Packing HiScale™, XK, and Tricorn™ chromatography columns with Capto™ and MabSelect™ resins

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Table of contents

Introduction

To obtain optimal performance during your protein purification, it is critical to use well-packed columns. For an optimal column packing, there are several parameters that need to be controlled during packing. These packing parameters are specific to the resin, and the type and dimension of the column that needs to be packed.

This guide summarizes parameters for packing small-scale HiScale, XK, and Tricorn columns with Capto and MabSelect resins from GE Healthcare Life Sciences.

Impact of column packing on results and efficiency

The way that liquid flows through a chromatography column depends on how it is packed. A well-packed bed generates a stable column that offers good resolution. An even flow of liquid through the column will generate peaks that are narrow and sharp, as shown in Fig 1B.

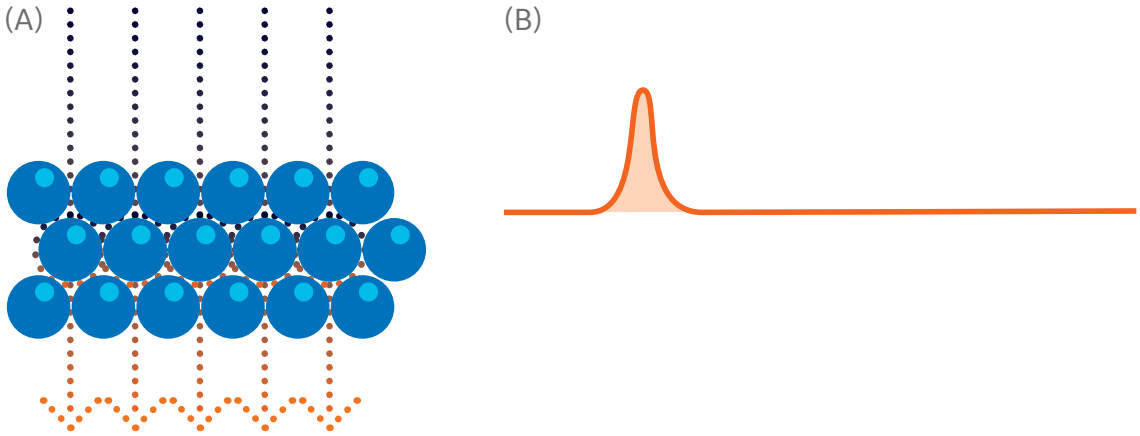


Fig 1. Consequence of a well packed resin bed: (A) Even flow of liquid; (B) Narrow and sharp peaks on the chromatogram.

A poorly packed bed generates an uneven flow through the column. Peaks will be broad, as shown in Fig 2B.

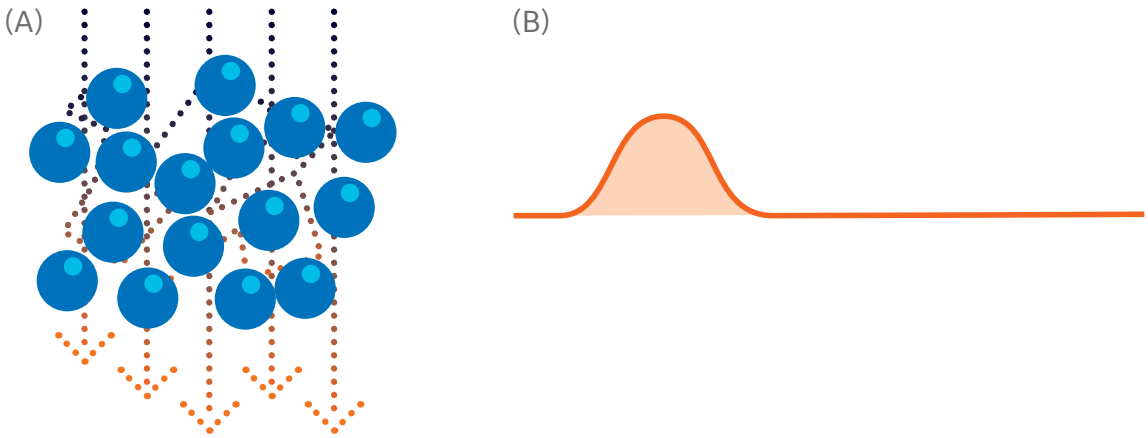


Fig 2. Consequence of a poorly packed resin bed: (A) Uneven flow of liquid; (B) Broad peaks on the chromatogram.

A well-packed column ensures reproducible column performance run after run. When liquid moves unevenly through the column, protein peaks will be broad and might overlap with other neighboring peaks. Therefore, the purity of the target protein could be negatively impacted when using a poorly packed column.

RETURN TO TABLE OF CONTENTS

Terminology used in the guide

Slurry concentration

The slurry concentration is used to facilitate the calculation of the amount or resin needed to pack a certain bed height. For successful packing, different resins require different slurry concentrations. To determine the slurry concentration, we recommend that you use the Slurry Concentration Kit. You can also watch our video *Column packing tutorial: Determining slurry concentration using a slurry kit*.

Other methods involving centrifugation and sedimentation are also possible to use.

Note: The level of accuracy for determining the slurry concentration is not as critical as it is when packing large-scale columns. Small-scale columns may be packed with an excess of resin, which is removed after packing.

Compression

Depending on the column type and resin, the compression may be performed in two different ways:

- Mechanical compression with packing factor: after applying the settling flow, note the height of the consolidated bed before stopping the flow (after the flow is stopped the bed can slightly expand). The final bed height is calculated by dividing the consolidated bed height with the packing factor (PF):

  Final bed height = Consolidated bed height/packing factor (PF)

  Set the adapter against the consolidated packed bed, tighten the O-ring, and turn the end cap down until the calculated final bed height is reached.
- Flow compression: after applying the packing flow, the adapter is moved a specific distance (mm) into the packed bed to avoid gap formation.

Custom Design Media (CDM) group

If the chromatography resin you require is not part of our standard product offering, our specialists can custom design your chromatography resin from an appropriate base matrix and ligand.

Please note that CDM products are not supplied with instruction manuals.

Planning to scale up?

If you are working in process development and intend to scale-up, consider from the start the bed heights and flow rates that you will require at larger scales.

For consistent results when scaling up, we recommend that you keep residence time and/or bed heights constant.

Also, please note these packing methods are adapted to small-scale columns (< 5 cm i.d.) and are not always scalable to large-scale columns. If you need to scale-up, refer to the packing recommendations for large-scale Axichrom™, BPG, and Chromaflow™ columns.

RETURN TO TABLE OF CONTENTS

Column packing recommendations

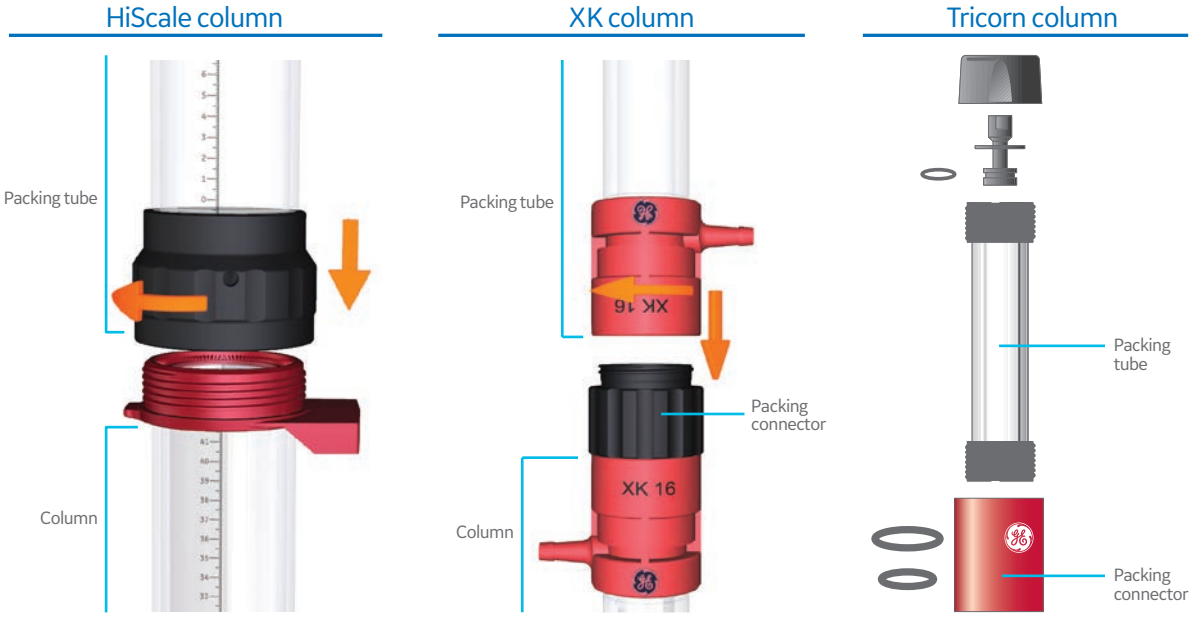
Slurry preparation

Ensure that the resin is washed thoroughly into the packing solution before starting the packing. Use a glass filter to wash the resin over to the packing solution. Suspend the resin by shaking and pour into the funnel and wash according to the following instructions:

1. Wash 5 times with 2 column volumes (CV) of packing solution. Gently stir with a plastic spatula between additions.
2. Pour the washed resin from the funnel into a beaker.
3. Add packing solution to obtain the indicated slurry concentration for specific resin and column type.

Use a packing tube

When packing HiScale, XK, and Tricorn, we recommend you use a packing connector together with an extra glass tube to serve as a packing reservoir (Fig 3). By using the packing tube, you can add the whole slurry volume in a single pouring. For detailed description on how to pack each column, we recommend that you download the column instructions document for the respective column types:



HiScale instruction 28967470
Packing video

XK column instruction 28992023

Tricorn column instruction 28409488

Fig 3. Connection of the packing tube for HiScale, XK, and Tricorn columns.

Test the efficiency of the packed column

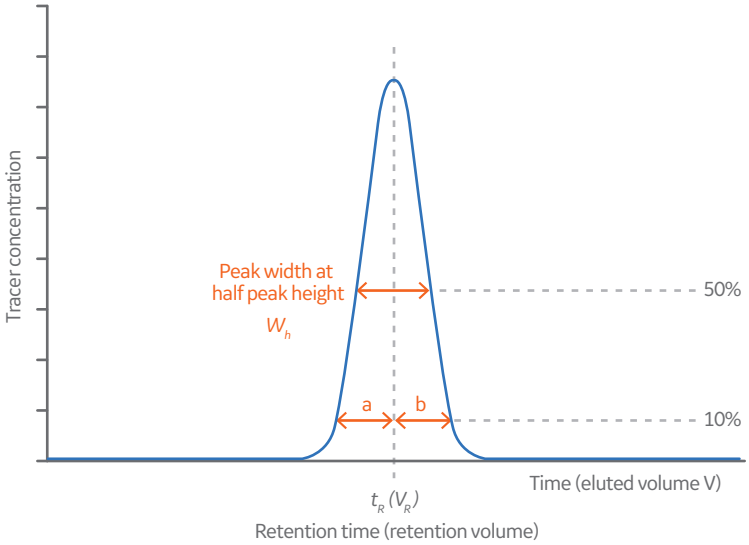
Column efficiency testing plays a central role in the qualification and monitoring of packed bed performance. The desirable high column efficiency gives low band/peak broadening and is an indicator of how well packed the column is before starting purification.

Column efficiency is typically defined in terms of two parameters (Fig 4):

- Peak broadening over the column is described by an equivalent number of theoretical plates.
- Peak symmetry is described by a peak asymmetry factor, A_s

The procedure is described in each GE resin protocol and is also described in this Column efficiency testing application note 28937207.

RETURN TO TABLE OF CONTENTS



$$h = \frac{L}{5.54\, d_p}\left(\frac{W_h}{V_R}\right)^2 \qquad A_S = b/a$$

$$N \approx 5.54\left(\frac{V_R}{W_h}\right)^2 \qquad HETP = \frac{L}{N} \qquad h = \frac{HETP}{d_p}$$

N = plate number
t_R = retention time
V_R = retention volume
W_h = peak width at half peak height
L = bed height
d_p = particle diameter
A_s = asymmetry factor
a = first half peak width at 10% peak height
b = second half peak width at 10% peak height

Fig 4. Determination of column efficiency by number of theoretical plates per meter *(N/m)* and peak asymmetry factor (A_s).

Not enough time to pack your own columns?

Packing a column can be both difficult and time-consuming and needs practice. For SEC, columns can take up to a full day to pack. For other techniques, packing can require over an hour (see figure).

Instead of spending hours of your time packing and testing your column before you can start to purify your protein, consider purchasing a manufactured prepacked column. This eliminates the need for repeated column packing and ensures that you have a well-packed column for immediate use.

If the prepacked column you need is not available as a regular product, contact our Custom Products group. We can customize columns and resins to your specific requirements.

	Packing your own columns		Buying a prepacked column
	SEC	**HIC/IEX/AC**	**Various chromatography techniques**
Prepare slurry	~ 1 h	5 min	–
Prepare column	15–30 min	15–30 min	–
Pack the column	1–4 h	~ 30 min	–
Test the column	45–120 min	30 min	–
Time until column is ready to use	3–7.5 h	60–90 min	Column ready to use!

RETURN TO TABLE OF CONTENTS

Capto Q ImpRes, Capto SP ImpRes, and Capto S ImpAct

Packing parameters

Your parameters				Resin preparation		Column packing						Post-column packing	
						Settling flow The flow that consolidates the resin suspension (slurry)		**Packing flow** The flow that compresses the bed		**Compression** Bed is further compressed by turning the adapter manually into the bed		**Conditioning flow** The flow to get a uniform bed over the entire column height	
Resin	**Packed bed height (cm)**	**Column type**	**Bed volume (mL)**	**Slurry/packing solution**	**Slurry concentration (%)**	**mL/min**	**cm/h**	**mL/min**	**cm/h**	**Mechanical compression packing factor (PF)[1]**	**Flow compression (mm)**	**mL/min**	**cm/h**
Capto Q ImpRes **Capto SP ImpRes** Particle size d_{50v}[2]: 40 µm	10	Tricorn 5	2.0	10 mM NaCl	45–55	7.4	2250	7.4	2250	N/A	1	N/A	N/A
		Tricorn 10	7.9			29.4		29.4					
		HiScale 10	7.9	20% ethanol with 0.4 M NaCl	63	10.3	783	14.5	1108	1.05	N/A	14.5	1108
		XK 16 and HiScale 16	20.1	10 mM NaCl	45–55	40	1200	N/A	N/A	1.12		40	1200
		XK 26 and HiScale 26	53.1			106				1.12		106	
		XK 50 and HiScale 50	196.3			393				1.12		393	
	20	HiScale 10	15.7	20% ethanol with 0.4 M NaCl	63	10.3	783	14.5	1108	1.05		14.5	1108
		XK 16 and HiScale 16	40.2	10 mM NaCl	45–55	33	1000	N/A	N/A	1.12		33	1000
		XK 26 and HiScale 26	106.1			88				1.12		88	
		XK 50 and HiScale 50	392.5			327				1.12		327	
	25	HiScale 10	19.6	20% ethanol with 0.4 M NaCl	63	10.3	783	14.5	1108	1.04		14.5	1108
	35	XK 16 and HiScale 16	70.3	10 mM NaCl	45–55	23	700	N/A	N/A	1.09		23	700
		XK 26 and HiScale 26	185.7			62				1.09		62	
		XK 50 and HiScale 50	686.9			229				1.09		229	
Capto S ImpAct Particle size d_{50v}: 50 µm	10	Tricorn 5	2.0	0.4 M NaCl	45–55	3.5	1070	3.5	1070	N/A	1	N/A	N/A
		Tricorn 10	7.9			14		14					
		XK 16 and HiScale 16	20.1	20% ethanol with 0.2 M sodium acetate	45–55	10	300	25	750	N/A	N/A	N/A	N/A
		XK 26 and HiScale 26	53.1			27		53	600				
		XK 50 and HiScale 50	196.3			98		196					
	20	XK 16 and HiScale 16	40.2			7.4	220	16.7	500				
		XK 26 and HiScale 26	106.1			19		35	400				
		XK 50 and HiScale 50	392.5			72		98	300				
	35	XK 16 and HiScale 16	70.3			3.3	100	8.4	250				
		XK 26 and HiScale 26	185.7			9		22					
		XK 50 and HiScale 50	686.9			33		65	200				

[1] The PF values in this table are specific for the lab-packing method used. The PF shown here bears no relation to the PF described for large-scale column packing procedures.
[2] d_{50v} = median particle size of the cumulative volume distribution.

RETURN TO TABLE OF CONTENTS

Capto Q, Capto S, Capto DEAE, Capto Core 400, and Capto Heparin

Packing parameters

Your parameters				Resin preparation		Column packing						Post-column packing	
						Settling flow The flow that consolidates the resin suspension (slurry)		**Packing flow** The flow that compresses the bed		**Compression** Bed is further compressed by turning the adapter manually into the bed		**Conditioning flow** The flow to get a uniform bed over the entire column height	
Resin	**Packed bed height (cm)**	**Column type**	**Bed volume (mL)**	**Slurry/packing solution**	**Slurry concentration (%)**	**mL/min**	**cm/h**	**mL/min**	**cm/h**	**Mechanical compression packing factor (PF)[2]**	**Flow compression (mm)**	**mL/min**	**cm/h**
Capto Q **Capto S** Particle size d_{50v}[3]: 90 µm	10	Tricorn 5	2.0	10 mM NaCl	40–60	1.8	540	9.8	3000	N/A	1	N/A	N/A
		Tricorn 10	7.9			7.1		39.3					
		XK 16 and HiScale 16	20.1	20% ethanol with 0.4 M NaCl	45–55	25	750	N/A	N/A	1.1	N/A	25	750
		XK 26 and HiScale 26	53.1			66				1.15		66	
		XK 50 and HiScale 50	196.3			250				1.15		250	
	20	XK 16 and HiScale 16	40.2			25				1.1		25	
		XK 26 and HiScale 26	106.1			66				1.1		66	
		XK 50 and HiScale 50	392.5			250				1.15		250	
	35	XK 16 and HiScale 16	70.3			25				1.06		14	420
		XK 26 and HiScale 26	185.7			66				1.06		37	
		XK 50 and HiScale 50	686.9			250				1.1		140	
Capto DEAE **Capto Heparin**[1] **Capto Core 400**[1] Particle size d_{50v}: 90 µm	10	Tricorn 5	2.0	20% ethanol with 0.2 M NaCl	45–60	5	1500	5	1500	N/A	1	N/A	N/A
		Tricorn 10	7.9			20		20					
		XK 16 and HiScale 16	20.1	20% ethanol with 0.4 M NaCl	45–55	25	750	N/A	N/A	1.1	N/A	25	750
		XK 26 and HiScale 26	53.1			66				1.15		66	
		XK 50 and HiScale 50	196.3			250				1.15		250	
	20	XK 16 and HiScale 16	40.2			25				1.1		25	
		XK 26 and HiScale 26	106.1			66				1.1		66	
		XK 50 and HiScale 50	392.5			250				1.15		250	
	35	XK 16 and HiScale 16	70.3			25				1.06		14	420
		XK 26 and HiScale 26	185.7			66				1.06		37	
		XK 50 and HiScale 50	686.9			250				1.1		140	

[1] Part of the CDM program from GE. Packing protocols for CDM-developed resins are not verified but are based on packing protocols for standard products having similar pressure-flow characteristics.
[2] The PF values in this table are specific for the lab-packing method used. The PF shown here bears no relation to the PF described for large-scale column packing procedures.
[3] d_{50v} = median particle size of the cumulative volume distribution.

RETURN TO TABLE OF CONTENTS

MabSelect PrismA and MabSelect

Packing parameters

Your parameters				Resin preparation		Column packing						Post-column packing	
						Settling flow The flow that consolidates the resin suspension (slurry)		**Packing flow** The flow that compresses the bed		**Compression** Bed is further compressed by turning the adapter manually into the bed		**Conditioning flow** The flow to get a uniform bed over the entire column height	
Resin	**Packed bed height (cm)**	**Column type**	**Bed volume (mL)**	**Slurry/packing solution**	**Slurry concentration (%)**	**mL/min**	**cm/h**	**mL/min**	**cm/h**	**Mechanical compression packing factor (PF)[1]**	**Flow compression (mm)**	**mL/min**	**cm/h**
MabSelect PrismA Particle size d_{50v}[2]: 60 µm	10	Tricorn 5	2.0	20% ethanol with 0.2 M NaCl	45–55	1.96	600	1.96	600	N/A	1	N/A	N/A
		Tricorn 10	7.9			7.85		7.85					
		HiScale 10	7.9	20% ethanol with 0.4 M NaCl	50	2.62	200	2.62	200	1.1	N/A	9.16	700
		XK 16 and HiScale 16	20.1		45–55	6.7		N/A	N/A	1.12		16.8	500
		XK 26 and HiScale 26	53.1			17.7				1.15		44.2	
		XK 50 and HiScale 50	196.3			65.4				1.16		114.5	
	20	HiScale 10	15.7		50	2.62		2.62	200	1.1		5.24	400
		XK 16 and HiScale 16	40.2		45–55	6.7		N/A	N/A	1.1		13.4	400
		XK 26 and HiScale 26	106.1			17.7				1.1		35.4	
		XK 50 and HiScale 50	392.5			65.4				1.14		98.2	300
	25	HiScale 10	19.6		70	2.62		2.62	200	1.1		4.19	320
	35	XK 16 and HiScale 16	70.3		45–55	6.7		N/A	N/A	1.1		7.7	230
		XK 26 and HiScale 26	185.7			17.7				1.1		20.4	
		XK 50 and HiScale 50	686.9			65.4				1.1		75.3	
MabSelect Particle size d_{50v}: 85 µm	10	Tricorn 5	2.0	20% ethanol with 0.2 M NaCl	45–55	2.29	700	2.29	700	N/A	1	N/A	N/A
		Tricorn 10	7.9			9.16		9.16					
		XK 16 and HiScale 16	20.1	20% ethanol with 0.4 M NaCl	45–55	10	300	N/A	N/A	1.1	N/A	25	750
		XK 26 and HiScale 26	53.1			27				1.15		26	
		XK 50 and HiScale 50	196.3			100				1.15		250	
	20	XK 16 and HiScale 16	40.2			10				1.1		15	450
		XK 26 and HiScale 26	106.1			27				1.13		40	
		XK 50 and HiScale 50	392.5			100				1.1		150	
	35	XK 16 and HiScale 16	70.3			10				1.06		8.6	260
		XK 26 and HiScale 26	185.7			27				1.1		23	
		XK 50 and HiScale 50	686.9			100				1.06		86	

[1] The PF values in this table are specific for the lab-packing method used. The PF shown here bears no relation to the PF described for large-scale column packing procedures.
[2] d_{50v} = median particle size of the cumulative volume distribution.

RETURN TO TABLE OF CONTENTS

MabSelect Xtra, VIII Select, MabSelect SuRe, MabSelect SuRe LX, and Capto L

Packing parameters

Your parameters				Resin preparation		Column packing						Post-column packing	
						Settling flow The flow that consolidates the resin suspension (slurry)		**Packing flow** The flow that compresses the bed		**Compression** Bed is further compressed by turning the adapter manually into the bed		**Conditioning flow** The flow to get a uniform bed over the entire column height	
Resin	**Packed bed height (cm)**	**Column type**	**Bed volume (mL)**	**Slurry/packing solution**	**Slurry concentration (%)**	**mL/min**	**cm/h**	**mL/min**	**cm/h**	**Mechanical compression packing factor (PF)[2]**	**Flow compression (mm)**	**mL/min**	**cm/h**
MabSelect Xtra **VIII Select**[1] Particle size d_{50v}[3]: 75 µm	10	Tricorn 5	2.0	0.2 M NaCl	25–50	0.5	150	3	900	N/A	1	N/A	N/A
		Tricorn 10	7.9			2		12					
		XK 16 and HiScale 16	20.1	20% ethanol with 0.4 M NaCl	45–55	10	300	N/A	N/A	1.1	N/A	25	750
		XK 26 and HiScale 26	53.1			27				1.15		66	
		XK 50 and HiScale 50	196.3			100				1.15		250	
	20	XK 16 and HiScale 16	40.2			10				1.1		15	450
		XK 26 and HiScale 26	106.1			27				1.13		40	
		XK 50 and HiScale 50	392.5			100				1.15		150	
	35	XK 16 and HiScale 16	70.3			10				1.06		8.6	260
		XK 26 and HiScale 26	185.7			27				1.1		23	
		XK 50 and HiScale 50	686.9			100				1.06		86	
MabSelect SuRe **MabSelect SuRe LX** **Capto L** Particle size d_{50v}: 90 µm	10	Tricorn 5	2.0	20% ethanol with 0.2 M NaCl	45–55	2.29	700	2.29	700	N/A	1	N/A	N/A
		Tricorn 10	7.9			9.16		9.16					
		HiScale 10	7.9	20% ethanol with 0.4 M NaCl	58	16	1222	16	1222	1.0	N/A	16	1222
		XK 16 and HiScale 16	20.1		45–55	10	300	N/A	N/A	1.1	N/A	25	750
		XK 26 and HiScale 26	53.1			27				1.15		66	
		XK 50 and HiScale 50	196.3			100				1.15		250	
	20	HiScale 10	15.7		58	16	1222	16	1222	1.0		16	1222
		XK 16 and HiScale 16	40.2		45–55	10	300	N/A	N/A	1.1		15	450
		XK 26 and HiScale 26	106.1			27				1.13		40	
		XK 50 and HiScale 50	392.5			100				1.1		150	
	25	HiScale 10	19.6		58	14	1070	14	1070	1.0		14	1070
	35	XK 16 and HiScale 16	70.3		45–55	10	300	N/A	N/A	1.06		8.6	260
		XK 26 and HiScale 26	185.7			27				1.1		23	
		XK 50 and HiScale 50	686.9			100				1.06		86	

[1] Part of the CDM program from GE. Packing protocols for CDM-developed resins are not verified but are based on packing protocols for standard products having similar pressure-flow characteristics.
[2] The PF values in this table are specific for the lab-packing method used. The PF shown here bears no relation to the PF described for large-scale column packing procedures.
[3] d_{50v} = median particle size of the cumulative volume distribution.

RETURN TO TABLE OF CONTENTS

Capto Core 700 and Capto MMC

Packing parameters

Your parameters				Resin preparation		Column packing						Post-column packing	
						Settling flow The flow that consolidates the resin suspension (slurry)		**Packing flow** The flow that compresses the bed		**Compression** Bed is further compressed by turning the adapter manually into the bed		**Conditioning flow** The flow to get a uniform bed over the entire column height	
Resin	**Packed bed height (cm)**	**Column type**	**Bed volume (mL)**	**Slurry/packing solution**	**Slurry concentration (%)**	**mL/min**	**cm/h**	**mL/min**	**cm/h**	**Mechanical compression packing factor (PF)[1]**	**Flow compression (mm)**	**mL/min**	**cm/h**
Capto Core 700 Particle size d_{50v}[2]: 85 µm	10	Tricorn 5	2.0	20% ethanol with 0.2 M NaCl	45–55	2.29	700	2.29	700	N/A	1	N/A	N/A
		Tricorn 10	7.9			9.16		9.16					
		XK 16 and HiScale 16	20.1	20% ethanol with 0.4 M NaCl	45–55	10	300	N/A	N/A	1.15	N/A	25	750
		XK 26 and HiScale 26	53.1			27				1.15		66	
		XK 50 and HiScale 50	196.3			100				1.15		250	
	20	XK 16 and HiScale 16	40.2			10				1.1		15	450
		XK 26 and HiScale 26	106.1			27				1.1		40	
		XK 50 and HiScale 50	392.5			100				1.1		150	
	35	XK 16 and HiScale 16	70.3			10				1.06		8.6	260
		XK 26 and HiScale 26	185.7			27				1.06		23	
		XK 50 and HiScale 50	686.9			100				1.06		86	
Capto MMC Particle size d_{50v}: 75 µm	10	Tricorn 5	2.0	10 mM NaCl	40–60	1.8	540	9.8	3000	N/A	1	N/A	N/A
		Tricorn 10	7.9			7.1		39.3					
		XK 16 and HiScale 16	20.1	20% ethanol with 0.4 M NaCl	45–55	25	750	N/A	N/A	1.1	N/A	25	750
		XK 26 and HiScale 26	53.1			66				1.15		66	
		XK 50 and HiScale 50	196.3			250				1.15		250	
	20	XK 16 and HiScale 16	40.2			25				1.1		25	
		XK 26 and HiScale 26	106.1			66				1.1		66	
		XK 50 and HiScale 50	392.5			250				1.15		250	
	35	XK 16 and HiScale 16	70.3			25				1.02		14	420
		XK 26 and HiScale 26	185.7			66				1.03		37	
		XK 50 and HiScale 50	686.9			250				1.03		140	

[1] The PF values in this table are specific for the lab-packing method used. The PF shown here bears no relation to the PF described for large-scale column packing procedures.
[2] d_{50v} = median particle size of the cumulative volume distribution.

RETURN TO TABLE OF CONTENTS

Capto adhere and Capto adhere ImpRes

Packing parameters

Your parameters				Resin preparation		Column packing						Post-column packing	
						Settling flow The flow that consolidates the resin suspension (slurry)		**Packing flow** The flow that compresses the bed		**Compression** Bed is further compressed by turning the adapter manually into the bed		**Conditioning flow** The flow to get a uniform bed over the entire column height	
Resin	**Packed bed height (cm)**	**Column type**	**Bed volume (mL)**	**Slurry/packing solution**	**Slurry concentration (%)**	**mL/min**	**cm/h**	**mL/min**	**cm/h**	**Mechanical compression packing factor (PF)[1]**	**Flow compression (mm)**	**mL/min**	**cm/h**
Capto adhere Particle size d_{50v}[2]: 75 µm	10	Tricorn 5	2.0	10 mM NaCl	40-60	0.25	76	10	3000	N/A	1	N/A	N/A
		Tricorn 10	7.9			1		40					
		HiScale 10	7.9	20% ethanol with 0.4 M NaCl	60	20	1528	20	1528	1.0	N/A	20	1528
		XK 16 and HiScale 16	20.1	20% ethanol with 0.4 M NaCl	45–55	25	750	N/A	N/A	1.1	N/A	25	750
		XK 26 and HiScale 26	53.1			66				1.15		66	
		XK 50 and HiScale 50	196.3			250				1.15		250	
	20	HiScale 10	15.7		60	20	1528	20	1528	1.0		20	1528
		XK 16 and HiScale 16	40.2		45–55	25	750	N/A	N/A	1.1		25	750
		XK 26 and HiScale 26	106.1			66				1.1		66	
		XK 50 and HiScale 50	392.5			250				1.15		250	
	25	HiScale 10	19.6		60	20	1528	20	1528	1.0		20	1528
	35	XK 16 and HiScale 16	70.3		45–55	25	750	N/A	N/A	1.02		14	420
		XK 26 and HiScale 26	185.7			66				1.03		37	
		XK 50 and HiScale 50	686.9			250				1.03		140	
Capto adhere ImpRes Particle size d_{50v}: 40 µm	10	Tricorn 5	2.0	10 mM NaCl	45–55	7.4	2250	7.4	2250	N/A	1	N/A	N/A
		Tricorn 10	7.9			29.4		29.4					
		HiScale 10	7.9	20% ethanol with 0.4 M NaCl	63	10.3	783	14.5	1108	1.05	N/A	14.5	1108
		XK 16 and HiScale 16	20.1		45–55	20	600	N/A	N/A	1.12	N/A	20	600
		XK 26 and HiScale 26	53.1			53				1.12		53	
		XK 50 and HiScale 50	196.3			196				1.12		196	
	20	HiScale 10	15.7		63	10.3	783	14.5	1108	1.05		14.5	1108
		XK 16 and HiScale 16	40.2		45–55	17	500	N/A	N/A	1.12		17	500
		XK 26 and HiScale 26	106.1			44				1.12		44	
		XK 50 and HiScale 50	392.5			164				1.12		164	
	25	HiScale 10	19.6		63	10.3	783	14.5	1108	1.05		14.5	1108
	35	XK 16 and HiScale 16	70.3		45–55	12	350	N/A	N/A	1.09		12	350
		XK 26 and HiScale 26	185.7			31				1.09		31	
		XK 50 and HiScale 50	686.9			115				1.09		115	

[1] The PF values in this table are specific for the lab-packing method used. The PF shown here bears no relation to the PF described for large-scale column packing procedures.
[2] d_{50v} = median particle size of the cumulative volume distribution.

RETURN TO TABLE OF CONTENTS

Capto MMC ImpRes, Capto Phenyl ImpRes, and Capto Butyl ImpRes

Packing parameters

Your parameters				Resin preparation		Column packing						Post-column packing	
						Settling flow The flow that consolidates the resin suspension (slurry)		**Packing flow** The flow that compresses the bed		**Compression** Bed is further compressed by turning the adapter manually into the bed		**Conditioning flow** The flow to get a uniform bed over the entire column height	
Resin	**Packed bed height (cm)**	**Column type**	**Bed volume (mL)**	**Slurry/packing solution**	**Slurry concentration (%)**	**mL/min**	**cm/h**	**mL/min**	**cm/h**	**Mechanical compression packing factor (PF)[2]**	**Flow compression (mm)**	**mL/min**	**cm/h**
Capto MMC ImpRes Particle size d_{50v}[3]: 40 µm	10	Tricorn 5	2.0	10 mM NaCl	45-55	7.5	2250	7.5	2250	N/A	1	N/A	N/A
		Tricorn 10	7.9			29.4		29.4					
		XK 16 and HiScale 16	20.1	20% ethanol with 0.4 M NaCl	35–45	20	600	N/A	N/A	1.15	N/A	20	600
		XK 26 and HiScale 26	53.1			53				1.15		53	
		XK 50 and HiScale 50	196.3			196				1.15		196	
	20	XK 16 and HiScale 16	40.2			17	500			1.12		17	500
		XK 26 and HiScale 26	106.1			44				1.12		44	
		XK 50 and HiScale 50	392.5			164				1.12		164	
	35	XK 16 and HiScale 16	70.3			12	350			1.09		12	350
		XK 26 and HiScale 26	185.7			31				1.09		31	
		XK 50 and HiScale 50	686.9			115				1.09		115	
Capto Phenyl ImpRes[1] **Capto Butyl ImpRes**[1] Particle size d_{50v}: 40 µm	10	Tricorn 5	2.0	20% ethanol	45–55	3.8	1125	3.8	1125	N/A	1	N/A	N/A
		Tricorn 10	7.9			14.7		14.7					
		HiScale 10	7.9	20% ethanol with 0.4 M NaCl	63	10.3	783	16	1222	1.05	N/A	16	1222
		XK 16 and HiScale 16	20.1	20% ethanol	45–55	20	600	N/A	N/A	1.15	N/A	20	600
		XK 26 and HiScale 26	53.1			53				1.15		53	
		XK 50 and HiScale 50	196.3			196				1.15		196	
	20	HiScale 10	15.7	20% ethanol with 0.4 M NaCl	63	10.3	783	16	1222	1.05		16	1222
		XK 16 and HiScale 16	40.2	20% ethanol	45–55	17	500	N/A	N/A	1.12		17	500
		XK 26 and HiScale 26	106.1			44				1.12		44	
		XK 50 and HiScale 50	392.5			164				1.12		164	
	25	HiScale 10	19.6	20% ethanol with 0.4 M NaCl	63	10.3	783	14	1070	1.05		14	1070
	35	XK 16 and HiScale 16	70.3	20% ethanol	45–55	12	350	N/A	N/A	1.09		12	350
		XK 26 and HiScale 26	185.7			31				1.09		31	
		XK 50 and HiScale 50	686.9			115				1.09		115	

[1] Part of the CDM program from GE. Packing protocols for CDM-developed resins are not verified but are based on packing protocols for standard products having similar pressure-flow characteristics.
[2] The PF values in this table are specific for the lab-packing method used. The PF shown here bears no relation to the PF described for large-scale column packing procedures.
[3] d_{50v} = median particle size of the cumulative volume distribution.

RETURN TO TABLE OF CONTENTS

Capto Phenyl (High Sub), Capto Butyl, Capto Octyl, KappaSelect, LambdaFabSelect, IgSelect, Alpha-1-Antitrypsin Select, Capto Chelating, Capto Blue, Capto Blue (High Sub), CaptoDeVirs, and VII Select

Packing parameters

Your parameters				Resin preparation		Column packing						Post-column packing	
						Settling flow The flow that consolidates the resin suspension (slurry)		**Packing flow** The flow that compresses the bed		**Compression** Bed is further compressed by turning the adapter manually into the bed		**Conditioning flow** The flow to get a uniform bed over the entire column height	
Resin	**Packed bed height (cm)**	**Column type**	**Bed volume (mL)**	**Slurry/packing solution**	**Slurry concentration (%)**	**mL/min**	**cm/h**	**mL/min**	**cm/h**	**Mechanical compression packing factor (PF)[2]**	**Flow compression (mm)**	**mL/min**	**cm/h**
Capto Phenyl (High Sub)	10	Tricorn 5	2.0	20% ethanol with 0.2 M NaCl	45–55	1	300	N/A	N/A	1.05	N/A	2	600
Capto Butyl		Tricorn 10	7.9			4				1.08		8	
Capto Octyl[1]		XK 16 and HiScale 16	20.1	20% ethanol with 0.4 M NaCl	45–55	25	750			1.1		25	750
KappaSelect[1]													
Lambda-FabSelect[1]		XK 26 and HiScale 26	53.1			66				1.15		66	
IgSelect[1]		XK 50 and HiScale 50	196.3			250				1.15		250	
Alpha-1-Antitrypsin Select[1]	20	XK 16 and HiScale 16	40.2			25				1.1		25	
Capto Chelating[1]		XK 26 and HiScale 26	106.1			66				1.1		66	
Capto Blue		XK 50 and HiScale 50	392.5			250				1.15		250	
Capto Blue (High Sub)[1]	35	XK 16 and HiScale 16	70.3			25				1.02		14	420
CaptoDeVirs[1]		XK 26 and HiScale 26	185.7			66				1.03		37	
VII Select[1]		XK 50 and HiScale 50	686.9			250				1.03		140	
Particle size d_{50v}[3]: 75 µm													

[1] Part of the CDM program from GE. Packing protocols for CDM-developed resins are not verified but are based on packing protocols for standard products having similar pressure-flow characteristics.
[2] The PF values in this table are specific for the lab-packing method used. The PF shown here bears no relation to the PF described for large-scale column packing procedures.
[3] d_{50v} = median particle size of the cumulative volume distribution.

RETURN TO TABLE OF CONTENTS

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GE Healthcare Bio-Sciences AB, Björkgatan 30, 751 84 Uppsala, Sweden
GE Healthcare Bio-Sciences Corp., 100 Results Way, Marlborough, MA 01752, USA
GE Healthcare Europe GmbH, Munzinger Strasse 5, D-79111 Freiburg, Germany
GE Healthcare Japan Corp., Sanken Bldg., 3-25-1, Hyakunincho Shinjuku-ku, Tokyo 169-0073, Japan
GE Healthcare UK Ltd., Amersham Place, Little Chalfont, Buckinghamshire, HP7 9NA, UK
For local office contact information, visit gelifesciences.com/contact
KA4551032119SG