

# Filtration Technology Overview for the Biopharmaceutical Industry



# A Profile of Sartorius Stedim Biotech



# Filtration Technology

Sartorius Stedim Biotech's filter products are especially designed developed and manufactured to match the application requirements of the biopharmaceutical industry ranging from R&D to pilot scale production and to commercial scale manufacturing. Backed up by decades of experience we guarantee consistent product quality, reliable supply, easy scale-up and multiple product configurations and materials for flexible integration of our filtration solutions into biopharmaceutical manufacturing processes.

### **Applications**

Cartridges, Mini Cartridges, MidiCaps® and MaxiCaps® are available with a multitude of different membrane and filter active fleece materials making them ideally suited for a broad range of applications in biopharmaceutical manufacturing across the complete process chain. These applications include:

- Sterilizing Grade Filtration
- Mycoplasma Retentive Filtration
- Bioburden Reduction
- Prefiltration
- Clarification
- Air & Gasfiltration

### **Unique Labeling**

All filter products of Sartorius Stedim Biotech feature a comprehensive and easy to read out labeling on the housing of the filter capsules or on the top-adapter of filter cartridges. This labeling typically includes:

- Filter Type
- Order Code | Lot Number
- Pore Size or Retention Rating
- Operating Parameters
- Flow Direction Indication (only for MidiCaps® and MaxiCaps®)
- 2-dimensional barcode incorporating the identical information

The labeling allows secure identification of each filter unit and assures traceability of the filters across the whole process. The 2-d barcode labeling allows together with the integrity testing unit Sartocheck® 4 Plus

the automatic data transfer of the filter element into the pre-determined fields of the integrity tester while programming an integrity test. As a result operator errors and mishandling of filters can be avoided, thus improving filter handling and overall security of the manufacturing process significantly.

### **Certified Quality**

All Sartorius Stedim Biotech filter products are manufactured according to an ISO 9001:2000 certified Quality Management System. Our manufacturing facilities operate in conformance with cGMP requirements in addition to the ISO standard. Sartorius Stedim Biotech's quality philosophy ensures that our customers receive products and services that meet the strictest quality requirements and assure reliable product performance.

#### Documentation

The entire range of our filter products is supplied with quality assurance certificates for compliance with regulatory requirements. Comprehensive product specific Validation Guides and Extractable Guides are available for all Sartorius Stedim Biotech filter products to support your process validation efforts.

#### **Process Validation**

Sartorius Stedim Biotech offers a wide range of validation support services to quality the use of our filter products for your processes. The Sartorius Stedim Biotech Validation Service has a proven track record in assisting customers in validating their products and achieving regulatory approval.



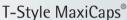
# Unparalleled Flexibility

Independently whether you run your filtration process on re-usable stainless steel equipment or a fully single use manufacturing process, Sartorius Stedim Biotech provides you with the right choice of filter designs and configurations for each process requirement. Standard filter cartridges and Mini Cartridges are available in different sizes and with multiple adapter geometries to fit into stainless steel housings. MaxiCaps® in T-Style or "in-line" format and MidiCaps® feature a broad variety of special adapter combinations and filter sizes to allow for a flexible integration into single use filtration systems and to adapt to changing process volumes.

Sartorius Stedim Biotech's filter products for liquids and gases are available starting with SartoScale devices with 17 cm<sup>2</sup> filtratioin area up 3 m<sup>2</sup> filtration area in Sartopore® Platinum 30" cartridges and MaxiCaps® allowing for reliable Scale-up with consistent materials and design parameters from R&D to commercial manufacturing.











Mini Cartridges







Connector Type S Tri-Clamp 50 mm (1 1/2")



Connector Type O 1/2" single stepped hose barb



Connector Type F Tri-Clamp 25 mm (3/4")



Connector Type H 1/4" multiple stepped hose barb







Connector Type S Tri-Clamp 50 mm (11/2")



Connector Type O 1/2" single stepped hose barb



Connector Type F Tri-Clamp 25 mm (3/4")

MaxiCaps<sup>®</sup>





Connector Type F Tri-Clamp 25 mm (1/2")

SartoScale





Adapter 21



Adapter 25 Double open end 2 Flange Bayonet adapter with flat gaskets with 226 double o-ring



Adapter 27 222 double o-ring



Adapter 28 Bayonet adapter with 3 Flange Bayonet adapter with 222 double o-ring



# **Application Matrix**

This matrix provides a guideline for selection of the right filter in a given application backed up by decades of experience in the biopharmaceutical industry. However, it is recommended carrying out small scale filtration trials to identify the optimal filter combination based on actual process conditions.

Process	Application	Prefilters				Bioburden Reduction			
		Sartoclean <sup>®</sup>		Sartopure <sup>®</sup>		Sartofine	Sartoguar		d
		GF	CA	PP2	GF Plus	PP	PES	GF	NF
Biotech									
mAb, rec.	Media Preparation				•		•	•	•
Proteine Vaccines	Cell Culture   Fermentation pH adjustment			•					
	Cell Removal   Clarification	•	•		•	•		•	
	Buffer Preparation			•		•	•		
	Downstream Intermediates (Protection of Columns, Crossflow)	•	•		•		•	•	•
	Prefiltration prior to virus filtration						•	•	•
	Form & Fill			•					
Viral Vaccines	Media Preparation				•		•	•	•
Cell Culture	Cell Culture   Fermentation pH adjustment			•					
	Cell Removal   Clarification	•	•		•	•		•	
	Buffer Preparation			•		•	•		
	Downstream Intermediates (Protection of Columns, Crossflow)	•	•	•	•		•	•	•
	Form & Fill		•	•					
Pharma									
Opthalmics	Form & Fill			•	•				
SVP   LVP	Form & Fill			•		•			
API	Form & Fill			•		•			
Blood & Plasm	1a								
Albumin Globulines	Intermediate Process Filtration (Protection of Columns, Crossflow)	•	•	•	•	•	•	•	•
	Prefiltration prior to virus filtration							•	•
	Form & Fill			•					
Clotting Factors	Intermediate Process Filtration (Protection of Columns, Crossflow)	•	•	•		•			
	Prefiltration prior to virus filtration								
	Form & Fill			•					
Other									
	Water			•					
	Oily formulations			•		•			
	Solvents			•		•			
	Venting   Gas Filtration			•					

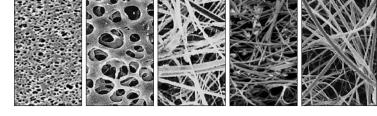
Sterile Liquid Filters						Mycoplasma Retentive Filters	Air   Gas Filtra	ation
Sartopore® Platinum**		Sartopore® 2	2	Sartobran® P	Sartolon <sup>®</sup>	Sartopore® 2	Sartopure <sup>®</sup>	Sartofluor
0.2 μm	HF	XLG	XLI	0.2 μm		XLM	GA	GA   LG
•		•	•	•		•		
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# Membrane Filters

			- C.	Was allowed		
	Cartridge Construction	Polyether- sulfone	Cellulose Acetate	PTFE	Nylon	Poly- propylene
Sartopore® Platinum	Protective Layer					•
Sterilizing Grade pharmaceutical filter	Prefilter Membrane	•				
with TwinPleat® Technology and perma-	Final Membrane	•				
nently hydrophilic membrane surface modification for optimal total throughput,	Drainage Layer					•
low binding and low flush volumes for secure and reliable integrity testing.	Outer Cage, Core and End Caps					•
Sartopore® 2	Protective Layer					•
Sterilizing Grade and Mycoplasma reten-	Prefilter Membrane	•				
tive pharmaceutical filter with high total throughput and flow rate performance in	Final Membrane	•				
a broad range of applications with broad	Drainage Layer					•
chemical compatibility.	Outer Cage, Core and End Caps					•
Sartopore® 2 XLG	Protective Layer					•
Sterilizing Grade pharmaceutical filter	Prefilter Membrane	•				
especially developed for complex cell culture media filtration and biological process	Final Membrane	•				
fluids with broad chemical compatibility.	Drainage Layer					•
	Outer Cage, Core and End Caps					•
Sartopore® 2 XLI	Protective Layer					•
Sterilizing Grade pharmaceutical filter	Prefilter Membrane	•				
especially developed for chemically defined cell culture media and classical	Final Membrane	•				
pharmaceuticals with broad chemical	Drainage Layer					•
compatibility.	Outer Cage, Core and End Caps					•
Sartopore® 2 XLM	Protective Layer					•
Mycoplasma retentive filter especially	Prefilter Membrane	•				
developed for secure retention of Myco- plasma and unusually small microorgan-	Final Membrane	•				
isms in cell culture media and biological	Drainage Layer					•
and pharmaceutical fluid streams.	Outer Cage, Core and End Caps					•
Sartopore® 2 HF	Protective Layer					•
Sterilizing Grade pharmaceutical filter	Final Membrane	•				
especially developed for filtration of buffers and large volume parenterals	Drainage layer					•
with exceptionally high flow rate.	Outer Cage, Core and End Caps					•
Sartobran® P	Protective Layer					•
Sterilizing Grade pharmaceutical filter	Prefilter Membrane		•			
with cellulose acetate membrane low unspecific adsorption and highest product	Final Membrane		•			
yield for filtration of highly valuable	Drainage Layer					•
protein and virus solutions.	Outer Cage, Core and End Caps					•
Sartolon <sup>®</sup>	Protective Layer					•
Sterilizing Grade pharmaceutical filter	Prefilter Membrane				•	
with nylon membrane with broad chemical compatibility for solvents	Final Membrane				•	
and solvent based formulations.	Drainage Layer					•
	Outer Cage, Core and End Caps					•
Sartofluor® GA   LG	Protective Layer					•
Sterilizing Grade pharmaceutical filter with highly hydrophobic PTFE membrane	Final Membrane			•		
for sterilizing grade filtration of gases	Drainage Layer					•
and aggressive liquids.	Outer Cage, Core and End Caps					•

O-Rings Standard	Pore Size Combinations	Autoclavable	γ-irrad MidiCaps <sup>®</sup>	liatable MaxiCaps®	Adapter Type Standard	Cartridges Mini	Connector Types* Maxi- & MidiCaps®
Silicone (optional: EPDM or Viton)	0.45 + 0.2 μm	•	•	•	25	-	SS   00   S0   FF
Silicone (optional: EPDM or Viton)	0.8 + 0.45 μm 0.45 + 0.2 μm 0.2 + 0.1 μm	•	•	•	21, 25, 27, 28	15, 18	SS 00 S0 FF
Silicone (optional: EPDM or Viton)	0.8 + 0.2 μm	•	•	•	25	-	SS 00 S0 FF
Silicone (optional: EPDM or Viton)	0.35 + 0.2 μm	•			25	-	SS   00   SO   FF
Silicone (optional: EPDM or Viton)	0.2 + 0.1 μm	•		•	25	-	SS 00 S0 FF
Silicone (optional: EPDM or Viton)	0.2 μm	•			25	-	-
Silicone (optional: EPDM or Viton)	0.65 + 0.45 μm 0.45 + 0.2 μm 0.45 + 0.1 μm	•			21, 25, 27, 28	15, 18	SS   00   S0   FF
Silicone (optional: EPDM or Viton)	0.45 + 0.2 μm	•			21, 25, 27, 28		SS   00   S0   FF
Silicone (optional: EPDM or Viton)	0.2 μm (GA) 0.1 μm (GA) 0.45 μm (LG) 0.2 μm (LG) 0.1 μm (LG)	•			25 (GA) 25, 28 (LG) 21, 27	12, 15, 18 14 (Junior)	SS   00   S0   FF

# Prefilters



	Cartridge Construction	Polyether- sulfone	Cellulose Acetate	Glass Fiber	PES Nanofleece	Poly- propylene
Sartoguard PES	Protective Layer					•
Pharmaceutical Grade membrane prefilter	Prefilter Membrane	•				
for bioburden reduction and protection of	Final Membrane	•				
sterilizing grade and Mycoplasma reten-	Drainage Layer					•
tive filters broad chemical compatibility.	Outer Cage, Core and End Caps					•
Sartoguard GF	Protective Layer					•
Pharmaceutical Grade membrane prefilter	Filter Active Fleece			•		
for bioburden reduction and protection	Prefilter Membrane	•				
of sterilizing grade and Mycoplasma	Final Membrane	•				
retentive filters with adsorptive power of glass fiber fleeces for effective removal	Drainage Layer					•
of colloids and lipids.	Outer Cage, Core and End Caps					•
Sartoguard NF	Protective Layer					•
Pharmaceutical Grade, gamma irradiat-	Filter Active Fleece				•	
able membrane prefilter for bioburden	Prefilter Membrane	•				
reduction and protection of sterilizing	Final Membrane	•				
grade and Mycoplasma retentive filters with innovative Nanofleece technology	Drainage Layer					•
for enhanced flow rate and throughput.	Outer Cage, Core and End Caps					•
Sartoclean <sup>®</sup> CA	Protective Layer					•
Pharmaceutical Grade membrane	Prefilter Membrane		•			
prefilter with low adsorptive cellulose	Final Membrane		•			
acetate membrane for low unspecific	Drainage Layer					•
adsorption and highest product yield.	Outer Cage, Core and End Caps					•
Sartoclean <sup>®</sup> GF	Protective Layer					•
Pharmaceutical Grade membrane	Filter Active Fleece			•		
prefilter for bioburden reduction and	Prefilter Membrane		•			
protection of sterilizing grade and Myco-	Final Membrane		•			
plasma retentive filters with adsorptive power of glass fiber fleeces for effective	Drainage Layer					•
removal of colloids and lipids.	Outer Cage, Core and End Caps					•

Sartopure® PP2	Protective Layer			•
Pharmaceutical Grade prefilter for	Filter Active Fleece			•
particle removing polypropylene depth	Drainage Layer			•
filter.	Outer Cage, Core and End Caps			•
Sartopure® GF Plus	Protective Layer			•
Pharmaceutical Grade adsorpive glass	Filter Active Fleece		•	
fiber prefilter for effective removal of	Drainage Layer			•
colloids and liquids and outstanding total throughput performance.	Outer Cage, Core and End Caps			•
Sartofine® PP	Protective Layer			•
Pharmaceutical Grade depth prefilter	Filter Active Fleece			•
made of progressivily finer Polypropylene	Drainage Layer			•
fleeces wounded around the inner core with high dirt holding capacity.	Outer Cage, Core and End Caps			•

	Rings ndard	Pore Size Combinations	Autoclavable	γ-irrac MidiCaps®	liatable MaxiCaps®	Adapter Type Ca Standard	artridges Mini	Connector Types* Maxi- & MidiCaps®
(opt	cone tional: JM or Viton)	0.45 + 0.1 μm 1.2 + 0.2 μm	•		•	25	-	SS 00 S0 FF
(opt	cone tional: JM or Viton)	0.45 + 0.1 μm 0.8 + 0.2 μm	•			25	-	SS 00 S0 FF
(opt EPD	cone tional: JM or Viton)	0.45 + 0.1 μm 0.8 + 0.2 μm	•	•	•	25	-	SS 00 S0 FF
(opt	cone tional: DM or Viton)	3 + 0.8 μm (double layer) 0.8 + 0.65 μm (double layer) 0.45 μm (single layer) 0.2 μm (single layer)	•			21, 25, 27, 28	15	SS   00   SO   FF
(opt	cone tional: bM or Viton)	3 + 0.8 μm 0.8 + 0.65 μm	•			21, 25, 27, 28	15	SS   00   S0   FF
		Nominal Retention Ratings						
(opt	cone tional: DM or Viton)	50 μm 3 μm 20 μm 1.2 μm 8 μm 0.65 μm 5 μm	•			21, 25, 27, 28	15	SS 00 S0 FF
(opt	cone tional: JM or Viton)	1.2 μm 0.65 μm	•			21, 25, 27, 28	-	SS   00   S0   FF
(opt	cone tional: JM or Viton)	40 μm 3 μm 20 μm 1 μm 10 μm 0.7 μm 5 μm 0.5 μm	•			00 (knife edge), 03, 05, 07, 08	-	-

# Filter Integrity Testing and Bag Testing

Filter Integrity Testing and Bag Testing | Sartorius Stedim Biotech offers a broad range of testing solutions – beginning with our stand-alone units of the Sartocheck® family for standard applications up to customized solutions like the WIThin concept and special filter management systems. There are no limits in terms of technical flexibility.

# Sartocheck® 3 plus

The stand-alone integrity tester for standard applications. This unit can be used to perform all established integrity test methods. Due to its paper-based concept the requirements regarding 21 CFR part 11 are not applicable.

### Sartocheck® 4 plus Filter tester

The state-of-the art integrity tester Sartocheck® 4 plus Filter tester offers a variety of additional features: An optional barcode scanner can be used for easy and error-free data entry. Moreover, an intelligent, automatic selection of test program after scanning increases the efficacy and safety of filter integrity testing. Short test times, new safety parameters and a unique cleaning function are only some fo the key characteristics. And the compliance with 21 CFR Part 11 is a matter of course.

# Sartocheck® 4 plus MultiUnit concept

Up to four Filter testers and or Bag tester MultiUnits can be connected to one Sartocheck® 4 plus Filter tester or to one Sartocheck® 4 plus Bag tester allowing independent and parallel testing of five systems. This significantly reduces the time required for testing and therefore improves the cost effectiveness.

# Sartocheck® 4 plus Bag tester

The Sartocheck® 4 plus Bag tester is the ideal tool for eliminating the risk of filling a defective single use bioreactor with high valuable cell cultures. The bioreactor (e.g. STR Cultibag) is tested pre-use after installation into its holder. A unique patented fleece avoids direct contact between the plastic film of the bag and the smooth stainless steel surface of the holder. Any kind of potential masking effect is therefore eliminated and environmental heat transfer is reduced giving unrivalled test accuracy.

# Filter Management Systems

# WIThin Concept

The WIThin concept allows integrity testing of filters inside specific equipment like autoclaves and freeze-dryers without connecting an external integrity tester. This unique Sartorius Stedim concept integrates Sartocheck® control functions as well as algorithms directly into the software platforms of the equipment manufacturer. This approach is adopted worldwide by leading manufacturers of autoclaves, freeze dryers, filling machines and bioreactors

## Filter Management System

The concept of the Filter Management System implements the in-place and off-line method which saves expensive time and eliminates the risk of integrity test failures before production runs. The filter is tested in its filter housing on a test bench and all integrity test steps can be performed automatically under sterile conditions. The sterile housing can then be installed and only the connection between the filter housing and the equipment requires to be sterilized.









Sartorius Stedim Biotech standard filter housings meet the highest requirements of the biopharmaceutical industry. Controlled production engineering is a quarantee for outstanding quality in processing and operational safety. All filter cartridge housings comply with Pressure Equipment Directive PED 97 23 EC. Our housings additionally feature GMP compliant designs and FDA USP Class VI approved gasket materials. Meticulously processed surfaces ensure operational safety wherever sterility and cleanability are concerned. Customer-specific documents are available for every filter cartridge housing. If requested, we can supply housing designs customized to meet your specific application.

An important feature of pharmaceutical process validation is documentation. All our housings are given stringent inspections during and after manufacturing including dimensional checks, weld inspections, surface measurements and hydrostatic testing. Each housing is labled by laser with a matching serial number on the bell and base. This serial number provides complete tracetability for the Quality Control Certificate, Material Test Reports, and Weld Logs.



# Services

Our capabilities are your key to success.

Source all your needs from one reliable partner for process optimization, customized validation and regulatory support, substantiated by practical training courses and instrument services. We are aware of our responsibilities toward the success of your business, and take them seriously. That's why we are rapidly deployable and globally available. You can expect the very best in sciencedriven consulting service, maximum requlatory expertise by our specialists, fast turnaround, on-site support and globally valid standards from Sartorius Stedim Biotech. But don't take our word for it. We invite you to see for yourself. Count on the people who know your industry inside and out: Sartorius Stedim Biotech.

### **CONFIDENCE®**

Our validation services:

- Validation designs
- Pre-approval inspection preparation
- Post-approval change support
- CFR 21 Part 11 | GAMP compliance
- Regulatory liaison
- Equipment qualification
- Filter | Cleaning | Process validation
- Risk assessment support
- Grouping support
- Extractables | Leachables testing for filters, fluid management systems and other polymer-based process components like tubing, gaskets, stoppers.

### **EXPAND®**

Our training and seminar services:

- FDA risk-based approach
- Regulatory inspection
- CFR 21 Part 11 | GAMP
- Aseptic processing
- Upstream | Downstream processing
- Process validation
- Cell culture | Fermentation
- Sterilization and integrity testing
- Quality control and quality assurance

Expore your possibilities – we continue

to lead and innovate in the field of services to increase the added value to the biopharmaceutical and pharmaceutical industry. Visit our website www.sartorius-stedim.com

# DISCOVER®

Our audit and survey services:

- Compliance audits
- Regulatory inspection readiness
- Plant | Process surveys
- Validation surveys
- Quality system surveys
- Technical studies

### INCREASE®

Our optimization services:

- Corrective actions guidance
- Process optimization and development support
- Design review and technology transfer
- Documentation and submittal optimization
- Regulatory guidance

# **EXTEND®**

Our instrument services:

- Installation
- IQ | OQ support and documentation
- Calibration services
- Spare part sales
- Preventative maintenance
- Instrument repairs
- Technical and application support





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