Bio-Works

INSTRUCTION

WorkBeads affimAb

WorkBeads™ affimAb resin is an alkali-stable resin designed for purification of monoclonal and polyclonal antibodies in laboratory to process scale. This resin has a superior base matrix in combination with an optimized alkali-stable protein A ligand. This results in high dynamic binding capacity also at short residence times, and stabile capacity over multiple purification cycles with cleaning-in-place using 0.5 M NaOH.

Prepacked GoBio™ affimAb columns are available from 1 mL to 21.4 L columns for small scale purifications to production scale. WorkBeads affimAb resin can also be used for purifications in other formats, such as batch and centrifugation purifications.

- Top performance dynamic binding capacity also at short residence times
- Outstanding alkali stability with 0.5 M NaOH, extends the numbers of purification cycles
- Excellent purity, recovery and reproducibility
- Negligible protein A leakage

Intended use

WorkBeads resins are developed and supported for both research and production-scale chromatography. WorkBeads resins are produced according to ISO 9001:2015, and Regulatory Support Files (RSF) are available to assist the process validation and submissions to regulatory authorities.

The GoBio prepacked column family has been developed for convenient, reproducible, and rapid results and can be used for small scale purification and all the way up to process development and full-scale manufacturing.

Safety

Please read the Safety Data Sheet (SDS) for WorkBeads affimAb and the safety instructions for any equipment to be used.

Unpacking and inspection

Unpack the shipment as soon as it arrives and inspect it for damage. Promptly report any damage or discrepancies to complaints@bio-works.com

Short protocol

This short protocol is for column packing of WorkBeads affimAb and antibody purification. Detailed instructions and recommendations for optimization are given later in this document. Recommended buffers are listed in Table 1.

1. Make a slurry of the desired resin concentration.
2. Pour the slurry into the column.
3. Pack the resin with an appropriate flow rate.
4. Apply an axial compression of less than 2%.
5. Equilibrate the column with binding buffer.
6. Apply sample.
7. Elute the target protein with elution buffer.
8. Wash the column with deionized water.
9. Equilibrate the column with 20% ethanol for storage.

Principle

Affinity chromatography is a useful technique for the separation of proteins by exploiting the reversible interaction between the target protein and the immobilized ligand. The interaction can be bio-specific, for example antibodies binding to protein A, or not bio-specific, for example histidine-tagged proteins binding to metal ions.

This chromatography technique provides high selectivity, resolution and capacity. High purity is often achieved in a single step. Large sample volumes can be processed, and samples applied under conditions that favour specific binding to the ligand. Elution is often carried out under gentle conditions which helps to preserve bioactivity. The target protein is eluted, in a purified and concentrated form, by modification of pH, ionic strength, or by introducing a competitive agent.

Column packing

WorkBeads resins are cross-linked using a proprietary method that results in a very rigid resin, which tolerate pressures of several bars and consequently can run at high flow rates. Follow both this general advice when packing a column and the column manufacturer's specific instructions. Preferably, use a column with an adjustable adaptor. In some instances, a packing reservoir or column extension may be needed.

Note: Always make sure that the maximum pressure of the column hardware is not exceeded. Backpressure caused by the chromatography system components connected downstream of the column may reduce the maximum flow that can be used. Wear eye protection.

1. Wash the resin

The resin is provided in 20% ethanol. To avoid undue backpressure when packing, wash the desired amount of resin with several column volumes of deionized water before packing.

2. Make a slurry

Add deionized water to the washed resin to obtain a 40% to 60% slurry concentration. Make approximately 15% extra slurry to compensate for the compression during packing. The amount of slurry to be prepared can be calculated according to:

$$\text{Slurry volume} = \frac{\text{bed volume} \times 100}{\%\ \text{slurry}} \times 1.15$$

3. Pour the slurry into the column

Pour the slurry slowly down the side of the column to avoid formation of air bubbles. Preferably, use a packing reservoir or an extra column tube to extend the column volume to accommodate the entire slurry volume during packing. If no packing adaptor is available packing can be done by stepwise additions and packing. Although not recommended this will give acceptable results for most applications.

4. Pack the bed

Pack the resin with a downward flow higher than the intended operational flow. We recommend 300 cm/h for columns up to 25 mm i.d. and with 200 mm bed height. Make sure the packing flow rate does not exceed the maximum pressure of the column hardware or the resin. The operational flow should not be more than 75% of the packing flow rate.

5. Close the column

When the bed height is constant mark the bed height on the column. Stop the flow and remove the packing reservoir or extra tube. Note that the bed height will increase temporarily when the flow is stopped. If needed, adjust the bed height by removing excess resin. Be careful not to remove too much resin. Gently fill the column with packing solution to its rim without disrupting the packed bed. Insert the adjustable adapter on top of the packed bed. Apply a small axial compression of less than 2% of the final bed height by lowering the adapter into the packed bed.

6. Apply a flow

Apply a flow of up to 225 cm/h (taking account of section 4) and check for any gap formation above the surface of the resin bed. If a gap is observed, stop the flow and adjust the adaptor to eliminate the gap.

Evaluation of the packed column

Test the column efficiency to check the quality of packing. Testing should be done after packing, at regular intervals during the usage of the column or when separation performance is seen to deteriorate.

The best method of expressing the efficiency of a packed column is in terms of the height equivalent to a theoretical plate (HETP) and the asymmetry factor (A_s). These values are easily determined by applying a sample such as 1% acetone solution to the column.

For optimal results, the sample volume should be 2.5% of the column volume (CV) and the flow rate 30 cm/h.

If an acceptance limit is defined in relation to column performance, the column plate number can be used as one of the acceptance criteria for column use.

Note: The calculated number of plates will vary according to the test conditions and should only be used as a reference value. Keep test conditions and equipment constant so that results are comparable. Changes of for example solute, solvent, eluent, sample volume, flow velocity, liquid pathway, temperature, etc. will influence the results.

Measuring HETP and A_s

Calculate HETP and A_S from the UV curve (or conductivity curve).

$$HETP = \frac{L}{N}$$

$$N = 5.54 \times \left(\frac{V_R}{W_h}\right)^2$$

L = bed height (cm)
N = number of theoretical plates
V_R = volume eluted from the start of sample application to the peak maximum
W_h = peak width measured as the width of the recorded peak at half of the peak height
V_R and W_h are in the same units

The concept of reduced plate height is often used for comparing column performance. The reduced plate height, h, is calculated:

$$h = \frac{HETP}{d_{50v}}$$

d_{50v} = Median particle size of the cumulative volume distribution (cm)

As a guideline, a value of < 3 is very good.

The peak must be symmetrical, and the asymmetry factor as close to 1 as possible. (A typical acceptable range is $0.7 < A_S < 1.3$). A change in the shape of the peak is usually the first indication of bed deterioration.

Peak asymmetry factor calculation:

$$A_s = \frac{a}{b}$$

a = ascending part of the peak width at 10% of peak height

b = descending part of the peak width at 10% of peak height

Figure 1 below shows a UV trace for acetone in a typical test chromatogram from which the HETP and A_s values are calculated.

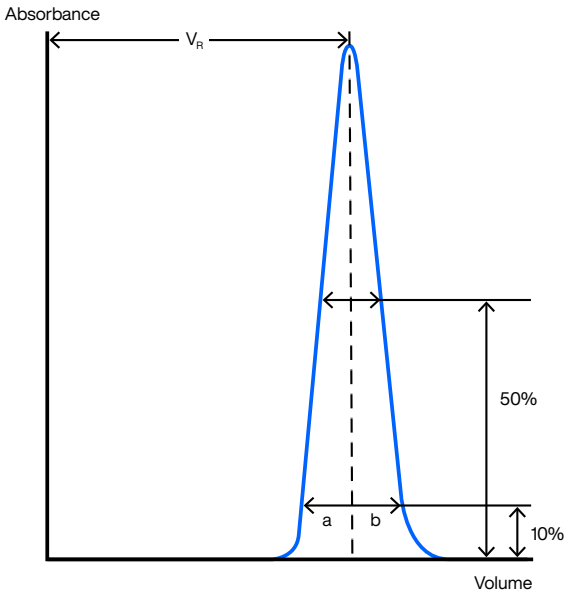

Figure 1. A typical test chromatogram showing the parameters used for HETP and A_s calculations.

Purification

The following brief instruction gives general conditions for purification using a column packed with WorkBeads affimAb. Recommended buffers are listed in Table 1 and recommendations for optimization are mentioned below.

Table 1. Recommended buffers for purification. Other buffers can possible be used.

Buffer	Composition
Binding buffer	20 mM sodium phosphate, 150 mM NaCl, pH 7.4 (PBS)
Elution buffer	100 mM sodium citrate, pH 3.0

Sample preparation

Clarify the sample by centrifugation at 10 000 – 20 000 × g for 15 – 30 minutes. It is recommended to also pass the sample through a 0.22 – 0.45 µm filter to remove any remaining particles. If the sample contains only small amounts of particles, it may be enough to only carry out filtration. Make sure that the sample has a pH between 5 and 8. Preferably, the sample should have the same pH and ionic strength as the binding buffer.

Standard purification

1. Equilibrate the column using 10 column volumes (CV) binding buffer.
2. Apply a clarified sample under neutral conditions.
3. Wash using 10-20 CV binding buffer.
4. Elute with 5 CV elution buffer. Include 100 µl 1 M Tris-HCl, pH 9 per 1 mL collected fraction, to prevent degradation of eluted target protein.
5. Re-equilibrate with 10 CV binding buffer.
6. Equilibrate with 10 CV 20% ethanol for storage.

Before starting a purification run, it is recommended to make a blank run (with no sample applied) to remove any loosely bound ligands or impurities on the resin. Do this also for a newly packed resin. Although the above standard conditions usually give excellent results it may be worthwhile to optimize the purification protocol for highest purity of the target protein, see “Optimization”.

Optimization

Selection of column size

The column size should be selected based on estimated amount of target protein in each run, and the dynamic binding capacity (DBC) of the resin. DBC is the capacity obtained under the chosen run conditions and is usually lower than the static binding capacity (total binding capacity). Figure 1 shows an example of DBC at different flow rates (or residence times). At a low flow rate, the capacity is higher. At increasing flow rate the binding capacity usually decreases.

To obtain the highest possible recovery of the target protein we recommend the loading of no more than 80% of the capacity of the packed column at the selected flow rate. Consider using a larger column or dividing the sample into repeated purification runs if needed. Collect the flow through material for subsequent analysis to determine whether the column was “over-saturated”. If desired the collected flow through material can be reapplied on the packed column after proper regeneration, in a new purification run.

Binding capacity

Antibody binding capacity depends on the flow rate used for binding and may differ between different antibody species and subclasses. For WorkBeads affimAb, the binding capacity is more than 40 mg human polyclonal IgG/mL resin at 2.5 minutes residence time in a 6.6 × 100 mm column, which corresponds to a linear flow rate of 240 cm/min. Normally the binding capacity decreases with increased flow rate, see Figure 2.

Optimization of binding

Human IgG and IgG from several other species bind to WorkBeads affimAb under neutral pH at moderate salt concentrations. Apart from the recommended binding buffer in Table 1, other buffers can be used. For example, 50 mM sodium phosphate, pH 7.4 or 50 mM sodium borate, pH 9. However, IgG with weaker affinity (e.g., mouse IgG_1) may need a binding buffer with a combination of high pH and ionic strength to be able to bind. For example, 50 mM sodium borate, 3 M NaCl, pH 9.

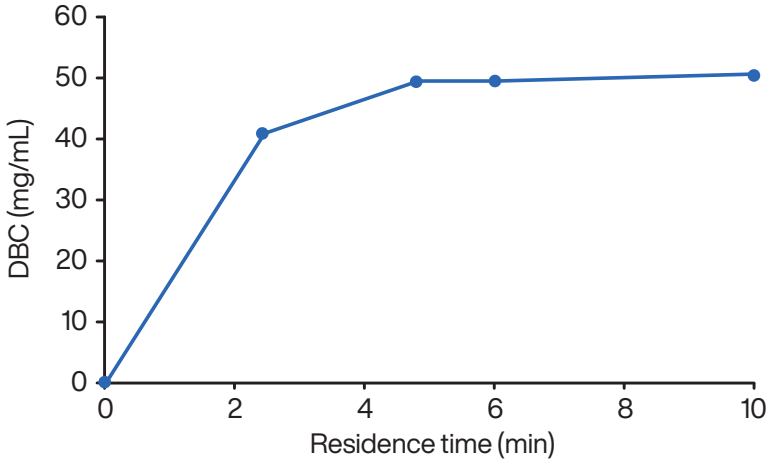

Figure 2. Dependency of dynamic binding capacity to residence time. Frontal analysis using 1 mg/mL human polyclonal IgG in PBS, pH 7.4 in a 6.6 × 100 mm glass column.

Extra wash step

To remove weakly adsorbed impurities, it may be useful to add an extra washing step after the standard wash. This can be done using a buffer with slightly increased ionic strength compared to the binding buffer or by a small decrease in pH that do not elute the target protein, see "Optimization of elution".

Optimization of elution

Apart from the recommended elution buffer in Table 1, other buffers can be used. For example, 100 mM glycine-HCl, pH 2.7. IgG can be sensitive to low pH. To avoid denaturation after elution with low pH, the pH can be neutralized by adding 100 µl of 1 M Tris-HCl, pH 9 per mL collected fraction to each fractionation tube before starting the purification, or immediately after completed elution. Alternatively, collect the target protein and perform buffer exchange using a prepacked GoBio Dsalt column equilibrated with a neutral buffer or pack your own column using WorkBeads Dsalt, see "Desaltiong and buffer exchange". In large-scale purifications or means of buffer exchange, e.g., diafiltration, may be more suitable.

The purity can sometimes be increased by applying a pH gradient for elution. This reduces the risk of elution of impurities adsorbed to the resin and denaturation of the target antibody.

For example, 100 mM sodium citrate, pH 6.0 to 100 mM sodium citrate, pH 3.0 over 20 CV can be applied. Desorption will occur when the pH is low enough, while avoiding too low pH. The pH measured at the tail of the peak can be selected for elution. Prepare a 100 mM sodium citrate buffer with the selected elution pH and use it in step elution in for scale-up runs.

Scale-up

After developing a chromatographic procedure in a small-scale column, e.g., 7 (i.d.) × 100 mm (bed height), WorkBeads resins can be packed into larger columns for scale-up. Large-scale purification is often carried out in columns with bed heights of 100 – 300 mm.

Scale-up principles

During scale-up the ratio between sample volume and column volume should be kept constant. The column volume is scaled up by increasing the column diameter while keeping the bed height the same (e.g., 100 – 200 mm). The linear flow rate should remain the same while the volumetric flow rate increases. The volumetric flow rate for each column can be calculated according to:

$$\text{Volumetric flow rate (mL/min)} = \frac{\text{Linear flow rate (cm/h)} \times \text{Column cross sectional area (cm}^2\text{)}}{60}$$

Flow

The concepts of volumetric flow, linear flow rate and residence time is important when doing scale-up in chromatography. Volumetric flow is measured in mL/min or L/min, linear flow in cm/h and residence time in minutes. The relationship between these metrics is:

$$\text{Linear flow rate (cm/h)} = \frac{\text{Volumetric flow (mL/min)} \times 60}{\text{Column cross sectional area (cm}^2\text{)}}$$

$$\text{Residence time (minutes)} = \frac{\text{Column bed height (cm)} \times 60}{\text{Linear flow rate (cm/h)}}$$

In the initial process development phase, it is common to use a small column, e.g., 7 × 100 mm, to save sample, buffers and time. This column has a shorter bed height than the final column, which may have a bed height of 100 – 200 mm or more. The flow rate for the larger column can be calculated from the flow established on the small column, using the equation above by keeping the residence time of the small column the same for the larger column. This will allow an increase of the linear flow in proportion to the increase in bed height between the columns see Table 2 for examples. If the column bed heights are constant during scale-up the linear flow rate should be also constant (as well as the residence time).

Table 2. Example of scale-up parameters.

Column dimension	Residence time (minutes)	Linear flow rate (cm/h)	Volumetric flow rate (mL/min)
16x100	4	150	5.0
26x100	4	150	13.3
80x200	8	150	126
130x200	8	150	332
200x200	8	150	785
240x200	8	150	1131
330x250	10	150	2138

Additional purification

Antibody purification on WorkBeads affimAb frequently gives high purity in a single step. For very high purity requirements, it may be necessary to add a second purification step. The additional purification step is used to remove traces of leached protein A ligand, host cell proteins and nucleic acids, aggregates of the target antibody, and other remaining impurities from the sample. In research-scale purification, size exclusion chromatography (gel filtration) is often a good polishing step since it removes impurities and potential aggregates of the target protein. Size exclusion chromatography can be done using e.g. WorkBeads 40/100 SEC.

Ion exchange chromatography is suitable for both research scale purification and industrial purification. WorkBeads TREN, WorkBeads 40S, WorkBeads 40Q and WorkBeads 40 DEAE resins provide different selectivities for ion exchange chromatography.

These resins are also available as ready-to-use columns in the GoBio prepacked columns family visit www.bio-works.com

The polishing purification step can be based on several chromatographic techniques depending on the target molecule and the contaminants.

Size exclusion chromatography

Size exclusion chromatography (SEC) can be used for the separation of monomeric antibodies from dimeric antibodies and aggregates as well as complexes of leached protein A and antibody. SEC separates proteins and other biomolecules according to size, hence the monomeric antibodies will elute after antibody dimers, aggregates and complexes of leached protein A and antibody.

This technique is simple to run. It is carried out under neutral conditions and is recommended for high purity demands in lab-scale purification, (e.g. using WorkBeads 40/100 SEC). Optimization is often not required for this technique, although it may sometimes be worthwhile. SEC is not recommended for bioprocess scale applications due to dilution effects, low capacity and that it is time consuming.

Cation exchange chromatography

Cation exchange chromatography is commonly used as a polishing step in antibody purification processes. Many antibodies are weakly basic at neutral pH and will bind to a cation exchange chromatography resin, (e.g., WorkBeads 40S). Conversely, protein A does not bind to a cation exchange resin under the same conditions. Dissociation between antibodies and potential leached protein A can therefore be carried out by cation exchange chromatography technique under neutral pH. This technique usually requires optimization for each specific antibody to be purified.

Anion exchange chromatography

Anion exchange chromatography technique is often used in a negative chromatography mode, during the polishing antibody purification. Potential leakage of protein A as well as complexes between protein A and the antibody tend to bind to an anion exchange chromatography resin (e.g., WorkBeads 40Q) at neutral pH, whereas the antibody itself usually does not bind and will elute in the flow through. Also, the use of this technique as a polishing step, usually require optimization for optimal antibody purification.

Multimodal anion exchange chromatography

WorkBeads 40 TREN is another type of anion exchanger that offers a unique separation possibility with the immobilized TREN ligand. This resin is useful as a “guard” column before loading the crude antibody sample directly on the protein A resin to prevent fouling and increase the lifetime of the protein A resin. Several of the host cell proteins as well as chromatins (large DNA-protein complexes) will bind to WorkBeads 40 TREN.

Desalting and buffer exchange

Buffer exchange or desalting of a sample can be used before analysis and/or after purification. This can be carried out quickly and easily in lab-scale using GoBio Mini Dsalt 1 mL, GoBio Mini Dsalt 5 mL, GoBio Prep 16x100 Dsalt (20 mL) and GoBio Prep 26x100 Dsalt (53 mL) prepacked columns depending on sample volumes. GoBio Prod prepacked columns starting from 1 L are available for larger sample volumes, see “Related products”.

These columns are very useful alternatives to dialysis for larger sample volumes or when samples need to be processed rapidly to avoid degradation.

Pre-swollen WorkBeads Dsalt is also available in bulk for packing column format of choice.

To find out more about Bio-Works’ chromatography products visit www.bio-works.com

Maintenance

Cleaning using NaOH

During purification impurities such as cell debris, lipids, nucleic acids and protein precipitates from the samples may gradually build up in the resin. The severity of this process depends on the type of sample applied to the packed column, and the pre-treatment of the sample. The bound impurities may reduce the performance of the column over time. Regular cleaning (Cleaning-in-place, CIP) keeps the resin clean, reduces the rate of further contamination, and retains the capacity, resolution and flow properties of the column. Cleaning the resin using 0.5 M NaOH gives efficient cleaning.

Sanitization (reduction of microorganisms) can be done using combinations of NaOH and ethanol, e.g., incubation with a mixture of 0.5 M NaOH and 40% ethanol for 3 hours. The sanitization procedure and its effectiveness will depend on the microorganisms to be removed and needs to be evaluated for each case. Prolonged wash with alkaline conditions will reduce the functionality of the column and must therefore be kept to a minimum (see Figure 3).

Regeneration of WorkBeads affimAb

After purification using WorkBeads affimAb perform the following steps:

1. Unless elution was carried out at very low pH there may be a need for regeneration by cleaning the column with, for example, 10 CV 100 mM glycine-HCl, pH 2.7 or 100 mM sodium citrate, pH 3.
2. Wash the column with 5 CV deionized water.
3. Cleaning-in-place by passing 5 – 10 CV 0.5 M NaOH over 15 – 30 minutes.

   For increased efficiency, before the NaOH wash, include a passage of 10 CV 100 mM 1-thioglycerol, pH 8.5 over 15 minutes to reduce any oxidized aggregates adsorbed to the column.
4. Wash with 10 CV neutral buffer. Make sure that neutral pH is restored in the column. Prolonged exposure to extreme pH may harm the resin.
5. Wash with 10 CV deionized water.
6. Wash with 10 CV 20% ethanol before storage.

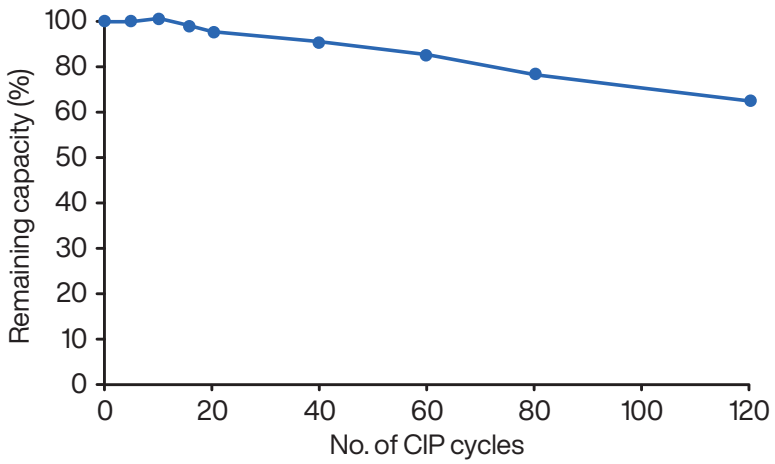

Figure 3. DBC for polyclonal human IgG on WorkBeads affimAb determined by frontal analysis at 2.5 minutes residence time after 120 CIP cycles with 0.5 M NaOH at 15 minutes contact time.

Storage

Store at 2 to 8°C in 20% ethanol.

Note: Use a reduced flow rate during equilibration with 20% ethanol, maximum 50% of the maximum flow rate

Product descriptions

	WorkBeads affimAb
Target substance	Antibodies (IgG), bound via the F_c-region
Matrix	Rigid, highly cross-linked agarose
Average particle size (D_{v50})[1]	50 µm
Ligand	Recombinant protein A expressed in *E. coli* using animal-free medium
Dynamic binding capacity (DBC)[2]	> 40 mg human IgG/mL resin
Max recommended flow rate[3]	300 cm/h
Chemical stability	Compatible with all standard aqueous buffers used for protein purification, 10 mM HCl (pH 2), 0.5 M NaOH (pH 12), 0.1 M sodium citrate buffer (pH 3), 6 M guanidine-HCl, 20% ethanol. Should not be stored at low pH for prolonged time.
pH stability	3 – 12
Cleaning-in-place stability	Up to 0.5 M NaOH
Storage	2 to 8 °C in 20 % ethanol

[1] The median particle size of the cumulative volume distribution.
[2] DBC was determined at 10% breakthrough ($Q_{B10\%}$) by frontal analysis with 1 mg/mL human polyclonal IgG in PBS, pH 7.4 at 1.4 mL/min (245 cm/h, 2.5 minutes residence time) in a column packed with WorkBeads affimAb resin, column bed 6.6 × 100 mm.
[3] Max recommended flow rate at 20 °C using aqueous buffers. Decrease the max flow rate if the liquid has a higher viscosity. Higher viscosities can be caused by low temperature (use half of the max flow rate when operating at 4 °C), or by additives (e.g., use half of the max flow rate for 20% ethanol).

GoBio prepacked column family

GoBio prepacked column family is developed for convenient, reproducible and fast results and includes columns with different sizes and formats.

GoBio Mini 1 mL and GoBio Mini 5 mL for small scale purification and screening using a shorter packed bed.

GoBio Screen 7x100 (3.8 mL) for reproducible process development including fast and easy optimization of methods and parameters.

GoBio Prep 16x100 (20 mL) and GoBio Prep 26x100 (53 mL) for lab-scale purifications and scaling up.

GoBio Prep 16x600 (120 mL) and GoBio Prep 26x600 (320 mL) for preparative lab-scale size exclusion chromatography.

GoBio Prod 80x200 (1 L), GoBio Prod 130x200 (2.7 L), GoBio Prod 200x200 (6 L), GoBio Prod 240x200 (9 L) and GoBio Prod 330x250 (21.4 L) for production-scale purifications.

Related products

Product name	Pack size[1]	Article number
Prepacked columns		
GoBio Mini affimAb 1 mL	1 mL × 5 1 mL × 5 1 mL × 10	45 800 101 45 800 103 45 800 104
GoBio Mini affimAb 5 mL	5 mL × 1 5 mL × 5 5 mL × 10	45 800 105 45 800 107 45 800 108
GoBio Mini S 5 mL	5 mL × 5	45 200 107
GoBio Mini Q 5 mL	5 mL × 5	45 100 107
GoBio Mini DEAE 5 mL	5 mL × 5	45 150 107
GoBio Mini TREN 5 mL	5 mL × 5	45 655 217
GoBio Mini Dsalt 5 mL	5 mL × 5	45 360 107
GoBio Screen 7x100 affimAb[2]	3.8 mL × 1	55 800 001
GoBio Prep 16x100 affimAb[2]	20 mL × 1	55 800 021
GoBio Prep 26x100 affimAb[2]	53 mL × 1	55 800 031
GoBio Prep 16x100 40S	20 mL × 1	55 420 021
GoBio Prep 16x100 40Q	20 mL × 1	55 410 021
GoBio Prep 16x100 40 TREN	20 mL × 1	55 463 021
GoBio Prep 16x100 Dsalt[2]	20 mL × 1	55 700 021
GoBio Prep 26x100 40S	53 mL × 1	55 420 031
GoBio Prep 26x100 40Q	53 mL × 1	55 410 031
GoBio Prep 26x100 40 TREN[2]	53 mL × 1	55 463 031
GoBio Prep 26x100 Dsalt2[2]	53 mL × 1	55 700 031
GoBio Prod 80x200 affimAb[2]	1 L	55 800 042
GoBio Prod 130x200 affimAb[2]	2.7 L	55 800 062
GoBio Prod 200x200 affimAb[2]	6 L	55 800 072
GoBio Prod 240x200 affimAb[2]	9 L	55 800 082
GoBio Prod 330x250 affimAb[2]	21.4 L	55 800 093
GoBio Prod 80x200 Dsalt[2]	1 L	55 700 042
GoBio Prod 130x200 Dsalt[2]	2.7 L	55 700 062
GoBio Prod 200x200 Dsalt[2]	6 L	55 700 072
GoBio Prod 240x200 Dsalt[2]	9 L	55 700 082
GoBio Prod 330x250 Dsalt[2]	21.4 L	55 700 093
Bulk resins		
WorkBeads 40S	25 mL 200 mL 1 L	40 200 001 40 200 002 40 200 010
WorkBeads 40Q	25 mL 200 mL 1 L	40 100 001 40 100 002 40 100 010
WorkBeads 40 DEAE	25 mL 200 mL 1 L	40 150 001 40 150 002 40 150 010
WorkBeads 40 TREN	25 mL 150 mL 1 L	40 603 001 40 603 003 40 603 010
WorkBeads Dsalt	300 mL 1 L	40 360 003 40 360 010

[1] All different pack sizes are available on www.bio-works.com
[2] Packed on request.

Ordering information

Product name	Pack size	Article number
WorkBeads affimAb	25 mL	40 800 001
	200 mL	40 800 002
	1 L	40 800 010
	5 L	40 800 050
	10 L	40 800 060

Orders: sales@bio-works.com or contact your local distributor.

For more information about local distributor and products visit www.bio-works.com or contact us at info@bio-works.com

bio-works.com

Bio-Works, Virdings allé 18, 754 50 Uppsala, Sweden. For local office contact information, visit bio-works.com/contact.

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