mL) Mustang Q, S	Volume of Membrane (mL) Mustang E	Typical Flow Rate [mL/min]	Availability
Acrodisc® syringe filter	0.18	0.18	n/a	Mustang Q, S, E
Novasip CLM05 capsule	10	10	100	Mustang Q, S, E
Novasip CL3 capsule	60	40	600	Mustang Q, S, E
Kleenpak Nova (10-inch) capsule	260	160	2,600	Mustang Q, S, E
Kleenpak Nova (20-inch) capsule	520	320	5,200	Mustang Q, S, E
Kleenpak Nova (30-inch) capsule	780	480	7,800	Mustang Q, S, E
Mustang Q XT5 capsule	5	n/a	50	Mustang Q
Mustang Q XT140 capsule	140	n/a	1,400	Mustang Q
Mustang Q XT5000 capsule	5000	n/a	50,000	Mustang Q



Acrodisc Syringe Filter



Novasip CLM05 Capsule



Novasip CL3 Capsule



Kleenpak Nova Capsule



Mustang Q XT5 Capsule

## Chromatography Sorbents

Product	Mode	Chemistry	Applications/Features	Typical Load Conditions	Typical Elution Conditions	Typical Dynamic Binding Capacity <sup>1</sup> [mg/mL]
Q HyperCel™	Strong anion exchange	Quaternary amine	<ul style="list-style-type: none"> <li>• Capture and purification of plasma or recombinant proteins</li> <li>• New selectivity</li> <li>• Low residence time</li> </ul>	pH 8.5	Salt and/or pH	≥ 160 BSA
Q Ceramic HyperD® F	Strong anion exchange	Quaternary amine	<ul style="list-style-type: none"> <li>• Capture and purification of proteins</li> <li>• Non-compressible – high flow rates</li> </ul>	pH 8.6	Salt and/or pH	≥ 85 BSA
DEAE Ceramic HyperD F	Weak anion exchange	Diethylaminoethyl	<ul style="list-style-type: none"> <li>• Capture and purification of proteins</li> <li>• Non-compressible – high flow rates</li> </ul>	pH 8.6	Salt and/or pH	≥ 85 BSA
S HyperCel	Strong cation exchange	Sulfonic acid	<ul style="list-style-type: none"> <li>• Capture and purification of antibody recombinant proteins</li> <li>• Impurities removal</li> <li>• New selectivity</li> <li>• Antibody purification in low conductivity (5 mS/cm)</li> </ul>	pH 4.5	Salt and/or pH	≥ 130 hlgG
S Ceramic HyperD F	Strong cation exchange	Sulfopropyl	<ul style="list-style-type: none"> <li>• Capture and purification of recombinant proteins and antibodies</li> <li>• Non-compressible – high flow rates</li> </ul>	pH 4.5	Salt and/or pH	≥ 75 Lysozyme
CM Ceramic HyperD F	Weak cation exchange	Carboxymethyl	<ul style="list-style-type: none"> <li>• Capture and purification of recombinant proteins, antibodies in moderate concentration of salt (15-20 mS/cm)</li> </ul>	pH 4.5	Salt and/or pH	≥ 60 hlgG
MEP HyperCel	Mixed-mode	4-mercapto-ethyl-pyridine	<ul style="list-style-type: none"> <li>• Antibody capture</li> <li>• Aggregate removal</li> <li>• Alternative to HIC support</li> </ul>	pH 7.4 <sup>2</sup>	< pH 5.5	≥ 20 hlgG
HEA HyperCel	Mixed-mode	Hexylamine	<ul style="list-style-type: none"> <li>• Capture and purification of recombinant proteins</li> <li>• Contaminant removal</li> <li>• Alternative to HIC support</li> </ul>	pH 7.4 <sup>2</sup>	< pH 5.5	≥ 40 BSA
PPA HyperCel	Mixed-mode	Phenylpropylamine	<ul style="list-style-type: none"> <li>• Capture and purification of recombinant proteins</li> <li>• Contaminant removal</li> <li>• Alternative to HIC support</li> </ul>	pH 7.4 <sup>2</sup>	< pH 5.5	≥ 40 BSA
HA Ultrogel®	Hydroxyapatite	Hydroxyapatite	<ul style="list-style-type: none"> <li>• Antibody separation</li> <li>• Glycoprotein purification</li> </ul>	pH 6.8	Phosphate gradient	n/a

<sup>1</sup> At 10% breakthrough. <sup>2</sup> Physiological saline concentration.

Chromatography support materials are available in columns of 1 mL or 5 mL (PRC Columns) or in vials (from 5 mL). To obtain more information on the whole range and to obtain selected products, please contact Pall.



Mustang Q XT140



Mustang Q XT5000



Chromatography Sorbents



PRC Columns



LRC Columns

# Scientific and Laboratory Services

## Global Expertise... Delivered

Pall Life Sciences provides high quality technical and scientific consulting services that enable speed to market and deliver insights for process efficiency. Our Scientific and Laboratory Services team offers consulting, training, validation services, and instrumentation services to our customers globally. Contact Pall today to find out how we can help to optimize your scale-up processes.



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