Data Sheet

Viresolve® NFR Filters

Fast, Reliable Retrovirus Removal

Viresolve® NFR filters quickly and efficiently remove retroviruses from recombinant protein solutions or human plasma sources. Viresolve® NFR filters are ideal for polishing monoclonal antibodies, and provide an easy-to-implement technology that eliminates retrovirus contaminants in essential media and protein feed streams. When placed downstream of a bioreactor, Viresolve® NFR filters help you minimize product and process risk caused by viruses common to mammalian cell expression systems.

Fast, Reliable Clearance

Cast from polyethersulfone, Retropore® membrane exhibits a patented void-free pore structure characterized by superior clearance and high flow rates. Denser internally than on its surface, the asymmetrical matrix of the membrane effectively traps large viruses and efficiently passes smaller proteins. By providing fast and highly reliable clearance, Viresolve® NFR filters improve product safety and protect downstream processes.

- ≥6 log removal of retroviruses
- >98% recovery of protein
- Robust processing
- Fast alcohol-free integrity testing
- Multiple formats available for easy scaling
- Each lot is 100% integrity tested

Membrane Type

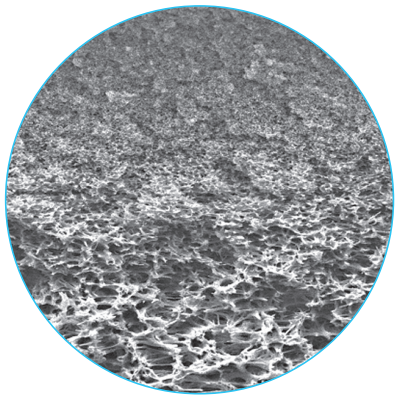
- Retropore® void-free membrane

Filter Formats

- OptiScale®-25 disposable devices
- Opticap® XL and XLT disposable capsule filters
- Cartridge filters

High Yields and Product Quality

Unlike inactivation methods, filters are inert and do not degrade proteins. High protein passage and low protein binding provide >98% protein product yields, while low extractables ensure product quality. Retropore® membrane technology passes proteins up to 700 kDa and consistently clears retroviruses at >6 LRV (Log Reduction Value).



Providing fast flow and unmatched retrovirus clearance, the Retropore® membrane used in Viresolve® NFR filters features a void-free structure in an asymmetrical matrix.

Predictable Scale-up and Scale-down

Viresolve® NFR filters with Retropore® membrane are available in two formats and multiple configurations that vary by filtration area and the type of inlet /outlet connection. Choose the best format for your process requirements.

Regulatory Compliance

All Viresolve® NFR filters are designed, developed, and manufactured in accordance with a Quality Management System approved by an accredited registering body to ISO® 9001 standards. Viresolve® NFR capsules and cartridge filters are integrity tested during manufacturing and are supported by a Validation Guide for compliance with regulatory requirements.

For traceability and easy identification, each filter is shipped with a Certificate of Quality in a sealed bag clearly labeled with the product name and identifying characteristics.

We have submitted a Biological Master File to the FDA and will submit it to other worldwide regulatory agencies as needed to support customer applications. Please contact Technical Support to obtain a Letter of Authorization to reference in your application.

Sizing

Sizing requires bench scale trials with small volumes of representative fluid samples, OptiScale®-25 (25 mm) devices, the Low Hold Up Volume V_{max}™ Test Kit, and comparable operating parameters to production. Flow decay is measured to assess the capacity of the filter. The volume per surface area of the trial then translates to the area needed to process a specific batch size. For a wide range of different solutions, minimal plugging is observed and sizing is based primarily on flow. The results of a typical sizing study are shown in Table 1.

Parameter	Performance
Full batch size	150 L
Process time	2 hrs
Pressure	30 psid
Feed	2.5 mg/mL
Prefiltration	None
Flow decay	<5%
Test filter	47 mm disk
Batch filter size	4-inch capsule*
φ6 LRV	>6.9 LRV
MAb quality	Unchanged
MAb yield	>98%

* 4-inch capsule no longer available for purchase

Table 1:
Typical Process Sizing Study

Summary of an evaluation performed at a biotech manufacturer to determine sizing and retention for a monoclonal antibody product processed on Viresolve® NFR.

Water Wettable Fast Integrity Testing

A convenient air-water diffusion based integrity test has been developed which relates to φ6 retention. Passing this test provides assurance of consistent and reliable virus retention. Retropore® membrane is water wettable and does not require the use of solvents such as alcohol for integrity testing.

Condition	Range
pH	4.5–8.5
Ionic Strength	25–250 mM
Process time	up to 4 hrs
Pressure	0.3–4.1 bar (5–60 psi)
Protein concentration	0–25 g/L

Table 2.

Feedstock and Processing Conditions for >6.5 LRV Virus Retention Using Viresolve® NFR Filters

Virus Retention

Pleated filters and OptiScale®-25 disposable devices have been extensively tested using the 78 nm diameter φ6. This bacteriophage is readily grown to monodispersed, uniform size, high titer challenges. A consistent >6.5 LRV has been observed over the range of feedstock and processing conditions shown in Table 2.

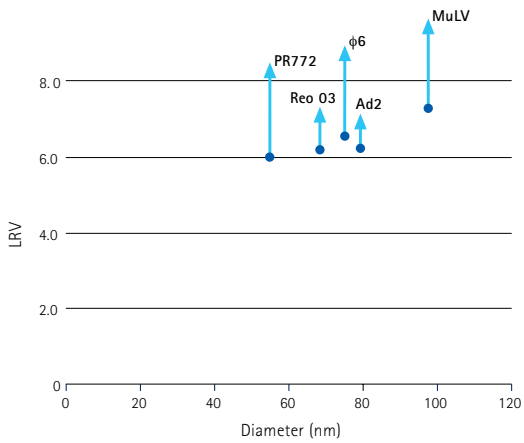


Figure 1.

Representative Virus Retention Data for Viresolve® NFR Filters

OptiScale®-25 Small Volume Disposable Devices

OptiScale®-25 Filters

OptiScale®-25 disposable devices with Viresolve® NFR membrane are used in small volume applications where feedstock requirements are minimal. Providing filtration area of 3.5 cm^2, these small devices are useful as an evaluation tool for impurity studies, protein passage studies, membrane area determination, and virus validation. A female Luer-Lok™/male luer slip connection ensures fast and secure setup. OptiScale®-25 disposable capsule filters are sold as Evaluation Kits. Each kit includes 9 capsules, either 3 devices each of 3 different membrane lots or 9 devices from a single membrane lot. These are ideal for use in validation and sizing studies with the Low Hold Up Volume V_{max}™ Test Kit.

Cartridge Filters

Cartridge Filters

Viresolve® NFR 10-, 20- and 30-inch cartridge filters are ideally suited for processes that require maximum pressure differentials. Each cartridge is integrity tested during the manufacturing process. A range of filtration areas is available to suit medium and large volume requirements.

Opticap® XL and XLT Disposable Capsule Filters

Opticap® XL Filters

Opticap® XLT Filters

XLT Capsule Stand

Convenient and Easy to Use

Capsule filters eliminate the time and expense associated with assembling, cleaning, and validating stainless steel housings. Adjustable, easy-to-turn, upstream vents and drain valves with O-ring seals and hose barb connections allow for easy process control. Other ease-of-use Opticap® XL and XLT capsule features include flow direction arrows and ribbed housing for easy gripping even with gloved hands.

The Right Connections

Self-contained and disposable, Opticap® XL and XLT capsule filters are supplied with a choice of inlet and outlet connections to optimize your filtration process, including sanitary flanges which provide a high flow rate and hose barb.

Proven Integrity

Each capsule is integrity tested during the manufacturing process to ensure reliable performance in your process.

Robust Construction

Opticap® XL and XLT's capsule design allows unparalleled thermal and hydraulic stress resistance in a disposable filter, resulting in reliability, high confidence in the sterilization process, and improved cleanliness.

Opticap® XL Capsule Filters

Opticap® XL disposable capsule filters offer a unique design which minimizes hold-up volume and reduces production losses. Available in the Opticap® XL10 capsule size.

Opticap® XLT Capsule Filters

Opticap® XLT disposable capsule filters offer a T-line design that accommodates series or parallel filtration and a specially-designed stand enables quick and easy integration into your process. Available in Opticap® XLT10, XLT20 and XLT30 capsule sizes.

Specifications

	OptiScale®-25	10-inch Cartridge	20-inch Cartridge	30-inch Cartridge
Materials of Construction				
Filter membrane:	Polyethersulfone	Polyethersulfone		
O-ring:	Silicone	Silicone		
Cage, core, end caps, non-woven supports, film edge:	–	Polypropylene		
Cap and base:	Acrylic	N/A		
Standard Connections	Female Luer-Lok™, male luer slip fittings	Code 7 (2-226) O-ring, bayonet with spear		
Maximum Operating Line Pressure (at 25 °C)	4.1 bar (60 psi)	5.5 bar (80 psi)		
Maximum Differential Pressure (at 25 °C)				
Forward:	4.1 bar (60 psi)	5.5 bar (80 psi)		
Reverse:	0.7 bar (10 psi)	3.4 bar (50 psi)		
Wetting/Flushing	Water wet filter for 10 min at 2 bar (30 psi) or for 5 min at 3.4 bar (50 psi) to a volume of 75 L/m^2.			
Autoclaving	Not autoclavable. Sold gamma irradiated	After wetting, may be autoclaved for 3 cycles of up to 60 min at 125 °C, using liquid cycle, slow exhaust. May be steamed-in-place for 30 minutes at 125 °C.		
Non-volatile Residue (NVR)[1]	–	Extractables level after a 10 min 1.5 Lpm/ft^2 flush, after 24 hrs in ASTM® Type 1 reagent-grade water at controlled room temperature:		
		≤ 35 mg	≤ 70 mg	≤105 mg
Bacteriophage Retention[1]	Lot release testing on samples exhibited ≥6 LRV for φ6 (78 nm) at a challenge of 10^7 pfu/cm^2.			
Bacterial Endotoxin[1]	Aqueous extraction contains < 0.5 EU/mL as determined by the Limulus Amebocyte Lysate (LAL) test.			
Non-fiber Releasing[1]	Component materials meet criteria for a "non fiber releasing" filter as defined in 21 CFR 210.3 (b)(6).			
Oxidizable Substances[1]	–	Meet the requirements of the USP Oxidizable Substances Test after a water flush of:		
		4,000 mL	8,000 mL	12,000 mL
Component Materials Toxicity[1]	Component materials were tested and meet the criteria of USP <88> Reactivity Test Class VI Plastics, and are non-toxic per the USP <88> Reactivity Safety Test.			
Integrity Test Specification[1]	–	Air/water diffusion rates at 23 °C, 3.4 bar (50 psi):		
		≤ 16 cc/min	≤ 32 cc/min	≤ 48 cc/min
Thermal and Hydraulic Stress[1]	–	Lot release testing on autoclaved samples at 25 °C exhibited integrity after a forward stress to 80 psid (5.5 bar) and a reverse stress to 50 psid (3.4 bar).		
Good Manufacturing Practices	These products are manufactured in a facility which adheres to FDA Good Manufacturing Practices.			

[1] A Certificate of Quality validating these specification is included with every shipment.

Specifications continued

	Opticap® XL 10	Opticap® XLT 10	Opticap® XLT 20	Opticap® XLT 30
Materials of Construction				
Filter membrane:	Polyethersulfone			
Cage, core, end caps, non-woven supports, film edge, capsule housing:	Polypropylene			
Vent O-rings:	Silicone			
Standard Connections	1½ in Sanitary flange			
Vent/Drain	¼ in Hose barb with double O-ring seal			
Maximum Operating Line Pressure (at 25 °C)	5.5 bar (80 psi)			
Maximum Differential Pressure (at 25 °C)				
Forward:	5.5 bar (80 psi)			
Reverse:	3.4 bar (50 psi)			
Wetting/Flushing	Water wet filter for 10 min at 2 bar (30 psi) or for 5 min at 3.4 bar (50 psi) to a volume of 75 L/m^2.			
Autoclaving	After wetting, may be autoclaved for 3 cycles of up to 60 min at 125 °C, using liquid cycle, slow exhaust.			
Non-volatile Residue (NVR)[1]	Extractables level after a 10 min 1.5 Lpm/ft^2 flush, after 24 hrs in ASTM® Type 1 reagent-grade water at controlled room temperature:			
	≤ 35 mg	≤ 35 mg	≤ 70 mg	≤ 105 mg
Bacteriophage Retention[1]	Lot release testing on samples exhibited ≥6 LRV for φ6 (78 nm) at a challenge of 10^7 pfu/cm^2.			
Bacterial Endotoxin[1]	Aqueous extraction contains <0.5 EU/mL as determined by the Limulus Amebocyte Lysate (LAL) test.			
Non-fiber Releasing[1]	Component materials meet criteria for a "non fiber releasing" filter as defined in 21 CFR 210.3 (b)(6).			
Oxidizable Substances[1]	Meet the requirements of the USP Oxidizable Substances Test after a water flush of:			
	4,000 mL	4,000 mL	8,000 mL	12,000 mL
Component Materials Toxicity[1]	Component materials were tested and meet the criteria of USP <88> Reactivity Test Class VI Plastics. This product meets the requirements of the USP <88> Safety Test utilizing a 0.9% sodium chloride extraction.			
Integrity Test Specification[1]	Air/water diffusion rates at 23 °C, 3.4 bar (50 psi):			
	≤ 16 cc/min	≤ 16 cc/min	≤ 32 cc/mi	≤ 48 cc/min
Thermal and Hydraulic Stress[1]	Lot release testing on autoclaved samples at 25 °C exhibited integrity after a forward stress to 80 psid (5.5 bar) and a reverse stress to 50 psid (3.4 bar).			
Good Manufacturing Practices	These products are manufactured in a facility which adheres to FDA Good Manufacturing Practices.			

[1] A Certificate of Quality validating these specifications is included with every shipment.

Sizing Guidelines

Device	Effective Filtration Area	Typical Processing Volume	Length	Typical Hold-up Volume*
OptiScale®-25 Capsule	3.5 cm^2 (0.54 in^2)	0.165 L	2.2 cm (0.87 in)	1 mL
10-inch Cartridge Filter	0.43 m^2 (4.6 ft^2)	600–1,200 L	30.5 cm (12 in)	175 mL
20-inch Cartridge Filter	0.854 m^2 (9.2 ft^2)	1,200–2,400 L	60.5 cm (22 in)	325 mL
30-inch Cartridge Filter	1.281 m^2 (13.8 ft^2)	1,800–3,600 L	86.6 cm (31.5 in)	490 mL
Opticap® XL 10 Capsule	0.43 m^2 (4.6 ft^2)	600–1,200 L	34 cm (13 in)	175 mL
Opticap® XLT 10 Capsule	0.43 m^2 (4.6 ft^2)	600–1,200 L	38 cm (15 in)	175 mL
Opticap® XLT 20 Capsule	0.854 m^2 (9.2 ft^2)	1,200–2,400 L	62 cm (25 in)	325 mL
Opticap® XLT 30 Capsule	1.281 m^2 (13.8 ft^2)	1,800–3,600 L	87 cm (34 in)	490 mL

* On filtrate side, after 1 minute of 20 psi upstream air pressurization.

Ordering Information

Device	Connections	Qty/Pk	Catalogue No.
OptiScale®-25 Capsule Evaluation Kit, 3 Membrane Lots	Female Luer-Lok™, male luer slip fittings	3 x 3 (9)	SZRV 025 NB9
OptiScale®-25 Capsule Evaluation Kit, Single Membrane Lot	Female Luer-Lok™, male luer slip fittings	9	SZRV SML NB9
Low Hold Up Volume V_{max}™ Test Kit	For use with OptiScale®-25 devices	1	VIRUSVMAX
10-inch Cartridge Filter	Code 7 (2-226) O-ring bayonet with spear	1	CZRV 71T P1
20-inch Cartridge Filter	Code 7 (2-226) O-ring bayonet with spear	1	CZRV 72T P1
30-inch Cartridge Filter	Code 7 (2-226) O-ring bayonet with spear	1	CZRV 73T P1
Opticap® XL 10 Capsule	1½ in Sanitary flange inlet and outlet	1	KZRV A10T T1
Opticap® XLT 10 Capsule	1½ in Sanitary flange inlet and outlet	1	KZRV A1TT T1
Opticap® XLT 20 Capsule	1½ in Sanitary flange inlet and outlet	1	KZRV A2TT T1
Opticap® XLT 30 Capsule	1½ in Sanitary flange inlet and outlet	1	KZRV A3TT T1
Standard Opticap® XLT Capsule Stand		1	XLTS TAN D1

To Place an Order or Receive Technical Assistance

In Europe, please call Customer Service:

France: 0825.045.645
Spain: 901.516.645 Option 1
Germany: 01805.045.645
Italy: 848.845.645
United Kingdom: 0870.900.46.45

For other countries across Europe, please call:
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