

Chromatography Guide

Modern, Advanced High-Flow,
Highly Cross-Linked Agarose Resins
For Improved Process Economics.



Why Purolite®?

For over 35 years, Purolite has supplied specialty ion exchange resin technology to industries within complex regulatory environments, including biotechnology, pharmaceutical, food, fine chemical and electric power generation. Purolite is the only global company to focus 100% on resin technology.

Security of Supply

Ensuring reliable availability of products in case of emergency is vital to customers and of paramount importance to Purolite.

As a leading supplier of resin media to the world's most regulated industries, Purolite has a real-world security-of-supply system in place to support your process requirements for business continuity in the instance of natural disaster or emergency.

Purolite has manufacturing facilities at 3 strategic global locations in the USA, Asia and Europe, and is currently building its 4th manufacturing plant in the UK. This facility will be the second largest agarose manufacturing plant globally, with a capacity of 100,000 L per annum.

Currently, approximately 90% of all biopharmaceuticals approved by the U.S. Food and Drug Administration utilise a single source of agarose resins from a single manufacturing site, presenting a security of supply risk to long-term clinical trial material production.

Purolite have addressed this industry-wide concern by providing the first proven and reliable alternative source of agarose resins, allowing customers to dual-source their products to mitigate their supply risks.

Regulatory Support

Purolite Life Sciences provides customers with regulatory support documentation for **Praesto** products used by our customers in GMP regulatory environments.

Comprehensive regulatory support files are available for each **Praesto** resin, and are provided under a confidential disclosure agreement.

The purpose of this Regulatory Support File (RSF) is to provide assistance with:

- ◆ Process development of clinical and commercial purification processes
- ◆ Manufacturing validation
- ◆ Quality control tests
- ◆ Standard Operating Procedure (SOP) for cleaning in place (CIP) and sanitization
- ◆ Application for various regulatory licenses or compliance
- ◆ Plant and document audits

Quality

Global ISO 9001:2008 standards ensure consistent operating practices across each of our plants. Compliance is monitored and maintained through a quality assurance and regulatory team who conduct internal audits to ensure operations meet the guidelines and protocols for equipment and procedures.

Additionally, our production team is given continual training on quality processes to ensure batch-to-batch consistency, and we host numerous customer audits each year to make sure that we are in compliance with user expectations.

Purolite maintains a global Quality Management System (QMS) which supports BSI requirements of ISO 9001:2008.

Raw Materials

Our raw material suppliers are selected and qualified from leading manufacturers and are part of our global network of suppliers. Each key raw material has at least one alternative supplier and is managed through a globally coordinated inventory system to ensure security of supply.

Additionally, a quality control protocol is in place for testing new batches/lots of raw materials to confirm product specifications and lot-to-lot consistency.

Purolite Life Sciences also has long-term supply agreements in place for our Protein A ligands, which are sourced from Repligen Corporation.

Repligen provides dual-site supply for critical raw materials and has a long-standing history of successfully supplying a variety of Protein A ligands to the industry.



100% focused
on resin technology.



The world's second
largest agarose
manufacturing facility.



De-risked long-term supply
through dual-sourcing.



25+ years of regulatory
experience from FDA
inspected cGMP facility.



Over 35+ years of experience
in solving advanced R&D and
purification challenges.

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Praesto® Formats

All **Praesto** resins are available in a variety of formats to suit your process needs, from high-throughput to full-scale commercial manufacture. Process development and up-scaling is further streamlined by using our pre-packed and pre-qualified formats.



Bulk Resins

Bulk resins are available in 10 ml, 25 ml, 100 ml, 500 ml, 1 L, 5 L and 10 L volumes. All **Praesto** Protein A resins are bottled in 20% ethanol.



HT Columns

For quick and easy separation offers pre-packed HT columns columns are available containing **Praesto** Protein A and Ion Exchange high-flow resins. The HT range of columns are available in 1 ml and 5 ml bed volumes and are compatible will all common chromatography systems.



RoboColumns®

For HTPD work, **Praesto** resins are available in RoboColumn volumes of 8 x 200 µL and 8 x 600 µL. They are 100% quality checked for HETP and asymmetry.



MiniChrom Columns

Praesto MiniChrom pre-packed columns provide a small bed volume for fast results and minimal sample and buffer consumption, as well as convenience in media screening and easy, direct connection to chromatography systems. They are 100% quality checked for HETP and asymmetry.

Praesto High-Flow Agarose Resins

Praesto high-flow agarose resins provide high performance, cost-effective downstream processing solutions. We offer a selection of Protein A and Ion Exchange resins in a variety of bulk and pre-packed formats to suit your needs, with some of the best technical minds in the industry on-hand to solve all of your purification challenges.

MAB Platform Process

The purification of commercially-available monoclonal antibodies (MAbs) on the market today is typically done in three chromatography steps.

The standard procedure for the majority of processes is to utilise Protein A affinity resins – typically the first choice in the purification process because they deliver high purity (> 99%) and yield in a single step.

This is then followed by utilising an SP cation exchange resin as the first polishing step in bind and elute mode, which removes aggregates and HCP.

The final polishing step utilises a Q anion exchange resin in flow-through mode, as a scavenger to remove trace contaminants and ensure sufficient viral clearance.

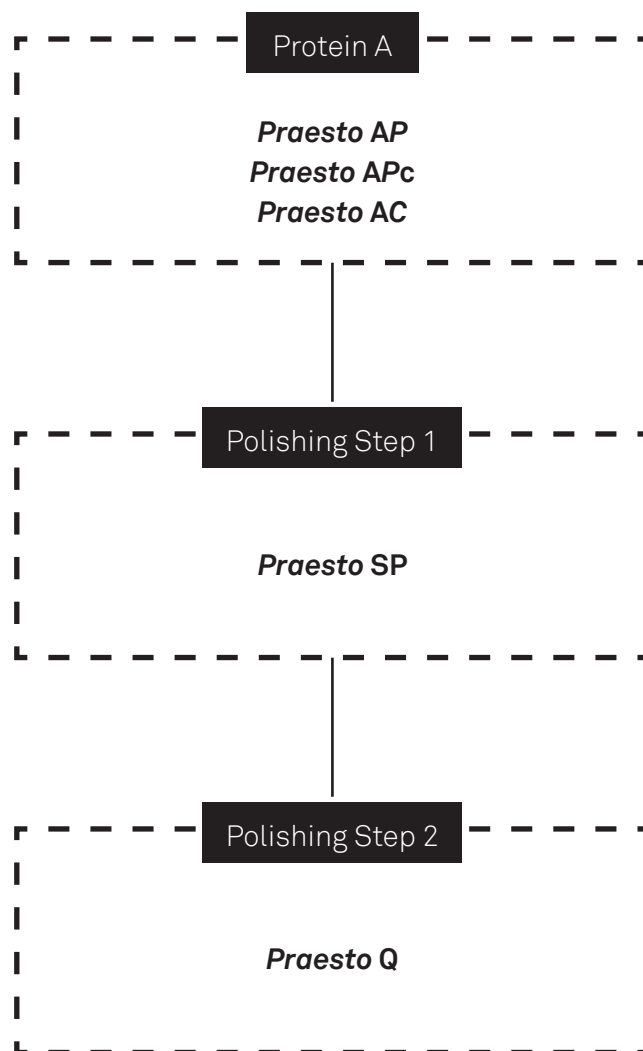
Purolite Life Sciences offer a full range of high-performance Protein A and Ion Exchange agarose resins, delivering exceptional results from Protein A to polishing steps.

Why Agarose?

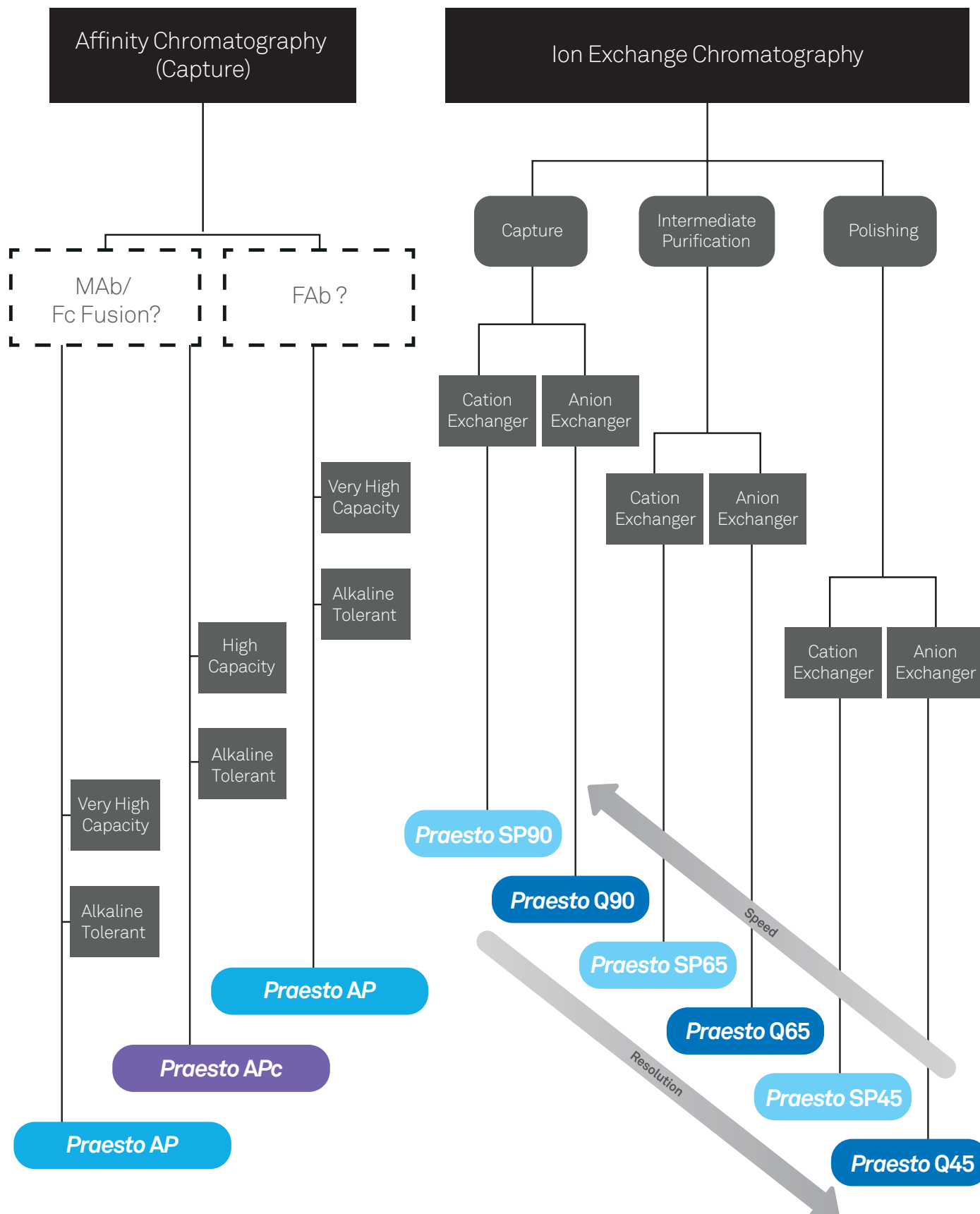
Agarose is widely considered the best material available for protein purification resins. It is highly hydrophilic (meaning less non-specific binding) and alkaline stable. In biomolecule purifications, this translates to high yields and very long functional life time.

All *Praesto* resins have an advanced high-flow, highly cross-linked agarose base matrix.

Praesto beads are manufactured with a porosity and pore structure ideal for high-performance protein chromatography.



MAB Platform Processing Solutions

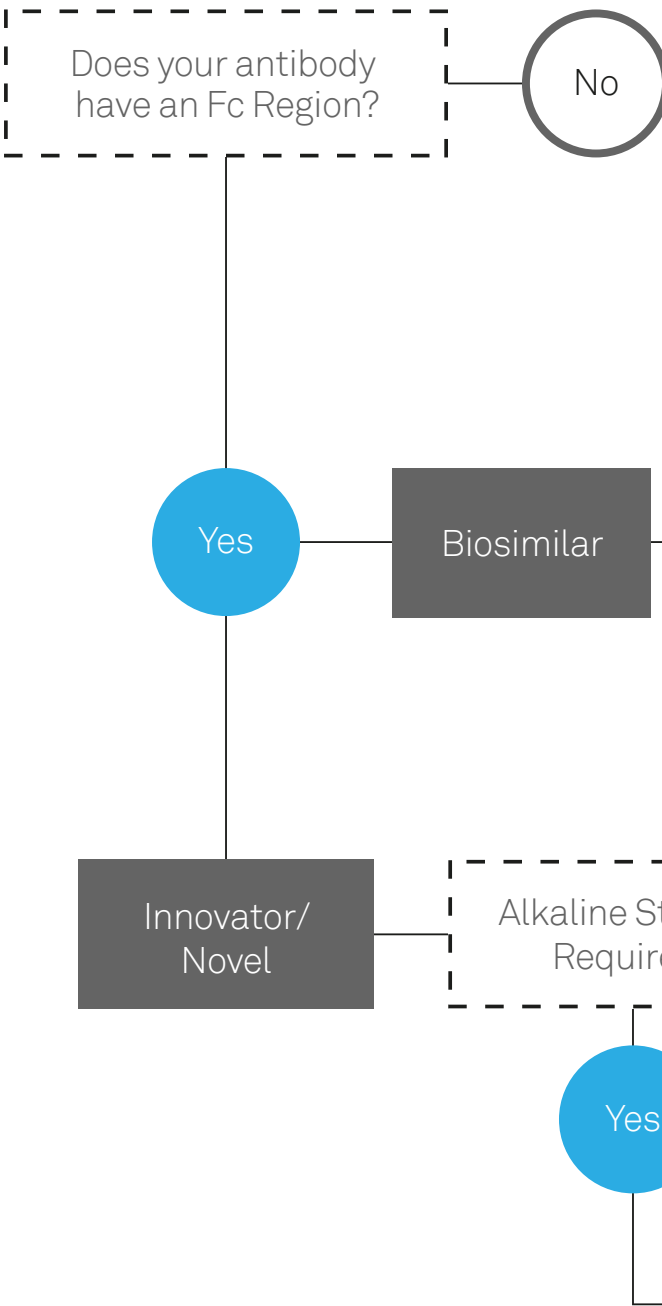


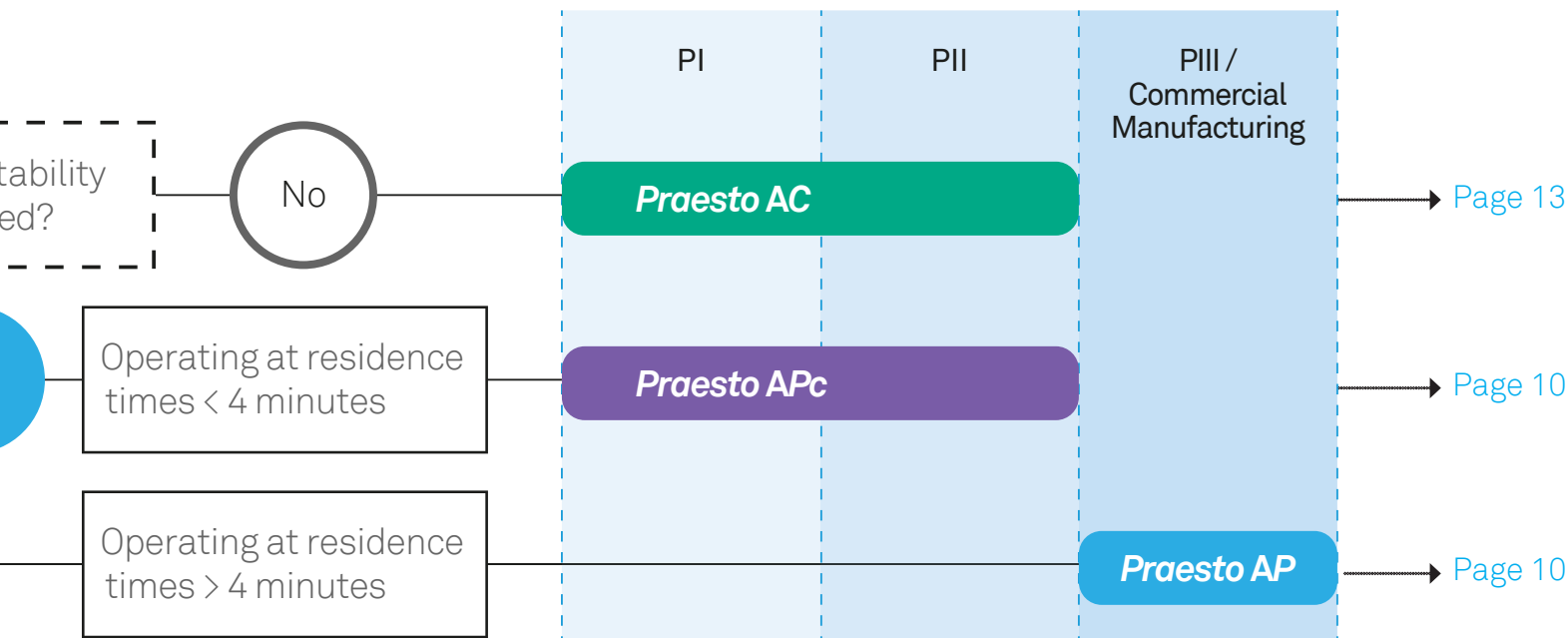
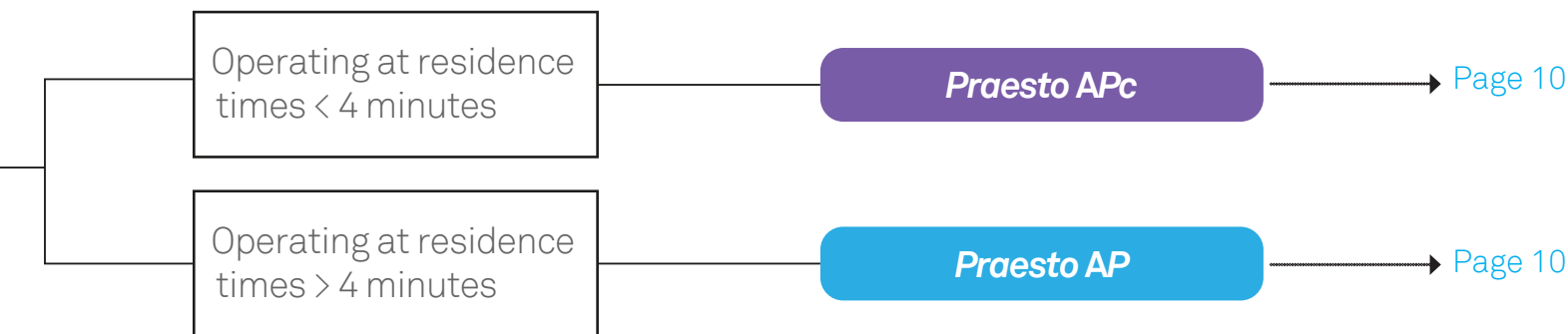
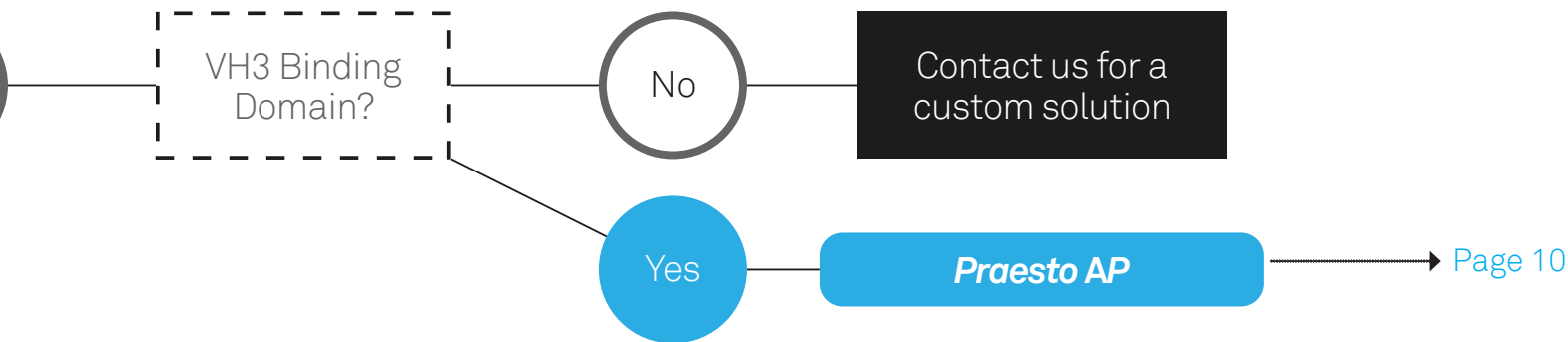
Reduce your clinical trial costs by up to 65% using *Praesto* resins

Production of early phase (PI & PII) clinical trial material can be very costly when balanced against high failure rates. Much of this unnecessary expense results from utilizing Protein A resins optimized for 100+ cycles when, typically fewer than 20 purification cycles are performed.

One method of maximizing your cost efficiencies is to follow Purolite Life Sciences' recommended strategy of switching Protein A resins after PII, only utilizing a higher-cost resin optimized for 100+ cycles when your process requirements justify your cost of goods.

Our selection of highly-optimized Protein A resins deliver the highest possible performance. Follow our Protein A resin selection guide to find your ideal *Praesto* Protein A resin.





* Can also be implemented in PIII and Commercial Manufacture due to long lifetime

Protein A Resins

Protein A Resins

Praesto[®] APc & *Praesto* AP

Modern, high flow agarose-based, alkaline-stable Protein A resins for cost-effective, high productivity MAb capture.

Praesto Protein A Resins

Purolite Life Sciences has designed two alkaline-stable Protein A resins – ***Praesto*** APc and ***Praesto*** AP.

Both ***Praesto*** APc and ***Praesto*** AP are based on the same 85 µm agarose base matrix and identical Protein A ligand, differing only in the amount of Protein A immobilization required.

Praesto APc provides high capacities of over 40 mg/ml, at 4 minutes residence time. It is purpose-designed and evaluated for phase I and II clinical trials - where typically less than 20 reuse cycles are performed - but ***Praesto*** APc can be implemented across all phases due to long life time.

Praesto AP provides ultra-high capacities of over 50 mg/ml, particularly at residence times of 6 minutes or higher. It is purpose-designed and evaluated for the production of late phase clinical trial material and commercial manufacture, where typically hundreds of reuse cycles are performed.

Key Performance Benefits

- ◆ Reduces volume required and overall process times with ultra-high capacities
- ◆ Increased throughput due to excellent pressure/flow performance
- ◆ Long lifetime due to alkaline-tolerant, modified Protein A
- ◆ Minimize non-specific binding due to hydrophilic agarose base matrix
- ◆ Minimal Protein A leaching via multi-point attachment
- ◆ Up to 50% cost savings compared to MabSelect SuRe/LX

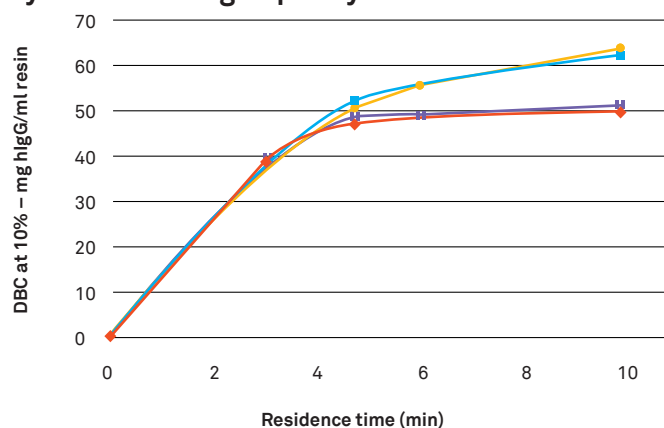
Praesto Protein A Ligand

The novel, alkaline-tolerant Protein A ligand was developed through protein engineering of a Protein A IgG-binding domain. The improved alkaline-stability permits the use of sodium hydroxide for CIP and sanitization whilst still achieving a functional lifetime of 100s of purification cycles.

Supply Agreement

The Protein A ligand is provided under a supply agreement with Repligen Corporation, with the production process free from sources of mammalian origin.

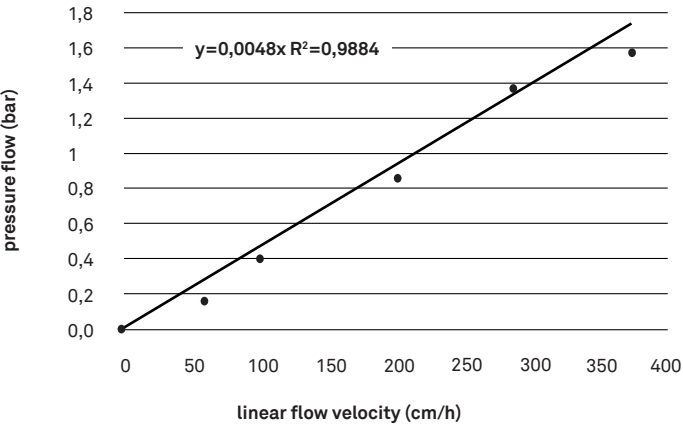
Dynamic Binding Capacity



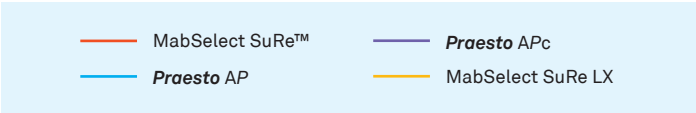
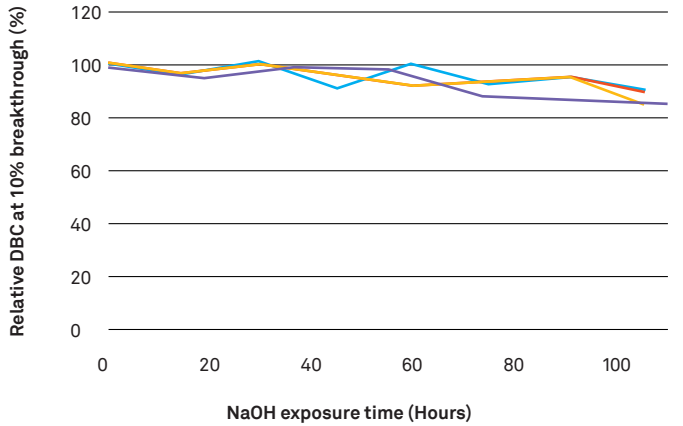
◆ MabSelect SuRe™ ◆ *Praesto* APc
◆ *Praesto* AP ◆ MabSelect SuRe LX

Pressure/Flow Performance

The **Praesto** high flow agarose base matrix provides a rigid, but open pore structure. This results in high productivities due to the ability to operate at high flow velocities at process-scale, compared to softer, cross-linked agarose resins with similar porosity.



Dynamic Binding Capacity After Cleaning In Place – 0.1 M NaOH



Protein A Leakage

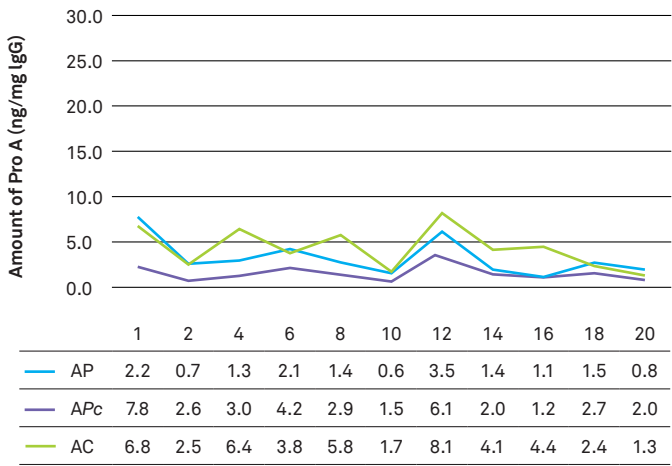
Protein A leakage occurs during:

- ◆ NaOH exposure
- ◆ Exposure to protease containing cell culture supernatants
- ◆ Spontaneous deamidation

The use of multipoint-attached alkaline-stable **Praesto** Protein A resins has a positive impact on each of these challenging factors.

The figure below shows Protein A eluate levels assayed during a re-use study over 20 cycles.

The results are consistently below 10 mg Protein A /mg IgG in all twenty product pools. The feed stock was kindly provided by Alvotech Biopharmaceuticals.



| Praesto AP & APc: Typical Physical & Chemical Characteristics | | |
|---|--|----------------------|
| | Praesto AP | Praesto APc |
| Application | MAb capture | |
| Polymer Structure | Highly cross linked agarose | |
| Appearance | Spherical beads | |
| Functional Group | Recombinant Protein A (<i>E. coli</i>) | |
| Dynamic Binding Capacity | >50 mg hlgG/ml resin | >40 mg hlgG/ml resin |
| Average Particle Size ² | 85 µm | |
| Pressure/Flow Specifications | > 500 cm/h at 3 bar in a 2.6 x 20 cm column | |
| pH Stability, Working Range | 3 - 10 | |
| pH Stability, CIP (Short-term) | 2 - 13.7 ³ | |
| Recommended Storage | 2 to 8°C, 20% ethanol, supplied in 20% ethanol | |

¹ Determined at 10% breakthrough by frontal analysis in a column with a bed height of 20 cm.

² d_{50v} is the median particle size of the cumulative volume distribution.

³ pH below 3 may be required to elute strongly bound species, but protein ligands can hydrolyse at very low pH.

Protein A Resins

Praesto[®] AC

Modern agarose-based Protein A affinity resin for cost-effective, high productivity MAb capture, designed to address today's early-phase clinical manufacturing challenges.

Praesto AC is purpose-designed and evaluated for production of early phase clinical trial material, where typically less than 20 cycles are run.

With capacity over 40 mg/mL at 4 minutes residence time or higher, **Praesto** AC combines high capacity, excellent pressure/flow performance, and NaOH CIP stability for over 20 cycles, thus meeting the common requirements for production of materials for PI and PII clinical trials. It is an excellent choice for the capture step in a typical MAb platform process.

Praesto AC can also be used in small scale MAb purification, in purification of MAbs for diagnostics, in process development and in pre-clinical processes.

Key Performance Benefits:

- ◆ Reduces volume required and overall process times with ultra-high capacities
- ◆ Increased throughput due to excellent pressure/flow performance
- ◆ Long lifetime due to alkaline-tolerant, modified Protein A
- ◆ Minimal Protein A leaching via multi-point attachment
- ◆ Up to 65% cost savings compared to MabSelect SuRe

Production Of Early Clinical Phase Material

Despite platform approaches to MAb processing, the production of materials for early-phase clinical trials can be costly.

Much of the expense comes from using the same purification tools that are used later for many cycles in full scale production. Particularly for more expensive resins like Protein A, the cost/cycle or cost/g product looks prohibitive when the resin is used for only a few cycles in clinicals production, instead of the 100s of cycles it is designed for.

Praesto AC is an example of a purpose-designed resin, specified and evaluated for production of early-phase clinical trial material. It delivers both process and cost efficiencies.



Praesto AC: Typical Physical & Chemical Characteristics

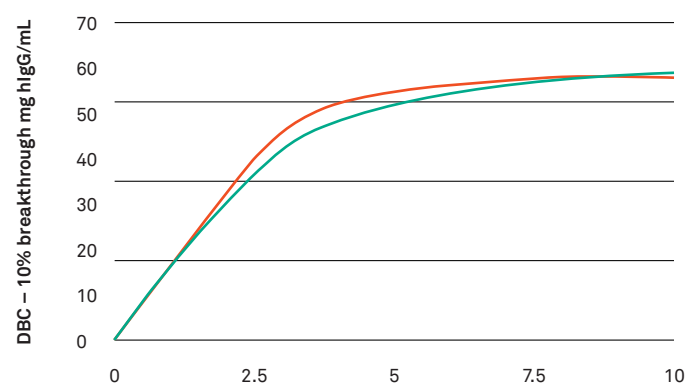
| | |
|------------------------------------|---|
| Application | MAB capture |
| Polymer Structure | Highly cross linked agarose |
| Appearance | Spherical beads |
| Functional Group | Recombinant Protein A (<i>E. coli</i>) |
| Dynamic Binding Capacity | >40 mg hIgG/ml resin at 4 minutes residence time ¹ |
| Average Particle Size ² | 85 µm |
| Pressure/Flow Specifications | > 500 cm/h at 3 bar in a 2.6 x 20 cm column |
| pH Stability, Working Range | 3 - 10 |
| pH Stability, CIP (Short-term) | 2 - 13 ³ |
| Recommended Storage | 2 to 8°C, 20% ethanol, supplied in 20% ethanol |

¹ Determined at 10% breakthrough by frontal analysis in a column with a bed height of 20 cm.

² d_{50v} is the median particle size of the cumulative volume distribution.

³ pH below 3 may be required to elute strongly bound species, but protein ligands can hydrolyse at very low pH.

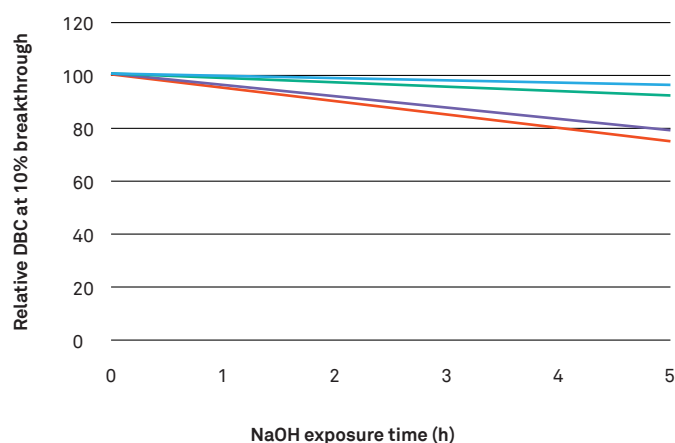
Dynamic Binding Capacity



DBC at 10% breakthrough at various residence times measured with a 5 mg hIgG/mL solution, pH 7.4

— MabSelect SuRe™
— Praesto AC

Dynamic Binding Capacity After Cleaning In Place – 0.1 M NaOH and 0.5 M NaOH



CIP study over 5 hour exposure time using 0.1 M and 0.5 M NaOH. DBC measured with a 5 mg hIgG/mL solution, pH 7.4.

— 0.1 M MabSelect — 0.1 M Praesto AC
— 0.5 M MabSelect — 0.5 M Praesto AC

Ion Exchange Resins

Praesto® 'Jetted' 35 µm High Resolution Ion Exchange Resins

Purolite is the first Agarose resin provider to produce process-scale volumes of a uniform particle size bead.

Jetting - Uniform Particle Size Beads

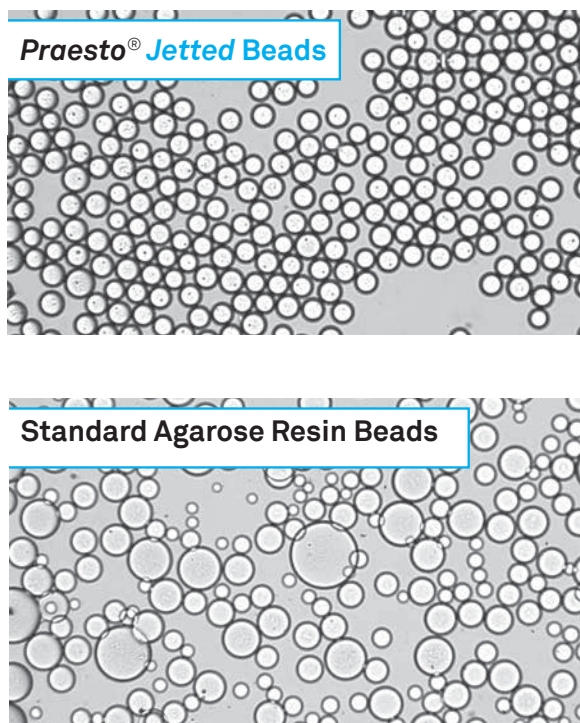
Jetting technology is a new patented method that produces agarose beads with a very narrow particle size distribution. Purolite is the first Agarose resin provider to produce process-scale volumes of a uniform particle size bead for the purification of recombinant proteins and monoclonal antibodies.

Jetted resins demonstrate superior performance characteristics including: increased pressure/flow properties meaning lower back pressure, improved resolution from uniform particles, improved packing reproducibility and stability, more homogenous ligand distribution, higher dynamic binding capacity, green manufacturing, the possibility to use larger mesh size column filters/nets and less risk for fouling of resin and/or supports.

Jetted Resins vs. Standard Agarose Resin Beads

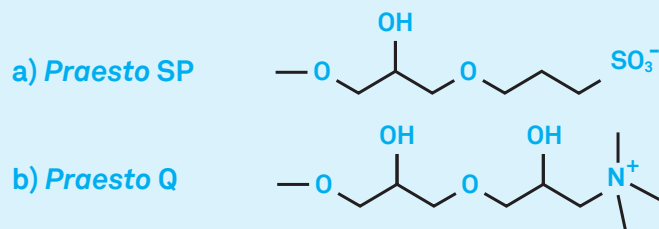
- ◆ Enhanced pressure/flow properties
- ◆ Uniform particle sizes
- ◆ Increased dynamic binding capacities for high-productivity operations and easy scale-up
- ◆ Higher resolution/selectivity for demanding separations, combined with high yields
- ◆ Significantly more narrow particle size distribution. Jetted 35 µm particle size = 95% within 25 - 50 µm compared to a 35 µm standard agarose resin beads = 95% within 25 - 100 µm

Figure 1. - Microscope Images



Ligand Structures

Purolite Life Sciences has commercialized highly cross linked agarose, **Praesto SP** 35 µm (cation) and **Praesto Q** 35 µm (anion) to provide high resolution polishing resins for recombinant proteins and other biomolecules.



The strong ion exchange ligand groups of **Praesto SP** (a) and **Praesto Q** (b) are well established in large scale purification.

Environmental Benefits

Jetted uniform beads also have several important benefits to the environment over standard agarose resin beads. Jetting technology is a continuous manufacturing process that produces beads in a more efficient way, with very high yields. Since the beads are uniform in size, it removes the need for extensive sieving, which generates considerably less waste. Another environmentally friendly advantage with this new technology is that it eliminates the need for high levels of organic solvents compared to standard agarose resin beads.

Since early 2017 Purolite was awarded ISO certification 14001:2015 for environmental management.

Pressure Flow

With new crosslinking methods, combined with jetting technology, Purolite Life Sciences have been able to develop 35 µm small particles for improved resolution for high polishing applications that are still suitable for large scale bioprocessing. For instance, a 45 µm standard agarose resin bead has a lower pressure flow rate capability compared to a 45 µm jetted bead. When packed at 4 bar and ran at 3 bar, in a HiScale 26/40 (with a 2.6 cm diameter and a 20 cm BH), the 45 µm standard agarose resin bead flow velocity reached 220 cm/h compared to the same size jetted resin (45 µm) which reached a maximum flow velocity of 282 cm/h.

| D50 | IgG DBC (10%) 2.4 min | IgG DBC (10%) 6 min | Flow velocity (cm/h) 20 cm bed height |
|---------------|--------------------------|------------------------|--|
| 45 (Standard) | 68 | 97 | 220 |
| 45 (Jetted) | 80 | 108 | 282 |

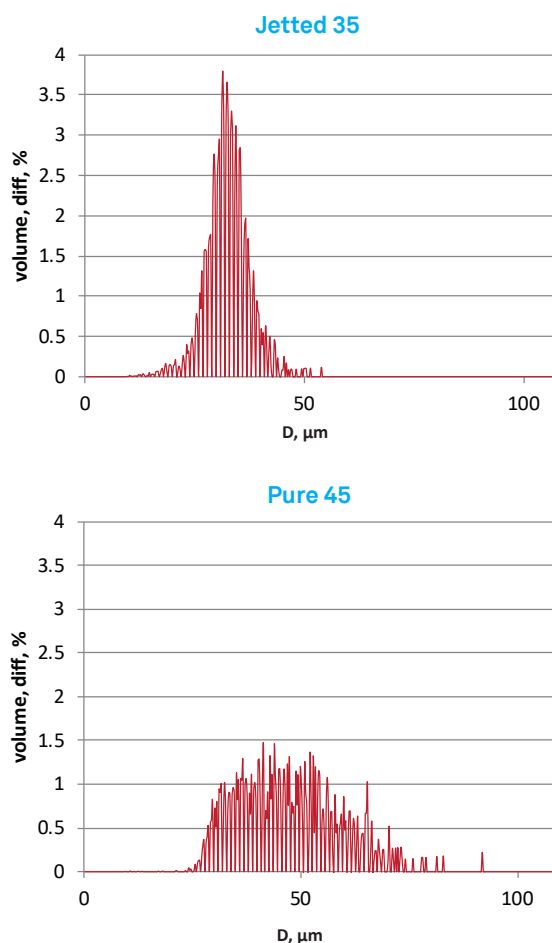
Dynamic Binding Capacity

Dynamic binding capacity is also increased with jetting technology, when compared to standard agarose resin beads. When tested at 2.4 and 6 minutes residence time, 15% high capacity results were obtained using polyclonal human IgG.

Particle Size Distribution

The particle size distribution of jetted agarose is significantly improved compared to standard agarose resin beads, e.g. a 35 µm jetted resin bead = 95% within 25 – 50 µm with a uniformity coefficient* of less than 1.3, compared to 45 µm standard agarose resin bead = 95% within 25 - 100 µm (with a uniformity coefficient of 1.9).

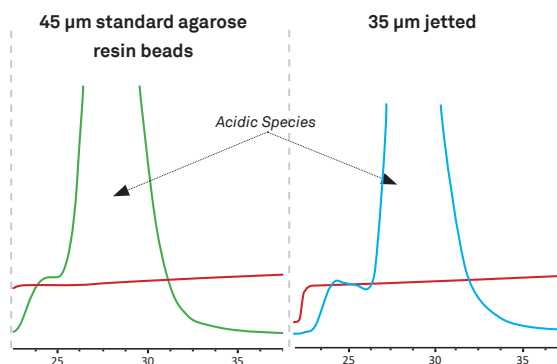
Figure 2. - Particle Size Distribution



*Uniformity coefficient (UC) is defined as the D60_(v) divided by the D10_(v).

Application Example

To demonstrate the high resolution of jetted agarose base beads over standard agarose resin base beads, we assessed the separation profiles of **Praesto** cation exchangers to reduce the acidic species using a customer-supplied biosimilar MAb. In this example, the goal was to ensure the acidic species of the biosimilar matched that of the originator. Purification with **Praesto** AP protein A affinity resin was followed by an anion multimodal in flow mode as the first polishing step. The material was then further purified in a bind and elution mode using two different CIEX. The first - SP 45 μm - a traditional standard agarose resin (95% within 25 - 100 μm), and a Jetted SP 35 μm , a uniform particle size agarose resin (95% within 25-50 μm , UC < 1.3). The separation profiles were assessed using a standard conductivity gradient elution.



Comparing SP 45 (standard agarose resins beads) with jetted SP 35, a far more pronounced shoulder of the acidic species can be seen on the chromatograms.

Praesto Jetted SP & Q: Typical Physical & Chemical Characteristics

| | Praesto Jetted SP | Praesto Jetted Q |
|---|--|--|
| Matrix | Cross-linked agarose | Cross-linked agarose |
| Functional Group | $\text{CH}_2\text{CH}_2\text{CH}_2\text{SO}_3$ | $\text{CH}_2\text{N}^+(\text{CH}_3)_3$ |
| Iconic Capacity, mmol/mL Resin | 0.11-0.16 | 0.14-0.18 |
| Average Particle Size (d_{50v}), μm | 35 | 35 |
| Flow Velocity cm/h at 3 bar in a 2.6 x 20 cm Column (packed at 4 bar) | > 150 | > 150 |
| Binding Capacity mg/mL Resin at 6' Residence Time | > 90 mg/ml IgG | > 80 mg/ml BSA |
| Operating pH Stability (Short-term) (Long-term) | pH 3-14 pH 4-13 | pH 2-14 pH 3-13 |
| Working Temperature | 4-30°C | 4-30°C |
| Chemical Stability | All commonly used aqueous buffers, 1M NaOH, 8M urea, 6M guanidine hydrochloride, 30% isopropanol and 70% ethanol | |
| Avoid | Oxidizing agents, cationic detergents | Oxidizing agents, cationic detergents |
| Storage | 20% ethanol, 0.2M sodium acetate, 4-30°C | 20% ethanol, 4-30°C |

Ion Exchange Resins

Praesto[®] SP & *Praesto* Q

Highly cross-linked, agarose-based ion exchange chromatography resins for efficient protein purification, from capture to polishing. *Praesto* SP (cation) and *Praesto* Q (anion) are designed for lab to process-scale purification of recombinant proteins and other biomolecules.

Praesto SP and *Praesto* Q are available in 90 µm, 65 µm and 45 µm particle sizes, covering the use of ion exchange in high-productivity capture steps as well as high-resolution polishing applications.

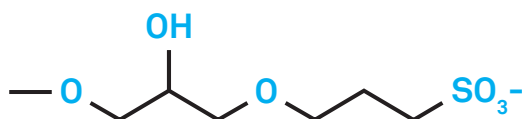
Based on highly cross-linked agarose, they offer very good flow and pressure drop characteristics, excellent chemical and physical stability, high capacity, and are readily scalable.

Key Performance Benefits

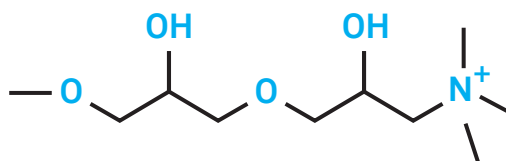
- ♦ Excellent dynamic binding capacities and pressure/flow properties for high-productivity operations and easy scale-up
- ♦ High resolution/selectivity for demanding separations with high yields
- ♦ 90 µm, 65 µm and 45 µm particle sizes match the goals of capture, removal and polishing steps
- ♦ Excellent chemical and physical stability for long functional life and reduced operating costs
- ♦ Secure, validated supply and regulatory support

Figure 1: Ligand Structures

a) *Praesto* SP



b) *Praesto* Q



The strong ion exchange ligand groups of *Praesto* SP (a) and *Praesto* Q (b) are well established in large scale purification.

Figure 2A: Cation Selectivity – Capture & Intermediate Purification

Protein separation of 25 mg/ml IgG and 5 mg/ml Lactoferrin over **Praesto** SP90, Sepharose 6 Fast Flow and Capto S.

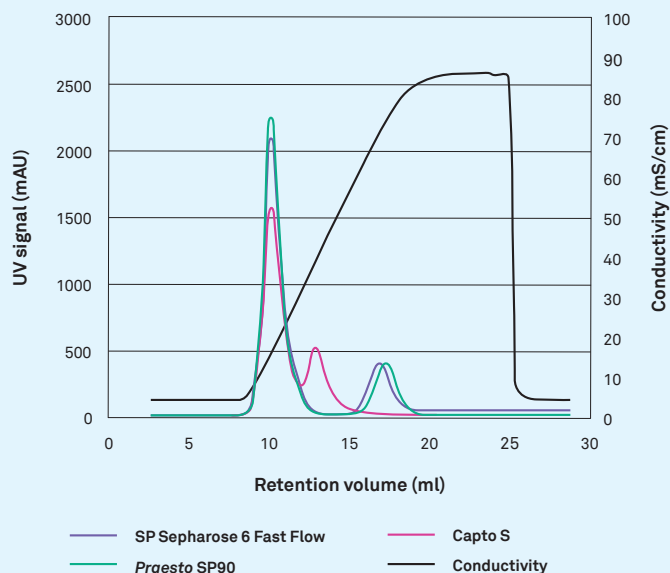


Figure 2B: Cation selectivity, intermediate & purification and polishing

Protein separation of 25 mg/ml IgG and 5 mg/ml Lactoferrin over **Praesto** SP45, **Praesto** SP65 and Capto SP ImpRes.

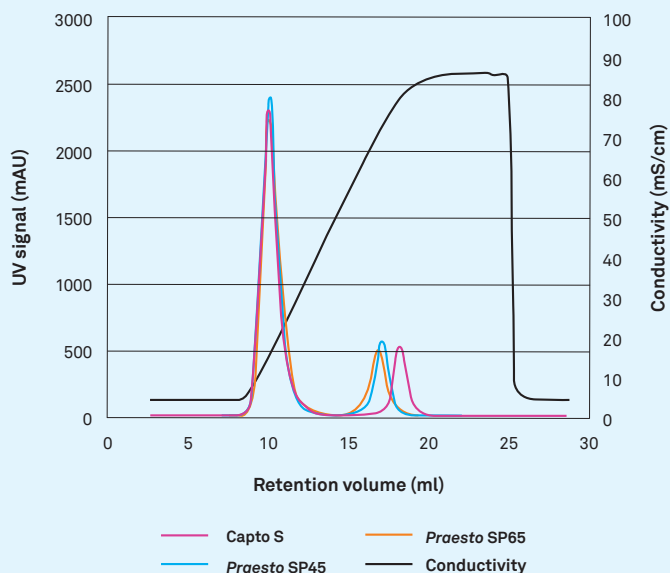


Figure 3A: Anion Selectivity – Capture & Intermediate Purification

Chromatograms showing the separation of α -Lactalbumin (left peak) trypsin inhibitor (right peak) **Praesto** Q90 demonstrates selectivity equal to Q Sepharose Fast Flow and Capto Q.

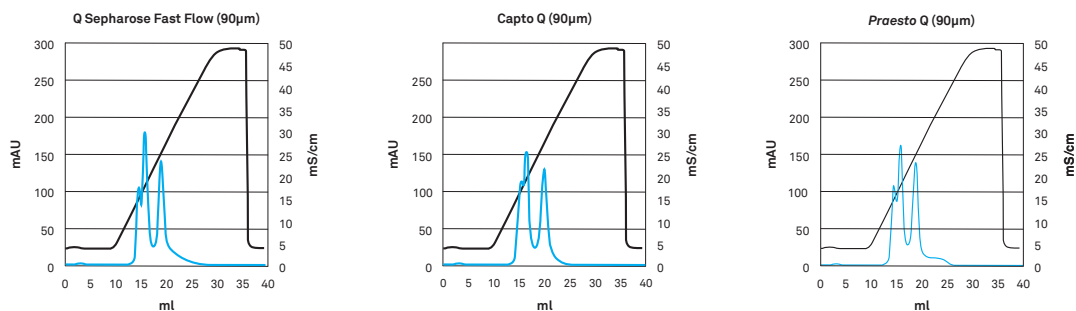
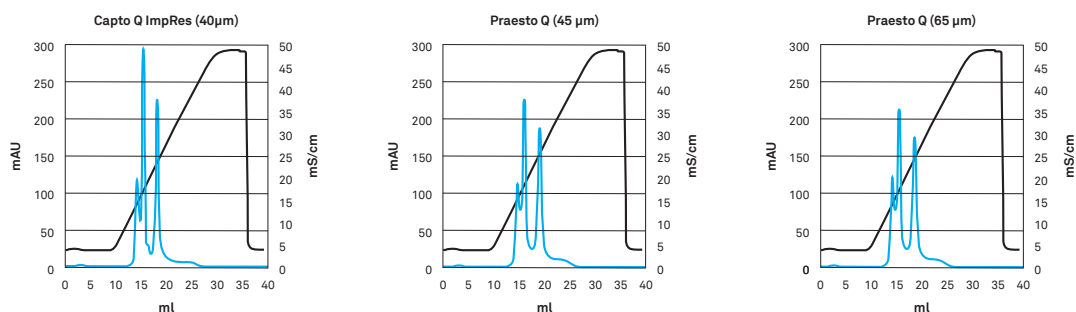


Figure 3B: Anion Selectivity – Intermediate Purification & Polishing

Chromatograms showing the separation of α -Lactalbumin (left peak) trypsin inhibitor (right peak) comparing **Praesto** Q45 (middle) and **Praesto** Q65 (right) with Capto Q ImpRes (left).



With the three different particles sizes available for **Praesto** media, demands on resolution in various purification steps can be met and difficult separation challenges can be solved.

Praesto SP & Praesto Q: Typical Physical & Chemical Characteristics

| | Praesto SP | | | Praesto Q | | |
|---|--|----------------|----------------|--|----------------|----------------|
| Matrix | Cross-linked agarose | | | Cross-linked agarose | | |
| Functional Group | CH ₂ CH ₂ CH ₂ SO ₃ ⁻ | | | CH ₂ N ⁺ (CH ₃) ₃ | | |
| Iconic Capacity, mmol/m Resin | 0.11-0.16 | | | 0.14-0.18 | | |
| Average Particle Size (d _{50v}), µm | 45 | 65 | 90 | 45 | 65 | 90 |
| Flow Velocity - cm/h at 3 bar in a 2.6 x 20 cm Column (packed at 4 bar) | > 200 | > 400 | > 800 | > 200 | > 400 | > 800 |
| Binding Capacity mg/mL Resin at 6' Residence Time | > 80 mg IgG | > 70 mg IgG | > 50 mg IgG | > 70 mg BSA | > 60 mg BSA | > 50 mg BSA |
| Operating pH Stability (Short-term) (Long-term) | pH 3-14 pH 4-13 | | | pH 2-14 pH 3-13 | | |
| Working Temperature | 4-30°C | | | 4-30°C | | |
| Chemical Stability | All commonly used aqueous buffers, 1M NaOH, 8M urea, 6M guanidine hydrochloride, 30% isopropanol and 70% ethanol | | | | | |
| Avoid | Oxidizing agents, cationic detergents | | | Oxidizing agents, anionic detergents | | |
| Storage | 20% ethanol, 0.2M sodium acetate, 4-30°C | | | 20% ethanol, 4-30°C | | |

The table shows the general characteristics of *Praesto* ion exchangers. *Praesto* SP and *Praesto* Q are compatible with all ranges of temperature, pH and chemical and physical conditions typically used in biopharmaceutical processes. The physical and chemical stability allows cleaning with sodium hydroxide, resulting in very long functional life.

Application

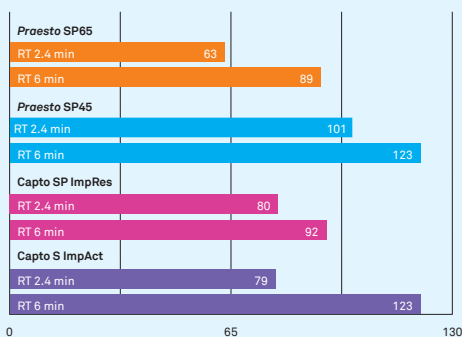
Several cation exchange resins were evaluated for capacity as well as aggregate and HCP removal using two different monoclonal antibodies.

This work was performed by an independent investigator, Prof. Anurag Rathore at the Department of Chemical Engineering, Indian Institute of Technology in Delhi.

The dynamic binding capacities (DBC) at two residence times are shown in Figure 4. As expected, all resins showed higher DBC at the longer (6 minute) residence time. *Praesto* SP45, however, showed superior binding capacity for both MABs.

Figure 4: DBC data for two different MABs on various anion exchangers

5% DBC data for MAB A on four resins at two different residence times.

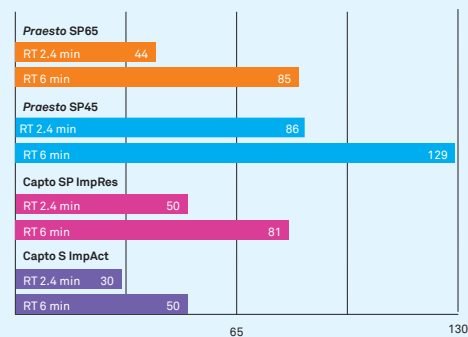


DBC MAB at 5% break through (mg/mL of resin)

Figure 4A: 5% DBC for MAB A at two residence times on *Praesto* SP65, *Praesto* SP45, Capto SP ImpRes and Capto S Impact.

Running buffer for MAB A: 20 mM sodium acetate, pH 5.5.

5% DBC data for MAB B on four resins at two different residence times.



DBC MAB at 5% break through (mg/mL of resin)

Figure 2B: 5% DBC for MAB B at two residence times on *Praesto* SP65, *Praesto* SP45, Capto SP ImpRes and Capto S Impact.

Running buffer for MAB B: 20 mM sodium acetate, pH 5.0.

Pre-Packed Formats

Particularly in a fast-paced environment, quick turnaround and optimized facility utilization are essential. By utilising pre-packed, pre-qualified *Praesto* formats, savings are maximized by avoiding time consuming operations such as packing, packing evaluation and cleaning procedures. Additionally, investment costs for packing hardware, as well as the risks associated with packing failures and microbial contamination, are significantly reduced.

Praesto® HT Columns

Pre-packed with your choice of **Praesto** modern, high-flow agarose resin for cost-effective, high productivity MAb purification.

HT Columns from Purolite Life Sciences streamline your separations, and are available pre-packed with any **Praesto** Affinity or Ion Exchange Chromatography agarose resin.

Columns are available in 1 ml and 5 ml bed volumes, with a 2.5 cm bed height. HT Columns are compatible with all commonly-used chromatography systems, due to universal 1/16" connectors.

HT Columns are constructed of polypropylene, preventing interaction with biological molecules and ensuring biocompatibility.

Key Performance Benefits

- ◆ Rapid purification of MAb and recombinant proteins
- ◆ Eliminate the need for column packing
- ◆ Efficient resin screening for further optimization and verification



| Praesto HT Columns: Physical & Chemical Characteristics | | |
|--|---|--------------------------|
| Column Volume | 1 ml or 5 ml resin | |
| Column Construction | Polypropylene | |
| Recommended Flow Rate | 1 mL/min (1 ml Column) | 1-4 mL/min (5 ml Column) |
| Max. Flow Rate | 4 mL/min (1 ml Column) | 20 mL/min (5 ml Column) |
| Max. Column Pressure | 5.0 bar | |
| Connector | Universal 10.32 (1/16") UNF Threads | |
| Dimensions | 0.7 x 2.5 cm (1 ml) and 1.6 x 2.5 cm (5 ml) | |
| Protein A Resin Recommended Storage (Praesto AP, APc & AC) | 2°C to 12°C | |
| IEX Resin Recommended Storage (Praesto SP & Q) | 4°C to 30°C | |

Pre-Packed Formats

Praesto[®] RoboColumns[®]

Praesto RoboColumns are designed for easy process development and parameter screening, as well as for small scale purification or sample preparation.



Praesto RoboColumns provide a small bed volume for fast results and minimal sample and buffer consumption, offering both very high reproducibility and very good scalability.

The RoboColumn format is designed for use with robotic workstations for HTPD work. **Praesto** RoboColumns are packed and delivered ready for use. They are 100% quality checked for HETP and asymmetry.

Individual laser labelling ensures traceability to corresponding resin and column performance data. The columns are made of biocompatible polypropylene.

Key Performance Benefits

- ◆ Cost effective without compromising buffer consumption or processing time
- ◆ Excellent reproducibility and scalability
- ◆ Pre-packed and pre-qualified
- ◆ High productivity and high capacity
- ◆ Excellent pressure/flow performance
- ◆ Secure, validated supply and regulatory support

Praesto RoboColumns: Typical Physical & Chemical Characteristics

| | |
|-----------------------|---|
| Inner Diameter | 5 mm |
| Packed Bed Height | 10 mm |
| Column Volume | 200 µl or 600 µl |
| Package | 1 row of 8 columns |
| Connector | For use with robotic liquid handling stations |
| Column Material | Polypropylene |
| Bed Material | Filter |
| Chemical Stability | All commonly used aqueous buffers, pH 1-14, organic solvents ¹ |
| Avoid | Halogenated organic solvents, hexane |
| Max. Working Pressure | Up to 8 bar ¹ |

¹ The chemical and physical stability of the packed chromatography media must also be taken into consideration.

Pre-Packed Formats

Praesto® MiniChrom Columns

Process development is streamlined by using **Praesto** MiniChrom columns, pre-packed with your choice of **Praesto** modern, high flow Affinity or Ion Exchange resin, enhancing both time and cost savings of MAb platform processing.



Praesto MiniChrom columns are designed for process development and parameter screening, as well as for small scale purification or sample preparation. MiniChrom columns are packed and delivered ready for use.

They are 100% quality checked for HETP and asymmetry. Individual laser labelling ensures traceability to corresponding resin and column performance data.

The columns are made of biocompatible polypropylene. **Praesto** MiniChrom pre-packed columns provide a small bed volume for fast results and minimal sample and buffer consumption, as well as convenience in media screening and easy, direct connection to most chromatography systems.

Key Performance Benefits

- ◆ Cost effective without compromising buffer consumption or processing time
- ◆ Excellent reproducibility and scalability
- ◆ Pre-packed and pre-qualified
- ◆ High productivity and high capacity
- ◆ Excellent pressure/flow performance
- ◆ Secure, validated supply and regulatory support

Praesto MiniChrom Columns: Typical Physical & Chemical Characteristics

| | <i>Praesto</i> MiniChrom 8 x 20 mm | <i>Praesto</i> MiniChrom 8 x 100 mm |
|-----------------------|--|-------------------------------------|
| Inner Diameter | 8 mm | |
| Packed Bed Height | 20 mm | 100 mm* |
| Column Volume | 1 ml | 5 ml |
| Connector | Fingertight 1/16", female | |
| Column Material | Polypropylene | |
| Bed Material | Filter | |
| Chemical Stability | All commonly used aqueous buffers, pH 1-4, organic solvents ¹ | |
| Avoid | Halogenated organic solvents, hexane | |
| Max. Working Pressure | Up to 30 bar ¹ | |

¹ The chemical and physical stability of the packed chromatography media must also be taken into consideration.

* For a 20 cm bed height, it is easy to connect 2 columns in series.

Base Matrices for Affinity Resin Production

Base Matrices

Praesto[®] Pure

Non-functionalized agarose chromatography beads – ideal base matrices for production of affinity resins or for gel filtration of large molecules such as viruses or plasmids.



Praesto Pure chromatography media are plain agarose-based beads designed for large-scale biomolecule purification.

Praesto Pure resins are the ideal base matrices for production of affinity resins with minimal unspecific interaction and long functional life time.

Praesto Pure media are available in 45 μm , 65 μm and 90 μm particle sizes,

covering use in preparative high-performance separations, intermediate applications, and in processing of large volumes in limited time frames.

Praesto Pure resins can also be used directly for purification by gel filtration of various large biomolecules such as viruses and plasmids.

Praesto Pure resins are based on highly cross-linked agarose. They offer very good flow and pressure drop characteristics, excellent chemical and physical stability, and excellent recoveries of active proteins.

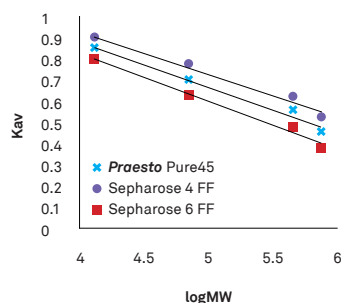
Pre-activated resins are also available in a variety of source chemistries.

Key Performance Benefits:

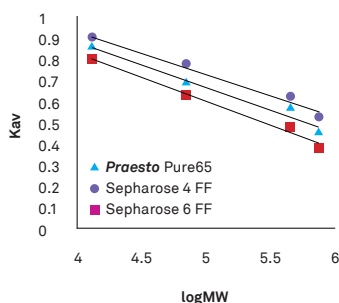
- ◆ Novel 45 μm , 65 μm and 90 μm non-functionalized, agarose-based chromatography beads
- ◆ Ideal base matrices for development of affinity chromatography resins
- ◆ Gel filtration of large biomolecules (e.g. viruses, plasmids)
- ◆ Low non-specific interactions and excellent recoveries
- ◆ High-flow agarose with excellent chemical and physical stability

Figure 1: Selectivity (Kav) Curves

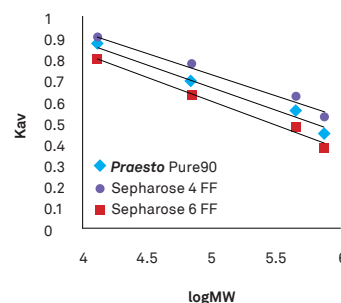
Selectivity curve of **Praesto** Pure45, compared with GE Sepharose 4 Fast Flow and GE Sepharose 6 Fast Flow, obtained with RNase, Bovine Serum Albumin, Ferritin and Thyroglobulin.



Selectivity curve of **Praesto** Pure65, compared with GE Sepharose 4 Fast Flow and GE Sepharose 6 Fast Flow, obtained with RNase, Bovine Serum Albumin, Ferritin and Thyroglobulin.



Selectivity curve of **Praesto** Pure90, compared with GE Sepharose 4 Fast Flow and GE Sepharose 6 Fast Flow, obtained with RNase, Bovine Serum Albumin, Ferritin and Thyroglobulin.



Praesto Pure: Typical Physical & Chemical Characteristics

| | | | |
|--|--|-------|-------|
| Matrix | Highly cross-linked agarose | | |
| Exclusion Limit, Globular Proteins | 10 ⁷ daltons | | |
| Average Particle Size (d _{50v}), µm | 45 | 65 | 90 |
| Flow Velocity cm/h at 3 bar in a 2.6 x 20cm column (packed at 4 bar) | > 200 | > 400 | > 800 |
| Operating pH Stability (Short-term) (Long-term) | pH 2-14 pH 3-13 | | |
| Working Temperature | 4-30°C | | |
| Chemical Stability | All commonly used aqueous buffers, 2M NaOH, 8M urea, 6M guanidine HCl, 30% isopropanol, 70% ethanol, 30% acetonitrile and commonly used detergents | | |
| Storage | 20% ethanol at 4-30°C | | |

Figure 2: Pressure/Flow Curves

Praesto Pure Chromatographic Performance

The rigidity of **Praesto** resins allows for high flow velocities below pressure limits. Compared to older agarose-based resins, pressure-flow performance is greatly improved, and exceeds that of other high flow agarose resins of similar particle size (Fig. 2). **Praesto** Pure resins demonstrate increased throughput and productivity.

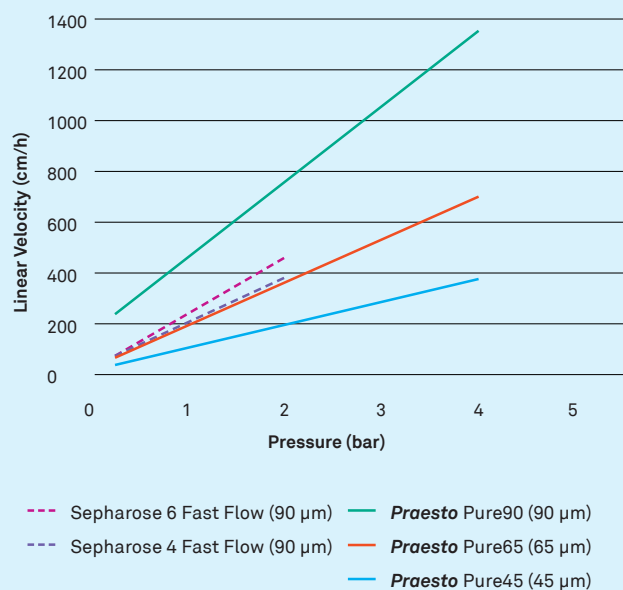


Sepharose and HiScale are registered trademarks of GE Healthcare.

Figure 2: The figure shows the pressure flow properties of **Praesto** Pure90, **Praesto** Pure65, **Praesto** Pure45, Sepharose 6 Fast Flow and Sepharose 4 Fast Flow.

Praesto Pure90, **Praesto** Pure65, **Praesto** Pure45 were packed at 4 bar to a bed height of 20 cm in a HiScale™ 26/40 column.

Sepharose 6 Fast Flow and Sepharose 4 Fast Flow were packed at 2 bar to a bed height of 20 cm in a HiScale™ 26/40 column.



Pre-Activated Resins

For simplified ligand immobilization and customizable affinity chromatography purification resins.

Pre-Activated Base Matrices

Praesto[®] CNBr

Pre-activated CNBr resin functionalized on a modern, high flow agarose base matrix for simplified ligand immobilization and fully customizable affinity chromatography purification solutions

Overview

To support in the development and manufacture of biopharmaceuticals, Purolite has developed a range of pre-activated agarose resins. These resins enable manufacturers to couple their own ligands to develop affinity chromatography solutions. NHS, Epoxy and CNBr pre-activated chemistries are available in three particle sizes - 45 µm, 65 µm and 90 µm.

Praesto CNBr Resins

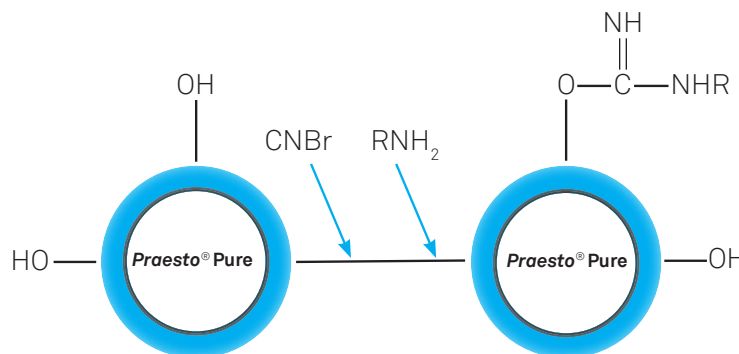
Praesto CNBr resins have been designed to offer a simple solution for the immobilization of ligands onto an agarose chromatography matrix, which can be utilized to make customized affinity resins. This enables rapid scale-up from R&D proof of concept to larger scale bioprocess production columns.

The use of Cyanogen bromide (CNBr) pre-activated base matrices is a well-established, rapid and familiar technique for the coupling of bio-specific ligands to generate affinity chromatography purification media. This choice of pre-activation chemistry is well suited for research, diagnostic and academic applications. Coupling is via primary amino groups. **Praesto** CNBr resins have a cyanogen-active group which form an isourea linkage between ligand and resin. Many well-documented references (published over several decades) are publicly available.

Key Performance Benefits

- ♦ Very low levels of non-specific binding due to the highly hydrophilic properties of the agarose base matrix
- ♦ Rigid base matrix allows significantly (over 100%) higher flow velocities than other agarose resins, making it suitable for process scale operations
- ♦ Quick and straightforward ligand coupling
- ♦ CNBr agarose has been successfully used for over two decades
- ♦ Chemically stable due to multipoint attachment ligand chemistry coupling
- ♦ Modern range of resins maximizes facility productivity, improving process economics significantly

Figure 1: Praesto CNBr Pre-Activated Resin Structure



Matrix Characteristics

The **Praesto** CNBr range of pre-activated chromatography resins use a modern, highly cross linked-agarose matrix formulation. Due to the unique rigidity and open pore structure of the **Praesto** agarose base beads, the **Praesto** CNBr range is well suited for process-scale chromatography, allowing large columns to be operated. This is due to high cross linking, which enables processes to operate at very high flow rates compared to other commercially available resins.

Proteins and other molecules are covalently coupled directly to the pre-activated gel via primary amino groups.

Figure 2 shows the pressure flow comparison against Sepharose 4 Fast Flow (90 µm) and Sepharose 6 Fast Flow (90 µm). Even at process scale, with larger diameter columns and bed heights, the rigidity of **Praesto** allows at least 100% higher linear flow velocity. The ability to run at high flow rates increases productivity and improves facility throughput.

Praesto CNBr pre-activated resins are available in three particle sizes - 45 µm, 65 µm and 90 µm. Across the range of three bead sizes, porosity and ligand density is maintained. This enables the selection of an optimal particle size for a particular downstream process to maximize productivity, resolution, and pressure restraints.

Operation and Use

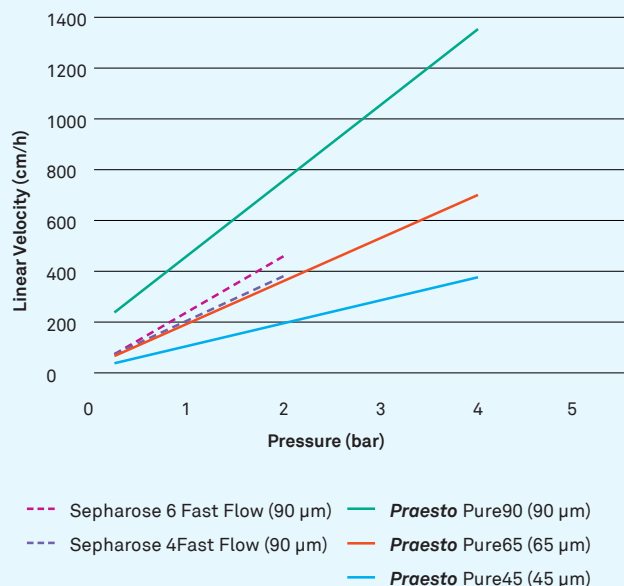
First, the **Praesto** CNBr resin requires swelling. 1 g of lyophilized powder typically provides 3.5-4 ml of final volume. Once swelled, the resin is then washed prior to ligand coupling. The coupling reaction is quick and spontaneous.

Instruction protocols are provided in the dedicated **Praesto** CNBr brochure. Contact praesto@purolite.com to request, or visit www.purolite.com/life-sciences for full documentation.

Figure 2: The figure shows the pressure flow properties of **Praesto** Pure90, **Praesto** Pure65, **Praesto** Pure45, Sepharose 6 Fast Flow and Sepharose 4 Fast Flow.

Praesto Pure90, **Praesto** Pure 65, **Praesto** Pure45 were packed at 4 bar to a bed height of 20 cm in a HiScale™ 26/40 column.

Sepharose 6 Fast Flow and Sepharose 4 Fast Flow were packed at 2 bar to a bed height of 20 cm in a HiScale™ 26/40 column.



Pre-Activated Base Matrices

Praesto® Epoxy

Pre-activated Epoxy resin functionalized on a modern, high flow agarose base matrix for simplified ligand immobilization and fully customizable affinity chromatography purification solutions

Overview

To support in the development and manufacture of biopharmaceuticals, PuroLite has developed a range of pre-activated agarose resins. These resins enable manufacturers to couple their own ligands to develop affinity chromatography solutions. NHS, Epoxy and CNBr pre-activated chemistries are available in three particle sizes - 45 µm, 65 µm and 90 µm.

Praesto Epoxy Resins

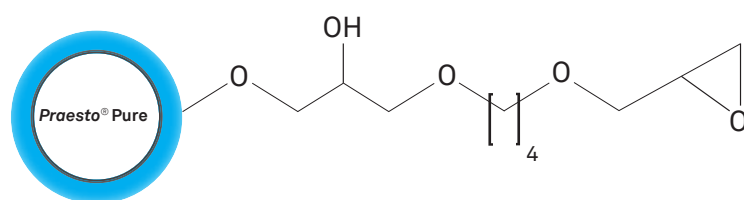
Praesto Epoxy resins have been designed to offer a simple solution for the immobilization of ligands onto an agarose chromatography matrix, which can be utilized to make customized affinity resins. This enables rapid scale-up from R&D proof of concept to larger scale bioprocess production columns.

Praesto Epoxy resins offer the versatility to couple ligands through primary amine, hydroxyl and thiol groups. The **Praesto** Epoxy resin design incorporates a spacer which separates the ligand from the chromatography carrier enabling maximum efficiency of the ligand. The epoxide group forms a stable linkage between the matrix and ligand, which has very low ligand leakage and high caustic stability. Many well-documented references (published over several years) are publicly available.

Key Performance Benefits

- ♦ Very low levels of non-specific binding due to the highly hydrophilic properties of the agarose base matrix
- ♦ Rigid base matrix allows significantly higher flow velocities, making them suitable for process-scale operations
- ♦ Quick and straightforward coupling of affinity ligands
- ♦ Spacer arm increases access to the Epoxy groups, maximizing ligand coupling and subsequent binding capacity
- ♦ No swelling required (supplied in suspension), compared to other commercially available epoxy agarose resins, increasing productivity
- ♦ Modern range of resins maximizes facility productivity, improving process economics significantly

Praesto Epoxy Pre-Activated Resin Structure



Matrix Characteristics

The **Praesto** Epoxy range of pre-activated chromatography resins use a modern, highly cross linked-agarose matrix formulation. Due to the unique rigidity and open pore structure of the **Praesto** agarose base beads, the **Praesto** Epoxy range is well suited for process-scale chromatography allowing large columns to be operated. Proteins and other molecules containing primary amino groups are coupled directly to the pre-activated gel via a spacer. The result is a chemically stable bond and high level of biological activity between the immobilised ligand and the base matrix.

Proteins and other molecules containing primary amino groups are coupled directly to the pre-activated gel via multipoint attachment. The use of multipoint attachment provides a good chemical stable bond and high level of biological activity between the immobilised ligand and the base matrix. At low pH, stability is also maintained during low elution for immunosorbents.

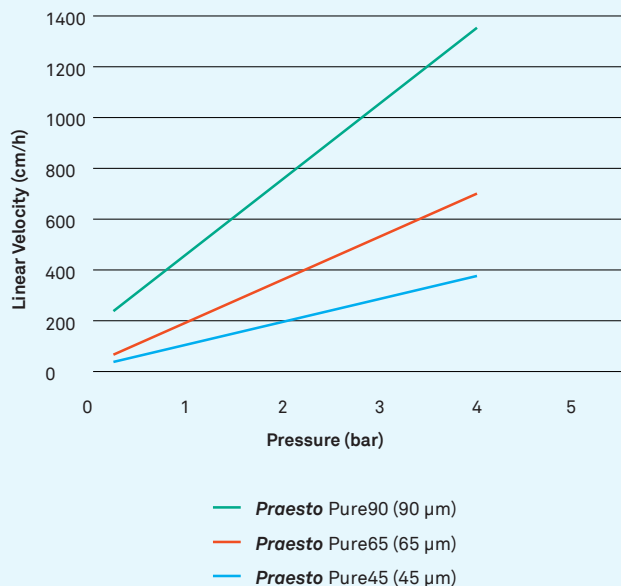
Figure 2 shows the pressure flow properties of **Praesto** Pure90, **Praesto** Pure65 and **Praesto** Pure45. Even at process scale, with larger diameter columns and bed heights, the rigidity of **Praesto** allows processes to operate at higher flow velocities. The ability to run at high flow rates increases productivity and improves facility throughput.

Praesto Epoxy pre-activated resins are available in three particle sizes, 45 µm, 65 µm and 90 µm. Across the range of three bead sizes, porosity and ligand density is maintained. This enables the selection of an optimal particle size for a particular downstream process to maximize productivity, resolution, and pressure restraints.



Figure 2: The figure shows the pressure flow properties of **Praesto** Pure90, **Praesto** Pure65 and **Praesto** Pure45

Praesto Pure90, **Praesto** Pure 65, **Praesto** Pure45 were packed at 4 bar to a bed height of 20 cm in a HiScale™ 26/40 column.



Operation and Use

Praesto Epoxy is supplied in 100% water, which is not compatible with long term storage. If the resin will not be used within a week of receipt, we recommend that it is washed and transferred to 100% isopropanol and stored at 2-8°C until use. In isopropanol at 2-8°C, the resin is stable for several months. Primary alcohol (ethanol) will react slowly with the pre-activated epoxide functionality and should be avoided prior to ligand coupling. Prior to coupling the isopropyl alcohol needs to be removed by washing with at least 3 equivalent volumes of water to resin. The coupling reaction is quick and spontaneous.

Instruction protocols are provided in the dedicated **Praesto** Epoxy brochure. Contact praesto@purolite.com to request, or visit www.purolite.com/life-sciences for full documentation.

Pre-Activated Base Matrices

Praesto[®] NHS

Pre-activated NHS resin functionalized on a modern, high flow agarose base matrix for simplified ligand immobilization and fully customizable affinity chromatography purification solutions

Overview

To support in the development and manufacture of biopharmaceuticals, Purolite has developed a range of pre-activated agarose resins. These resins enable manufacturers to couple their own ligands to develop affinity chromatography solutions. NHS, Epoxy and CNBr pre-activated chemistries are available in three particle sizes - 45 µm, 65 µm and 90 µm.

Praesto NHS Resins

Praesto NHS resins have been designed to offer a simple solution for the immobilization of ligands onto an agarose chromatography matrix, which can be utilized to make customized affinity resins. This enables rapid scale-up from R&D proof of concept to larger scale bioprocess production columns.

Praesto NHS resins couple ligands which have a primary amine. **Praesto** NHS incorporates a spacer chain which separates the ligand from the chromatography matrix enabling maximum accessibility to the ligand.

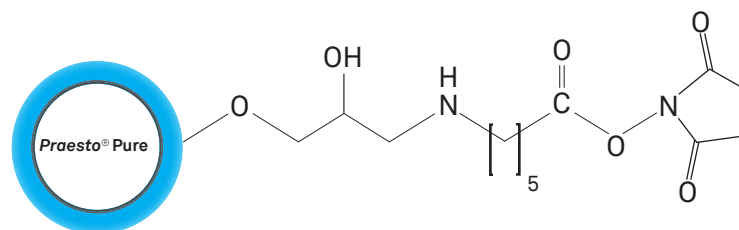
The pre-activated NHS resin forms a stable amide linkage between the matrix and ligand resulting in very low ligand leakage and high caustic stability.

A common application for NHS resins is immobilization of antibodies to create immunosorbents. Coupling is via primary amino groups. Many well documented references are publicly available.

Key Performance Benefits

- ♦ Very low levels of non-specific binding due to the highly hydrophilic properties of the agarose base matrix
- ♦ Rigid base matrix allows significantly higher flow velocities than other pre-activated resins (e.g. Sepharose), making them suitable for process-scale operations - flow velocities are more than 100% higher
- ♦ Quick and straight forward coupling of ligands containing primary amines
- ♦ Spacer arm increases access to the NHS groups, maximizing ligand coupling and subsequent binding capacity
- ♦ Modern range of resins maximizes facility productivity, improving process economics significantly

Praesto NHS Pre-Activated Resin Structure



Matrix Characteristics

The **Praesto** NHS range of pre-activated chromatography resins use a modern, highly cross linked-agarose matrix formulation. Due to the unique rigidity and open pore structure of the **Praesto** agarose base beads, the **Praesto** NHS range is well suited for process scale chromatography to allow large columns to be operated. Proteins and other molecules containing primary amino groups are coupled directly to the pre-activated gel via a spacer. The result is a chemically stable bond and high level of biological activity between the immobilised ligand and the base matrix.

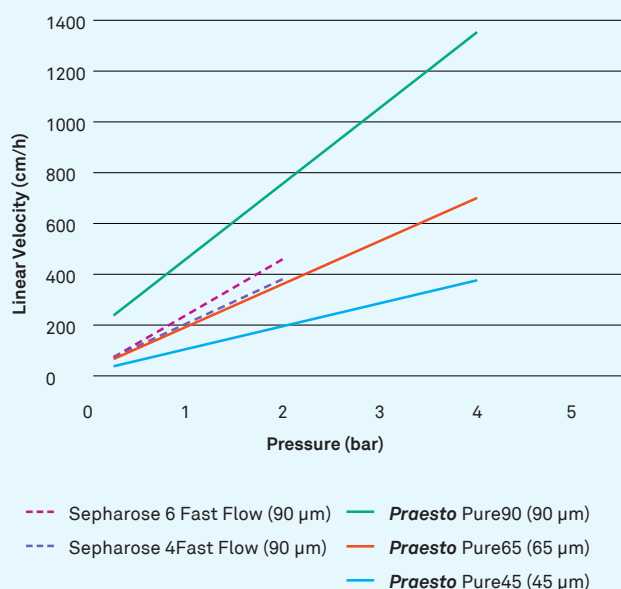
Figure 2 shows the pressure flow properties of **Praesto** Pure90, **Praesto** Pure65 and **Praesto** Pure45 when compared to Sepharose 4 Fast Flow (90 µm) and Sepharose 6 Fast Flow (90 µm). Even at process scale, with larger diameter columns and bed heights, the rigidity of **Praesto** allows processes to operate at higher flow velocities. The ability to run at high flow rates increases productivity and improves facility throughput.

Praesto NHS pre-activated resins are available in three particle sizes, 45 µm, 65 µm and 90 µm. Across the range of three bead sizes, porosity and ligand density is maintained. This enables the selection of an optimal particle size for a particular downstream process to maximize productivity, resolution, and pressure restraints.

Figure 2: The figure shows the pressure flow properties of **Praesto** Pure90, **Praesto** Pure65, **Praesto** Pure45, Sepharose 6 Fast Flow and Sepharose 4 Fast Flow.

Praesto Pure90, **Praesto** Pure 65, **Praesto** Pure45 were packed at 4 bar to a bed height of 20 cm in a HiScale™ 26/40 column.

Sepharose 6 Fast Flow and Sepharose 4 Fast Flow were packed at 2 bar to a bed height of 20 cm in a HiScale™ 26/40 column.



Operation and Use

Praesto NHS is supplied in 100% isopropyl alcohol and shipped under ambient conditions. It is recommended to store the resin between 2-8°C. Washing with at least 3 column volumes is required to remove the solvent prior to ligand coupling. The coupling reaction is quick and spontaneous. Shelf life is expected of at least 24 months when stored in 100% IPA and between 2-8°C.

Instruction protocols are provided in the dedicated **Praesto** NHS brochure. Contact praesto@purolite.com to request, or visit www.purolite.com/life-sciences for full documentation.



Ordering Information

To place your order simply contact the relevant regional office via email or telephone using the information on the back page of this brochure and quote your order number from the tables on the following pages.

If you wish to discuss your purification challenges with a specialist, we have dedicated experts on-hand across the globe to provide knowledgeable, same-day technical assistance.

Protein A Resins

| Praesto APc | | |
|--|------------------|---------------------|
| BULK RESIN | PACK SIZE | ORDER NUMBER |
| <i>Praesto APc</i> | 10 ml | PR00310-163 |
| <i>Praesto APc</i> | 25 ml | PR00310-166 |
| <i>Praesto APc</i> | 100 ml | PR00310-164 |
| <i>Praesto APc</i> | 500 ml | PR00310-165 |
| <i>Praesto APc</i> | 1 L | PR00310-310 |
| <i>Praesto APc</i> | 5 L | PR00310-311 |
| <i>Praesto APc</i> | 10 L | PR00310-312 |
| PRE-PACKED COLUMNS | | |
| <i>Praesto APc MiniChrom Column (8 x 20 mm)</i> | 1 x 1 ml | PR00310-175 |
| <i>Praesto APc MiniChrom Column (8 x 100 mm)</i> | 1 x 5 ml | PR00310-176 |
| <i>Praesto APc RoboColumn® (5 x 10 mm)</i> | 8 x 200 µl | PR00310-174 |
| <i>Praesto APc RoboColumn® (5 x 10 mm)</i> | 8 x 600 µl | PR00310-279 |
| <i>Praesto APc HT Column</i> | 1 ml | PR00310-275 |
| <i>Praesto APc HT Column</i> | 5 x 1 ml | PR00310-575 |
| <i>Praesto APc HT Column</i> | 5 ml | PR00310-276 |
| <i>Praesto APc HT Column</i> | 5 x 5 ml | PR00310-576 |

| Praesto AP | | |
|-------------------|------------------|---------------------|
| BULK RESIN | PACK SIZE | ORDER NUMBER |
| <i>Praesto AP</i> | 10 ml | PR00300-163 |
| <i>Praesto AP</i> | 25 ml | PR00300-166 |
| <i>Praesto AP</i> | 100ml | PR00300-164 |
| <i>Praesto AP</i> | 500 ml | PR00300-165 |
| <i>Praesto AP</i> | 1 L | PR00300-310 |
| <i>Praesto AP</i> | 5 L | PR00300-311 |
| <i>Praesto AP</i> | 10 L | PR00300-312 |

Praesto AP Continued...

PRE-PACKED COLUMNS

| | | |
|---|------------|-------------|
| <i>Praesto AP</i> MiniChrom Column (8 x 20 mm) | 1 x 1 ml | PR00300-175 |
| <i>Praesto AP</i> MiniChrom Column (8 x 100 mm) | 1 x 5 ml | PR00300-176 |
| <i>Praesto AP</i> RoboColumn® (5 x 10 mm) | 8 x 200 µl | PR00300-174 |
| <i>Praesto AP</i> RoboColumn® (5 x 10 mm) | 8 x 600 µl | PR00300-279 |
| <i>Praesto AP</i> HT Column | 1 ml | PR00300-275 |
| <i>Praesto AP</i> HT Column | 5 x 1 ml | PR00300-575 |
| <i>Praesto AP</i> HT Column | 5 ml | PR00300-276 |
| <i>Praesto AP</i> HT Column | 5 x 5 ml | PR00300-576 |

Praesto AC

| BULK RESIN | PACK SIZE | ORDER NUMBER |
|---|------------|--------------|
| <i>Praesto AC</i> | 10 ml | PR00200-163 |
| <i>Praesto AC</i> | 25 ml | PR00200-166 |
| <i>Praesto AC</i> | 100 ml | PR00200-164 |
| <i>Praesto AC</i> | 500 ml | PR00200-165 |
| <i>Praesto AC</i> | 1 L | PR00200-310 |
| <i>Praesto AC</i> | 5 L | PR00200-311 |
| <i>Praesto AC</i> | 10 L | PR00200-312 |
| PRE-PACKED COLUMNS | | |
| <i>Praesto AC</i> MiniChrom (8 x 20 mm) | 1 x 1 ml | PR00200-175 |
| <i>Praesto AC</i> MiniChrom (8 x 100 mm) | 1 x 5 ml | PR00200-176 |
| <i>Praesto AC</i> RoboColumn® (5 x 10 mm) | 8 x 200 µl | PR00200-174 |
| <i>Praesto AC</i> RoboColumn® (5 x 10 mm) | 8 x 600 µl | PR00200-279 |
| <i>Praesto AC</i> HT Column | 1 ml | PR00200-275 |
| <i>Praesto AC</i> HT Column | 5 x 1 ml | PR00200-575 |
| <i>Praesto AC</i> HT Column | 5 ml | PR00200-276 |
| <i>Praesto AC</i> HT Column | 5 x 5 ml | PR00200-576 |

'Jetted' Ion Exchange Resins

| Praesto Jetted Bulk Resin | | |
|----------------------------|-----------|--------------|
| BULK RESIN | PACK SIZE | ORDER NUMBER |
| <i>Praesto Jetted SP35</i> | 25 ml | PR00432-166 |
| <i>Praesto Jetted SP35</i> | 100 ml | PR00432-164 |
| <i>Praesto Jetted SP35</i> | 500 ml | PR00432-165 |
| <i>Praesto Jetted SP35</i> | 1 L | PR00432-310 |
| <i>Praesto Jetted SP35</i> | 5 L | PR00432-311 |
| <i>Praesto Jetted SP35</i> | 10 L | PR00432-312 |
| | | |
| <i>Praesto Jetted Q35</i> | 25 ml | PR00436-166 |
| <i>Praesto Jetted Q35</i> | 100 ml | PR00436-164 |
| <i>Praesto Jetted Q35</i> | 500 ml | PR00436-165 |
| <i>Praesto Jetted Q35</i> | 1 L | PR00436-310 |
| <i>Praesto Jetted Q35</i> | 5 L | PR00436-311 |
| <i>Praesto Jetted Q35</i> | 10 L | PR00436-312 |

| Praesto Jetted HT Columns | | |
|-------------------------------|-----------|--------------|
| PRODUCT | PACK SIZE | ORDER NUMBER |
| <i>Praesto Jetted SP35 HT</i> | 5 x 1 ml* | PR00432-575 |
| <i>Praesto Jetted SP35 HT</i> | 5 x 5 ml* | PR00432-576 |
| <i>Praesto Jetted Q35 HT</i> | 5 x 1 ml* | PR00436-575 |
| <i>Praesto Jetted Q35 HT</i> | 5 x 5 ml* | PR00436-576 |

* HT columns packed with Ion Exchange resins available in packs of 5 only

Ion Exchange Resins

| Praesto SP | | |
|---|------------------|---------------------|
| BULK RESIN | PACK SIZE | ORDER NUMBER |
| <i>Praesto SP45</i> | 25 ml | PR00242-166 |
| <i>Praesto SP45</i> | 100 ml | PR00242-164 |
| <i>Praesto SP45</i> | 500 ml | PR00242-165 |
| <i>Praesto SP45</i> | 1 L | PR00242-310 |
| <i>Praesto SP65</i> | 25 ml | PR00262-166 |
| <i>Praesto SP65</i> | 100 ml | PR00262-164 |
| <i>Praesto SP65</i> | 500 ml | PR00262-165 |
| <i>Praesto SP65</i> | 1 L | PR00262-310 |
| <i>Praesto SP90</i> | 25 ml | PR00292-166 |
| <i>Praesto SP90</i> | 100 ml | PR00292-164 |
| <i>Praesto SP90</i> | 500 ml | PR00292-165 |
| <i>Praesto SP90</i> | 1 L | PR00292-310 |
| PRE-PACKED COLUMNS | | |
| <i>Praesto SP45 MiniChrom (8 x 20 mm)</i> | 1 x 1 ml | PR00242-175 |
| <i>Praesto SP65 MiniChrom (8 x 20 mm)</i> | 1 x 1 ml | PR00262-175 |
| <i>Praesto SP90 MiniChrom (8 x 20 mm)</i> | 1 x 1 ml | PR00292-175 |
| <i>Praesto SP45 MiniChrom (8 x 100 mm)</i> | 1 x 5 ml | PR00242-176 |
| <i>Praesto SP65 MiniChrom (8 x 100 mm)</i> | 1 x 5 ml | PR00262-176 |
| <i>Praesto SP90 MiniChrom (8 x 100 mm)</i> | 1 x 5 ml | PR00292-176 |
| <i>Praesto SP45 RoboColumn® (5 x 10 mm)</i> | 8 x 200 µl | PR00242-174 |
| <i>Praesto SP65 RoboColumn® (5 x 10 mm)</i> | 8 x 200 µl | PR00262-174 |
| <i>Praesto SP90 RoboColumn® (5 x 10 mm)</i> | 8 x 200 µl | PR00292-174 |

| Praesto SP Continued... | | |
|--------------------------------|-----------|-------------|
| PRE-PACKED COLUMNS | | |
| <i>Praesto SP45 HT Column</i> | 5 x 1 ml* | PR00242-575 |
| <i>Praesto SP45 HT Column</i> | 5 x 5 ml* | PR00242-576 |
| <i>Praesto SP65 HT Column</i> | 5 x 1 ml* | PR00262-575 |
| <i>Praesto SP65 HT Column</i> | 5 x 5 ml* | PR00262-576 |
| <i>Praesto SP90 HT Column</i> | 5 x 1 ml* | PR00292-575 |
| <i>Praesto SP90 HT Column</i> | 5 x 5 ml* | PR00292-576 |

* HT columns packed with Ion Exchange resins available in packs of 5 only.

| Praesto Q | | |
|--------------------|------------------|---------------------|
| BULK RESIN | PACK SIZE | ORDER NUMBER |
| <i>Praesto Q45</i> | 25 ml | PR00246-166 |
| <i>Praesto Q45</i> | 100 ml | PR00246-164 |
| <i>Praesto Q45</i> | 500 ml | PR00246-165 |
| <i>Praesto Q45</i> | 1 L | PR00246-310 |
| <i>Praesto Q65</i> | 25 ml | PR00266-166 |
| <i>Praesto Q65</i> | 100 ml | PR00266-164 |
| <i>Praesto Q65</i> | 500 ml | PR00266-165 |
| <i>Praesto Q65</i> | 1 L | PR00266-310 |
| <i>Praesto Q90</i> | 25 ml | PR00296-166 |
| <i>Praesto Q90</i> | 100 ml | PR00296-164 |
| <i>Praesto Q90</i> | 500 ml | PR00296-165 |
| <i>Praesto Q90</i> | 1 L | PR00296-310 |

| Praesto Q Continued... | | |
|--|------------|-------------|
| PRE-PACKED COLUMNS | | |
| <i>Praesto Q45 MiniChrom (8 x 20 mm)</i> | 1 x 1 ml | PR00246-175 |
| <i>Praesto Q65 MiniChrom (8 x 20 mm)</i> | 1 x 1 ml | PR00266-175 |
| <i>Praesto Q90 MiniChrom (8 x 20 mm)</i> | 1 x 1 ml | PR00296-175 |
| <i>Praesto Q45 MiniChrom (8 x 100 mm)</i> | 1 x 5 ml | PR00246-176 |
| <i>Praesto Q65 MiniChrom (8 x 100 mm)</i> | 1 x 5 ml | PR00266-176 |
| <i>Praesto Q90 MiniChrom (8 x 100 mm)</i> | 1 x 5 ml | PR00296-176 |
| <i>Praesto Q45 RoboColumn® (5 x 10 mm)</i> | 8 x 200 µl | PR00246-174 |
| <i>Praesto Q65 RoboColumn® (5 x 10 mm)</i> | 8 x 200 µl | PR00266-174 |
| <i>Praesto Q90 RoboColumn® (5 x 10 mm)</i> | 8 x 200 µl | PR00296-174 |
| <i>Praesto Q45 HT Column</i> | 5 x 1 ml* | PR00246-575 |
| <i>Praesto Q45 HT Column</i> | 5 x 5 ml* | PR00246-576 |
| <i>Praesto Q65 HT Column</i> | 5 x 1 ml* | PR00266-575 |
| <i>Praesto Q65 HT Column</i> | 5 x 5 ml* | PR00266-576 |
| <i>Praesto Q90 HT Column</i> | 5 x 1 ml* | PR00296-575 |
| <i>Praesto Q90 HT Column</i> | 5 x 5 ml* | PR00296-576 |

* HT columns packed with Ion Exchange resins available in packs of 5 only.

Base Matrices

| Praesto Pure | | |
|-----------------------|-----------|--------------|
| PRODUCT | PACK SIZE | ORDER NUMBER |
| <i>Praesto Pure45</i> | 25 ml | PR00240-166 |
| <i>Praesto Pure45</i> | 100 ml | PR00240-164 |
| <i>Praesto Pure45</i> | 500 ml | PR00240-165 |
| <i>Praesto Pure65</i> | 25 ml | PR00260-166 |
| <i>Praesto Pure65</i> | 100 ml | PR00260-164 |
| <i>Praesto Pure65</i> | 500 ml | PR00260-165 |
| <i>Praesto Pure90</i> | 25 ml | PR00290-166 |
| <i>Praesto Pure90</i> | 100 ml | PR00290-164 |
| <i>Praesto Pure90</i> | 500 ml | PR00290-165 |

Pre-Activated Base Matrices

| Praesto CNBr | | |
|-----------------------|-----------|--------------|
| PRODUCT | PACK SIZE | ORDER NUMBER |
| <i>Praesto CNBr90</i> | 10 g | PR01246-270 |
| <i>Praesto CNBr90</i> | 250 g | PR01246-271 |
| <i>Praesto CNBr90</i> | 1 kg | PR01246-272 |
| <i>Praesto CNBr90</i> | 2 kg | PR01246-273 |
| <i>Praesto CNBr65</i> | 10 g | PR01242-270 |
| <i>Praesto CNBr65</i> | 250 g | PR01242-271 |
| <i>Praesto CNBr65</i> | 1 kg | PR01242-272 |
| <i>Praesto CNBr65</i> | 2 kg | PR01242-273 |
| <i>Praesto CNBr45</i> | 10 g | PR01240-270 |
| <i>Praesto CNBr45</i> | 250 g | PR01240-271 |
| <i>Praesto CNBr45</i> | 1 kg | PR01240-272 |
| <i>Praesto CNBr45</i> | 2 kg | PR01240-273 |

| Praesto Epoxy | | |
|------------------------|------------------|---------------------|
| PRODUCT | PACK SIZE | ORDER NUMBER |
| Praesto Epoxy90 | 25 ml | PR01266-166 |
| Praesto Epoxy90 | 100 ml | PR01266-164 |
| Praesto Epoxy90 | 500 ml | PR01266-165 |
| Praesto Epoxy90 | 1 L | PR01266-310 |
| Praesto Epoxy65 | 25 ml | PR01260-166 |
| Praesto Epoxy65 | 100 ml | PR01260-164 |
| Praesto Epoxy65 | 500 ml | PR01260-165 |
| Praesto Epoxy65 | 1 L | PR01260-310 |
| Praesto Epoxy45 | 25 ml | PR01262-166 |
| Praesto Epoxy45 | 100 ml | PR01262-164 |
| Praesto Epoxy45 | 500 ml | PR01262-165 |
| Praesto Epoxy45 | 1 L | PR01262-310 |

| Praesto NHS | | |
|----------------------|------------------|---------------------|
| PRODUCT | PACK SIZE | ORDER NUMBER |
| Praesto NHS90 | 25 ml | PR01296-166 |
| Praesto NHS90 | 100 ml | PR01296-164 |
| Praesto NHS90 | 500 ml | PR01296-165 |
| Praesto NHS90 | 1 L | PR01296-310 |
| Praesto NHS65 | 25 ml | PR01292-166 |
| Praesto NHS65 | 100 ml | PR01292-164 |
| Praesto NHS65 | 500 ml | PR01292-165 |
| Praesto NHS65 | 1 L | PR01292-310 |
| Praesto NHS45 | 25 ml | PR01290-166 |
| Praesto NHS45 | 100 ml | PR01290-164 |
| Praesto NHS45 | 500 ml | PR01290-165 |
| Praesto NHS45 | 1 L | PR01290-310 |

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