

Mobius® FlexReady Solution with Smart Flexware™ Assemblies for Chromatography and TFF

For Purification of Clinical and
Process Scale Biologics

The Mobius® FlexReady Solution with Smart Flexware™ Assemblies is a flexible system, allowing end user to have a single, scalable system for chromatography and tangential flow filtration at various scales.

The fully automated system is designed to achieve separation and purification of mAbs, vaccines, plasma and therapeutic proteins.

The Mobius® FlexReady Solution with Smart Flexware™ Assemblies delivers optimal operational flexibility in a very simple and fast way. Thanks to our innovative single-use flow paths, contamination is no longer a threat, giving you the confidence you need to tackle any chromatography and TFF challenge.



Features & Benefits

- **Flexibility**—Standard hardware platform supports multi-unit operation, multi-product and multi-scale production, maximizing the flexibility of high-value investments
- **100% single-use flowpath**—Smart Flexware™ single-use assemblies provide ease-of-use, robust reproducibility and elimination of carryover from previous batches
- **Fully Automated**—Enables you to easily and consistently produce clinical- and preclinical-scale quantities of high-value drug products
- **Services**—Comprehensive services ensure rapid implementation and optimized performance
- **Ease of Use**—The system shares common elements, such as software, design, and maintenance components, with our other systems, making training and validation easier across scales and applications
- Supports **industry-leading resins** and devices, such as Fractogel® resin, Eshmuno® resin, ProSep® Ultra Plus resin, and Pellicon® cassettes

System Hardware

The Mobius® FlexReady Solution with Smart Flexware™ assemblies covers multiple scales and applications, allowing production facilities to maximize the return on their investment.

Smart Cart

The Smart Cart is the heart of the system, and houses the clamshell and automation software for all applications. Designed for maximum mobility, the system's Smart Cart does not exceed the standard height and width of a door. In addition, the system has been designed to allow a single technician to manage, maintain and switch applications via the use of accessories to lift and store application components.



Clamshells, Lift and Storage Rack

This unique solution has already been widely adopted.

Valuable space and time are saved with the multiple size of clamshells for TFF and chromatography that can be installed on any Smart Cart.

A single operator can change application and/or scale in a matter of minutes.



Common Control Platform® (CCP®) Software

The automation software (CCP®), allows central control of all pumps and valves on the Smart Cart and any connected carts. In addition, all application recipes can be edited and stored for different applications, reducing the need for multiple automation systems. Each aspect of your process can be monitored from the home screen, and the report generator quickly creates batch reports.

The software is designed for cGMP facilities, developed in line with GAMP® 5 recommendations for automation software, and fulfills FDA guideline 21 CFR Part 11 requirements for electronic records and signatures. Our CCP® Software provides one software platform across our portfolio of automated systems for a familiar look and feel at each step of your process, reducing training time for operators.

Smart Flexware™ Assemblies

The USP class VI and Animal-Free or EMA/410/01-compliant Smart Flexware™ single-use assemblies deliver equivalent performance to that of traditional stainless steel systems, while maximizing system flexibility. Smart Flexware™ assemblies are clearly labeled, significantly reducing the risk of operator error and the challenges typically associated with installing single-use flow paths. Our groundbreaking flow path eliminates moving parts and minimizes dead space, decreasing the risk of contamination to virtually zero.

Benefits

- Gamma irradiated and ready to use, reducing set-up time
- Highly automated system increases robustness and consistency of production processes
- Reduced number of connections versus traditional single-use, reducing risk of integrity failure
- The main flow paths are 100% Integrity Tested during manufacturing, ensuring robust performance
- Reduced dead-legs maximize product purity and diafiltration efficiency
- No cleaning validation required

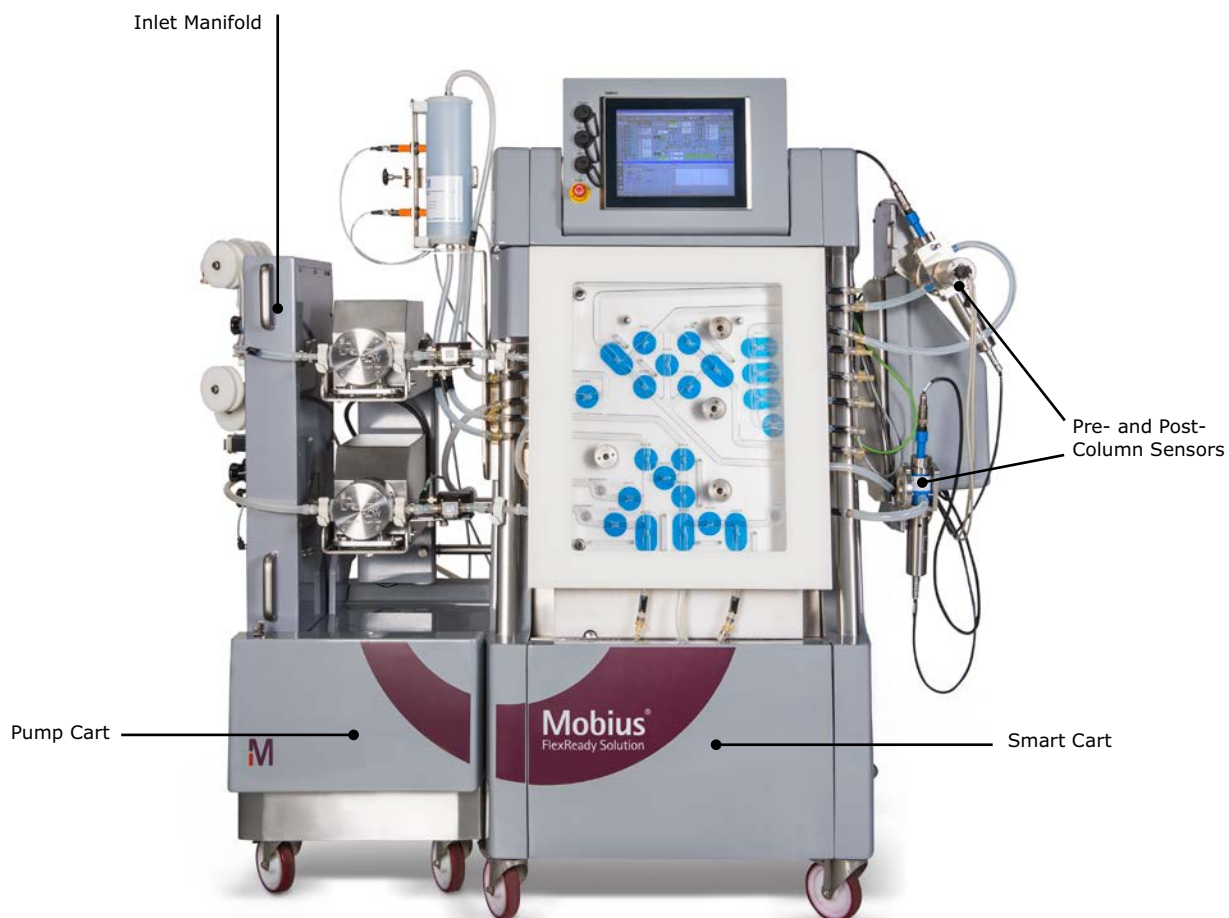
Sensor Instrumentation

The system gives the option to choose multi- or single-use sensors, for both Pre-/Post-Column and TFF Filtrate, without having to sacrifice performance in favor of reducing cleaning or risk of carryover.

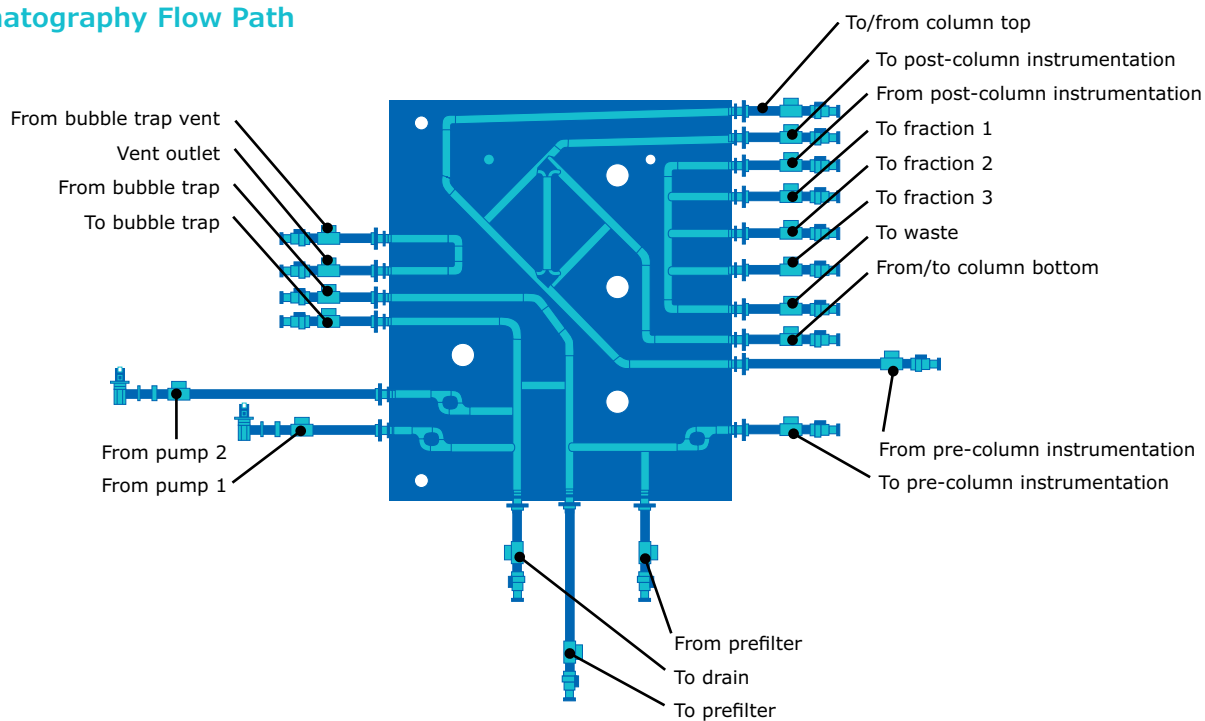
The hardware for receiving and transmitting data is the same regardless of single- or multi-use approach, increasing the flexibility of your facility, balancing economy and scale-up effort.



Chromatography Configuration



Chromatography Flow Path



General Chromatography Specifications

Pressure Rating	Up to 4 bar (58 psi)
Environmental Temperature Range	2–30 °C (TF3S 20–30 °C)
Process Connection Type	Colder CPC and TC connections
Humidity	10–90% (non-condensing)
Utility Requirements	Compressed air: 6 bar minimum (oil-free). Maximum consumption: 4 L/min Power supply: Smart Cart: 220–240 VAC, 50/60 Hz, 1 phase or 100–120 VAC, 50/60 Hz, 1 phase, maximum consumption: 0.4 KW Electrical cable with CN, EU, JP, NA or UK plugs delivered with the system
Wetted Materials	PureFlex® film, Platinum cured silicone tubing, PE fittings, Polysulfone flow cell (SUC), PP TC connections, Polysulfone connections, SS316 L (flow meters and conductivity pins on SUC), PP pump body, Santoprene® pump diaphragms, EPDM pump non-return valve, quartz UV cell windows, PFA (flow meter body), USP <88> Class VI, Animal Free or EMA/410/01 compliant.
Electrical Compliance	CE (2006/95, 2004/108, 2006/42/EEC)

Chromatography Specifications XMO1/2 and XMO3

	XMO1/2	XMO3
Flow Rate	0.1–2.2 L/min	1.6–10 L/min
Process Fluid Temperature Range	2–30 °C	
Buffer/Solvent Inlets	2 times 5 inlets	
Column Connectivity	¾ in. TC connection	
Pipe Work Inside Diameter	¼ in.	⅜ in. i.d.
Gradient Capability	10–90% (lowest controllable flow)	
Fraction Ports	3 + 1 waste	
Holdup Volume	Volume between buffer inlet to column inlet (Bubble trap bypass, filter bypass and column bypass) 300 mL for 2.2 L/min system, and 550 mL for 8.0 & 10.0 L/min systems Bubble trap (full): 1.1–1.9 L small-scale and large-scale	
Dimensions	Height: 175 cm (69 in.) Width: 172 cm (68 in.) Depth: 88 cm (34 in.)	
Uncrated Weight	~ 650 kg (1450 lbs) — depends on configuration	

Chromatography Sensor Performance

Sensor Type	Range	Accuracy
Pressure Sensors	0–4 bar	+/- 0.2 bar
Flow Meter	Multi-Use 2.2 L/min: 1.0–2.2 L/min 0.1–1.0 L/min 8 L/min: 1.6–8.0 L/min Single-Use 10 L/min: 1.6–10.0 L/min	+/- 1% MV +/- 0.01 L/min +/- 1% MV +/- 2% MV
Multi-Use Conductivity Default range	0–200 mS/cm 0–50 mS/cm	+/- 2%
Single-Use Conductivity Default range	0–150 mS/cm 0–50 mS/cm	+/- 2%
Pre- and Post-Column Temperature	2–30 °C	+/- 1 °C
pH	1–14	+/- 0.1 (between pH 3–9)
Multi-Use and Single-Use Post-Column UV	0–2 AU (wavelengths 280/300 nm)	+/- 2% FS

Related Products

QuikScale® Chromatography Columns

Designed to achieve ultra-high throughput, our robust QuikScale® columns are easily packed to deliver optimal resolution across a wide range of chromatographic applications, accommodating all media types.

QuikScale® Chromatography Column



Featuring Industry-Leading Chromatography Media (Affinity and Ion Exchange)

Eshmuno® Resin

This unique family of ion-exchange resins is specifically designed for highly productive downstream purification.

Fractogel® Resin

This tentacle-modified synthetic polymer resin is designed for ion exchange, hydrophobic interaction, size exclusion and metal chelate affinity.

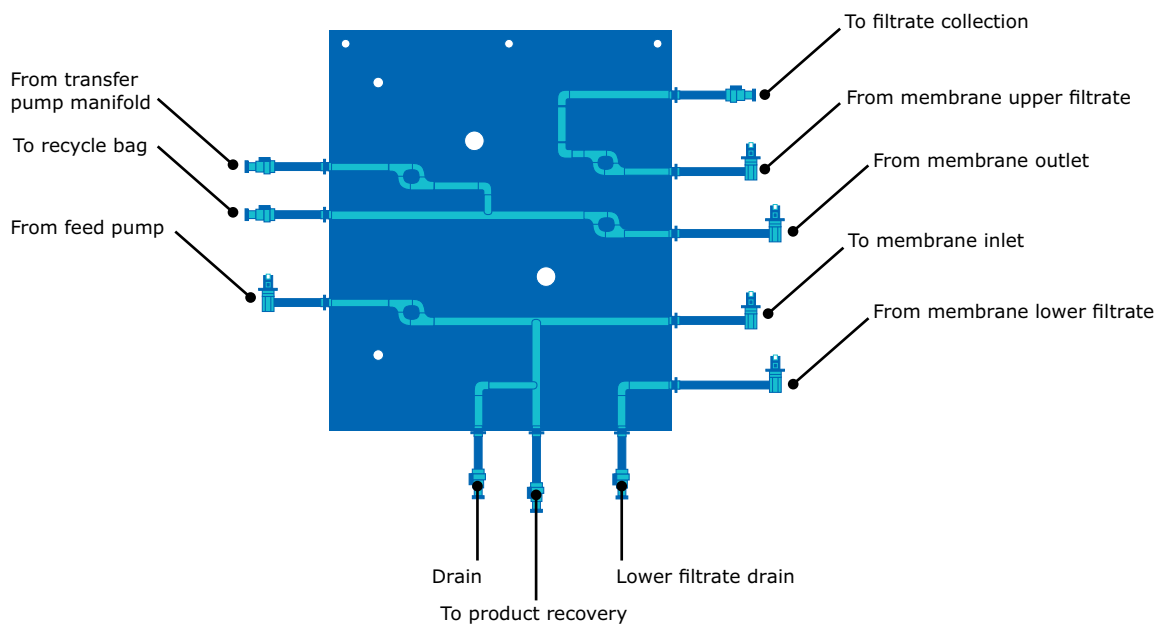
ProSep® Ultra Plus Resin

Designed for cost-effective, large-scale purification of today's higher titer therapeutic antibodies, the ProSep® Ultra Plus Resin is the highest dynamic binding capacity Protein A affinity chromatography media.

Tangential Flow Filtration (TFF) Configuration



TFF Flow Path



General TFF Specifications

Pressure Rating	Up to 4 bar (58 psi)
Environmental Temperature Range	2–30 °C (TF3S 20–30 °C)
Process Connection Type	Colder CPC and TC connections
Humidity	10–90% (non-condensing)
Utility Requirements	Compressed air: 6 bar minimum (oil-free). Maximum consumption: 4 L/min Power supply: Smart Cart: 220–240 VAC, 50/60 Hz, 1 phase or 100–120 VAC, 50/60 Hz, 1 phase, maximum consumption: 0.4 KW Tank Cart: 220–240 VAC, 50–60 Hz, 1 phase, maximum consumption: 0.4 KW TF3S Pump Cart: 3 x 200 – 240 VAC, 50/60 Hz, 3 phases + neutral + ground or 3 x 400 – 460 VAC, 50/60 Hz, 3 phases + neutral + ground, maximum consumption: 3 KW Electrical cable with CN, EU, JP, NA or UK plugs delivered with the system
Wetted Materials	PureFlex® film, Platinum cured silicone tubing, PE fittings and Inline Sampler, Polysulfone flow cell (SUC) and TFF cassette/ Liner, PP TC connections, Polysulfone connections, SS316 L (flow meters and conductivity pins on SUC), PP pump body, Santoprene® pump diaphragms, EPDM pump non-return valve, quartz UV cell windows, USP <88> Class VI, Animal Free or EMA/410/01 compliant.
Electrical Compliance	CE (2006/95, 2004/108, 2006/42/EEC)

TFF Specifications TF2S/TF3S

	TF2S	TF3S
Membrane Holder Capacity	0.5–5.0 m ²	2.0–10.0 m ²
Feed Flow Rate	2.0–18.0 L/min	4.0–40.0 L/min
Feed Flow Measurement	Flow is calculated to an accuracy of +/- 10% MV with a minimum pressure of 1 bar on the feed line	
Filtrate Flow Measurement	Flow can be calculated to an accuracy of +/- 5% MV (between 0.5–8.0 LPM) using the optional external 0–600 kg floor weight scale. RC Flow can be measured using an optional non-intrusive flowmeter to an accuracy of +/- 5% MV above 2 L/min, +/- 0.12 below 2 L/min.	
Process Fluid Temperature Range	2–45 °C	
Inlets	5 inlets (air plus 4 fluids)	
Pipe Work Inside Diameter	TF2S ¾ in. (Inlet Manifold), ⅝ in. (recirculation loop), ½ in. (Filtrate & Diafiltration lines), ⅜ in. (Product Recovery & Drains) i.d.	TF3S ¾ in. (Inlet Manifold), ¾ in. (recirculation loop), ⅝ in. (Filtrate & Diafiltration lines), ½ in. (Product Recovery & Drains) i.d.
Outlet Ports	1 drain, 1 Recovery, 1 Filtrate	
Tank Size	50L, 100L	200L
Minimum Working Volume (Excluding cassette's feed volume, and function of recirculation flow rate)	Down to 0.7 L	Down to 2.2 L
Hold-up Volume	<700 mL (exc filtration device)	<2200 mL (exc filtration device)
Unrecoverable Volume	Virtually zero using a displacement by buffer	
Dimensions	Height: 202 cm Width: 217 cm Depth: 101 cm	Height: 202 cm Width: 233 cm Depth: 119 cm
Uncrated Weight	~ 1000 kg — depends on configuration	

TFF Sensor Performance

Sensor Type	Range	Accuracy
Pressure Sensors	0–4 bar	+/- 0.2 bar
Optional Filtrate Conductivity	0–150 µS/cm Default range: 0–100 µS/cm	+/- 2% FS
Tank Temperature	2–45 °C	+/- 2 °C
Optional Filtrate UV	0–2 AU (wavelengths 280/300 nm)	+/- 2% FS
Tank Weight	0–50 kg; 0–100 kg 0–200 kg	+/- 0.3% FS
Flow Meter	Not-product contacted >2.0 L/min 0.4 to 2.0 L/min	+/- 5% MV at 20 °C +/- 0.12 L/min

Tangential Flow Filtration System Performance

The Mobius® FlexReady Solution with Smart Flexware™ assemblies for TFF is optimized and validated for a feed flow capacity up to 40 L/min and a membrane holder that can accommodate from 0.5–10.0 m² of Pellicon® devices, making it suitable for a wide range of concentration and diafiltration processes. In addition to the feed pump and retentate valve control loops, the system also includes an automated flow control valve on the filtrate line to enable open UF and MF operations, increasing the overall flexibility for clinical development and manufacturing facilities.

A variety of recycle vessel configurations are available with the Mobius® FlexReady Solution to provide maximum process capability. In addition to different vessel volumes, users can select a plastic carrier or a double-jacketed carrier, depending on whether or not temperature control is required. All recycle vessels come with integrated load cells, mixer and temperature sensor, and have been designed to allow containers to be easily and accurately installed by a single operator. For even greater plant flexibility, the recycle vessel skids have a built-in “stand-alone” setting, where they can be used as a mix container decoupled from the TFF system.

The Mobius® FlexReady Solution with Smart Flexware™ assemblies for TFF performance is documented in the system performance guide. Some examples of key performance data are highlighted below.

The system includes several unique design features that make it especially suited to demanding final concentration and buffer exchange applications, where the ability to accommodate elevated protein viscosity, low final volume and high purity requirements is key to process success. Feed pump capability and line pressure drop were tested with solutions up to 35 cP, giving you confidence in your operation as protein concentration increases. The recycle container and flow path were

designed to enable recirculation at process flow rates with a minimum product volume, while maintaining adequate mixing and avoiding vortexing or air entrainment.

The Smart Flexware™ assembly includes innovative valving where the transfer and product recovery lines intersect with the recirculation flow path. By replicating the functionality of traditional stainless steel zerostatic valves, dead-legs are eliminated in the critical product path to maintain product purity and enable highly effective buffer exchange for demanding final UF/DF operations (**Figure 1**).

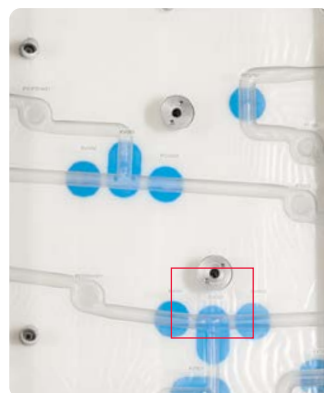


Figure 1. Innovative Smart flow path provides zero-dead-leg valving for excellent buffer exchange and purity.

At the end of concentration and diafiltration operations, achieving maximum recovery of product from the system is essential for process success. A straightforward sequence of steps has been developed to maximize product yield during recovery. The method can be carried out using either air or buffer to displace product from the flow path lines and membrane channels (**Figures 2 and 3**). This provides flexibility for users to select a product recovery strategy that is most in line with their specific process objectives, knowing that either choice will result in success.

Figure 2. Proven methodology for high product recovery using air or buffer displacement, using TF2S.

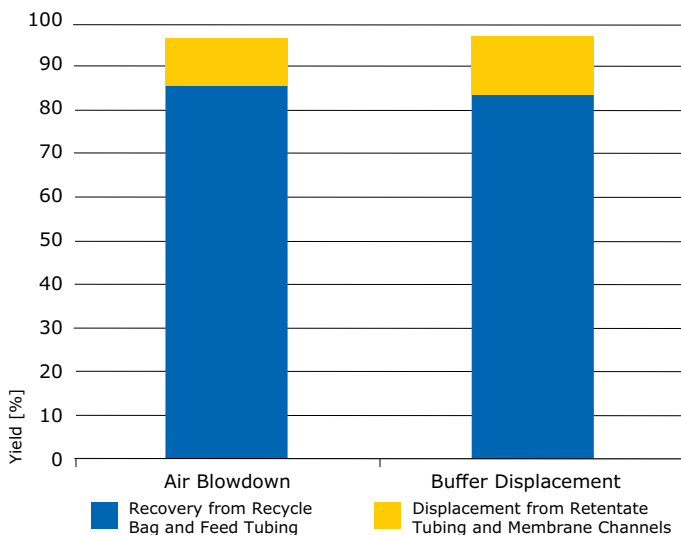
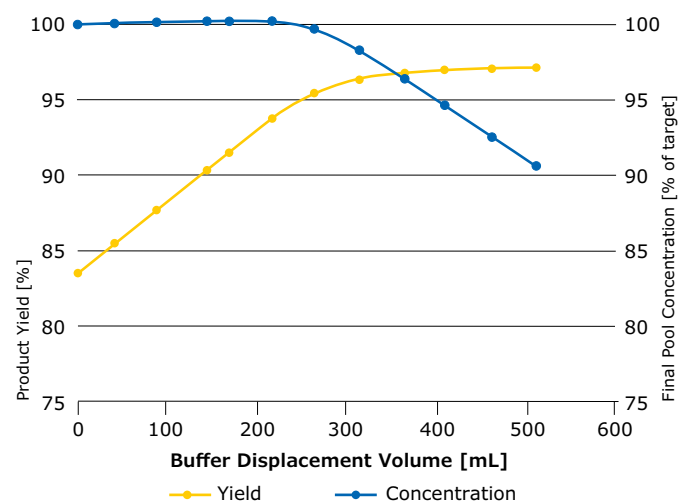


Figure 3. Product dilution during recovery with buffer can be minimized while achieving high product yield.



Related Products

TFF Cassette Holder

The TFF system includes a Pellicon® cassette holder adapted to utilize single-use liner plates, which isolates the process fluid from the holder endplates in order to achieve robust membrane compression, while eliminating cleaning and validation effort.

Pellicon® Cassettes

These advanced, high-performance cassettes are ideal for today's higher titer therapeutic antibodies, as well as the more demanding filtration processes that require higher operating pressures, temperatures and caustic cleaning regimes.

Pellicon® 3
(size 0.57
and 1.14 m²)



Pellicon® Capsules

Our innovative Pellicon® Capsules with Ultracel® membrane are ideal TFF devices to process biopharmaceuticals that require single-use capabilities, including enhanced ease-of-use, process flexibility, rapid product turnaround, and reduced operator exposure. First-of-its-kind, the capsule has a holderless, self-contained design and is provided gamma sterilized, offering easy installation and removal, and reduced pre-use steps.



Pellicon®
Capsule

Services

Qualification Services

- Factory Acceptance Test (FAT)
- Site Acceptance Test (SAT)
- Installation Qualification/Operational Qualification (IQ/OQ)
- Performance Qualification Support (PQ)

Maintenance & Repair Services

- Preventive Maintenance (PM)
- Corrective Maintenance (CM)
- Spare Parts

Specialized Support

Common Control Platform® (CCP®) Software Recipe Design

Every process is unique and, to ensure that your system is optimized to deliver the best performance, our biomanufacturing engineers will configure CCP® software recipes for your specific process. This allows your system to run fully automatically, resulting in consistency and reduced operator error.

Gradient Testing (only valid for Chromatography)

To check mixing efficiency, linear and step gradient tests will be performed, and gradient accuracy will be verified using standard or customer conditions.

Trainings

Operator Training

Designed for pharmaceutical, biotechnology, and medical device manufacturing personnel who operate downstream processing equipment, our interactive course provides an overview of the Mobius® FlexReady system with Smart Flexware™ assemblies. Installation of Smart Flexware™ assemblies and CCP® software use are also described and practiced in hands-on sessions. To meet cGMP requirements, course graduates will receive a certificate upon completion.

After training with our technical experts, your operators will be prepared to operate and manage your Mobius® FlexReady system with Smart Flexware™ with greater confidence. This is especially important if your company experiences rapid ramp-up or high operator turnover.

CCP® Software Training

If your system is used in process development or supports many different molecules and needs to rapidly adapt your system to new process characteristics, our biomanufacturing engineers can also provide you with a specific training, including a hands-on session so you can create and manage your own recipes and system.

References

1. FDA Guidance for Industry Process Validation: General Principles and Practices — January 2011
2. Annex 15 to the EU Guide to Good Manufacturing Practice Qualification and Validation — March 2015
3. Performance guide — Mobius® FlexReady Solution with Smart Flexware™ assemblies for Tangential Flow Filtration — AN4465EN00
4. Performance guide — Mobius® FlexReady Solution with Smart Flexware™ assemblies for Chromatography — TB5222EN00

MerckMillipore.com/Mobius-Flexready

To place an order or receive technical assistance, visit

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For additional information, visit

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