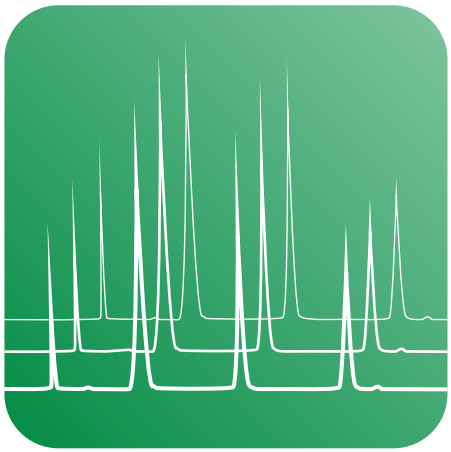
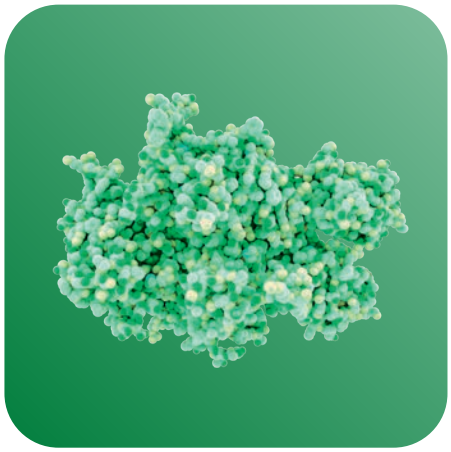
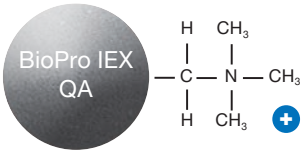


IEX

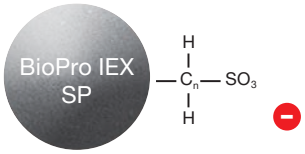


IEX – HPLC selectivities

- **Porous or non-porous hydrophilic polymers**
- **High binding capacity and recovery of biomolecules**
- **Very high resolution**
- **Low nonspecific adsorption**
- **Excellent reproducibility**



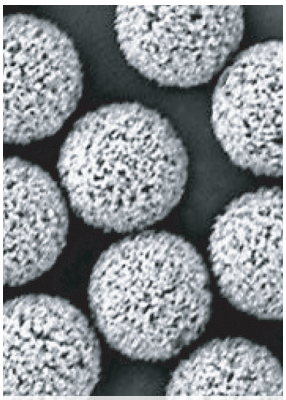
strong anion exchanger



strong cation exchanger

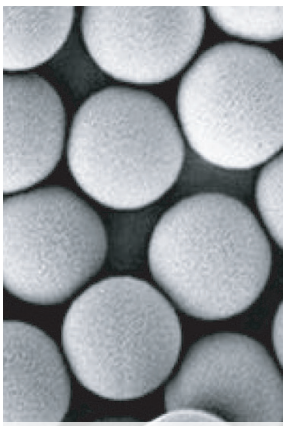
	BioPro IEX QA	BioPro IEX SP
Matrix	hydrophilic polymer (polymethacrylate)	hydrophilic polymer (polymethacrylate)
Particle size / µm	5	5
Pore size / nm	100	100
Charged group	$-CH_2N^+(CH_3)_3$	$-(CH_2)_3SO_3^-$
Counter ion	Cl^-	Na^+
Available pH range	2.0–12.0	2.0–12.0
Temperature range	4–60 °C	
Pressure limit	2.5–3.5 MPa (360–510 psi)	
Column hardware	PEEK	

Also available in 10, 20, 30 or 75 µm for preparative scale



Porous polymer beads

	BioPro IEX QF	BioPro IEX SF
Matrix	hydrophilic polymer (polymethacrylate)	hydrophilic polymer (polymethacrylate)
Particle size / µm	3, 5	3, 5
Pore size / nm	non-porous	non-porous
Charged group	$-CH_2N^+(CH_3)_3$	$-(CH_2)_3SO_3^-$
Counter ion	Cl^-	Na^+
Available pH range	2.0–12.0	2.0–12.0
Temperature range	4–60 °C	
Pressure limit	3 µm: 18–25 MPa (2,610–3,625 psi) 5 µm: 6–12 MPa (870–1,740 psi)	
Column hardware	PEEK	



Non-porous polymer beads

YMC´s BioPro IEX series of ion exchange columns are available in QA and SP chemistries, based on 5 µm porous (QA or SP columns) or on 3 or 5 µm non-porous (QF and SF columns) hydrophilic polymer beads.

The porous materials offer excellent binding capacity with exceptionally high efficiency and low operating pressure, whilst the non-porous particles offer high efficiency, very high resolution and low operating pressures.

High binding capacity and high recovery for porous type

The porous versions of YMC´s BioPro IEX show high dynamic binding capacity and excellent recovery, making them useful for semi-preparative separations of proteins and antibodies.

Comparison of dynamic binding capacity (DBC) for BSA

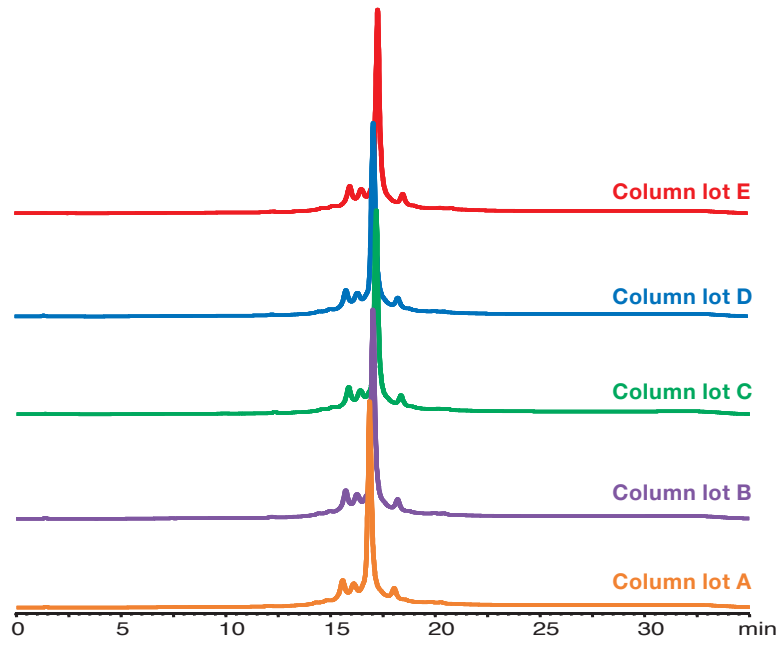
	Dynamic binding capacity (mg/mL-gel, 10% breakthrough)	Eluted amount (mg/mL-gel)	Recovery* (%)
BioPro IEX QA	126	120	95
Mono Q	100	35	35
TSKgel BioAssist Q	73	58	79

High recovery rates for BioPro IEX

* Recovery: (Eluted amount/Dynamic binding capacity) x 100

Compared with conventional porous polymer anion exchange columns, BioPro IEX QA provides higher DBC and recovery rates. This indicates that BioPro IEX has a much lower nonspecific adsorption compared to conventional columns.

Excellent batch-to-batch reproducibility



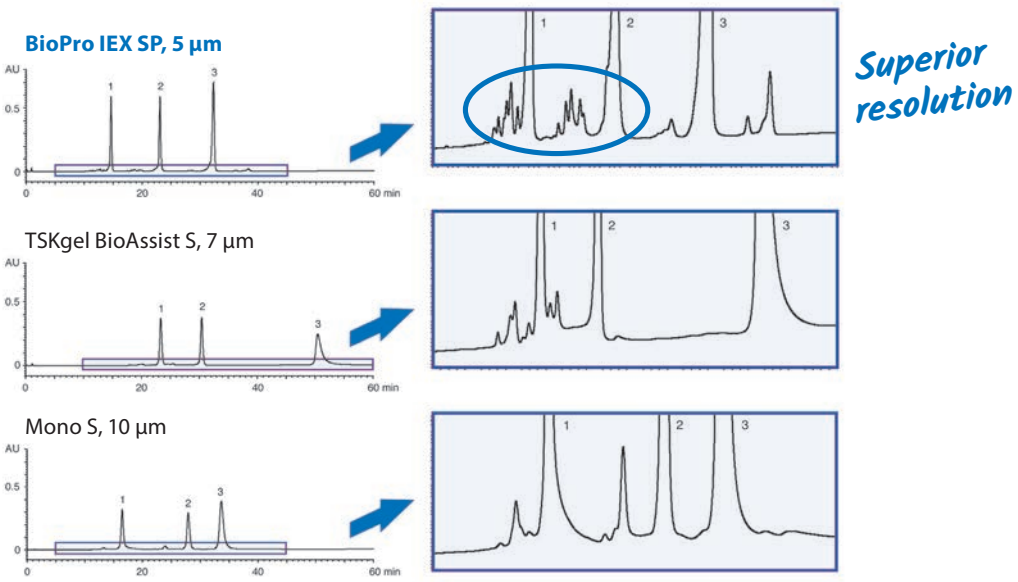
Column:	BioPro IEX SF (5 µm) 100 x 4.6 mm ID	Flow rate:	0.5 mL/min (180 cm/h)
Part No.:	SF00S05-1046WP	Temperature:	25 °C
Eluent:	A) 20 mM NaH_2PO_4-Na_2HPO_4 (pH 6.5)	Detection:	UV at 215 nm
	B) 20 mM NaH_2PO_4-Na_2HPO_4 (pH 6.5) containing 0.2 M NaCl	Injection:	10 µL
Gradient:	0–50%B (0.5–30 min)	Sample:	Monoclonal antibody (IgG1)

BioPro IEX SF columns exhibit excellent batch-to-batch reproducibility for mAb analysis with resolution of peaks for small charge variants. All gel batches are inspected by rigorous quality control tests, including HPLC analysis of mAbs, and must meet the required criteria before release.
BioPro IEX columns are the best choice for the quality control of mAbs, proteins, oligonucleotides and other biopharmaceuticals.

IEX – BioPro IEX: Resolution & throughput

Superior resolution

Comparison of standard protein separation on BioPro IEX SP and commercial S type products

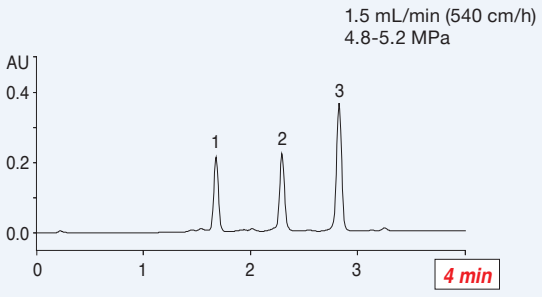


Eluent:	A) 20 mM KH_2PO_4-K_2HPO_4 (pH 6.8)		Detection:	UV at 220 nm	
	B) 20 mM KH_2PO_4-K_2HPO_4 (pH 6.8) containing 0.5 M NaCl		Injection:	BioPro IEX SP, TSKgel BioAssist S	20 µL
Gradient:	0–100%B (0–60 min)			Mono S	23.6 µL
Flow rate:	BioPro IEX SP, TSKgel BioAssist S	0.5 mL/min	Sample:	1. Ribonuclease A	(0.5 mg/mL)
	Mono S	0.59 mL/min		2. Cytochrome *c*	(0.5 mg/mL)
Temperature:	25 °C			3. Lysozyme	(0.5 mg/mL)

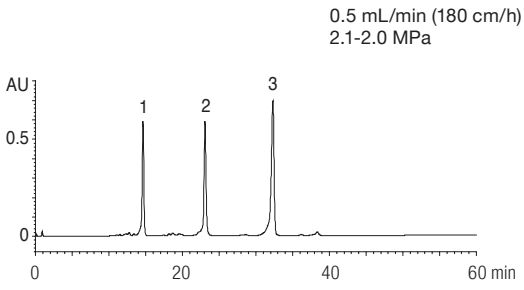
Only BioPro IEX is available in the smaller particle size and is therefore able to provide superior resolution.

Ultra-high-throughput analysis with non-porous BioPro IEX

Non-porous type
BioPro IEX SF (5 µm) 30 x 4.6 mm ID



Porous type
BioPro IEX SP (5 µm) 50 x 4.6 mm ID

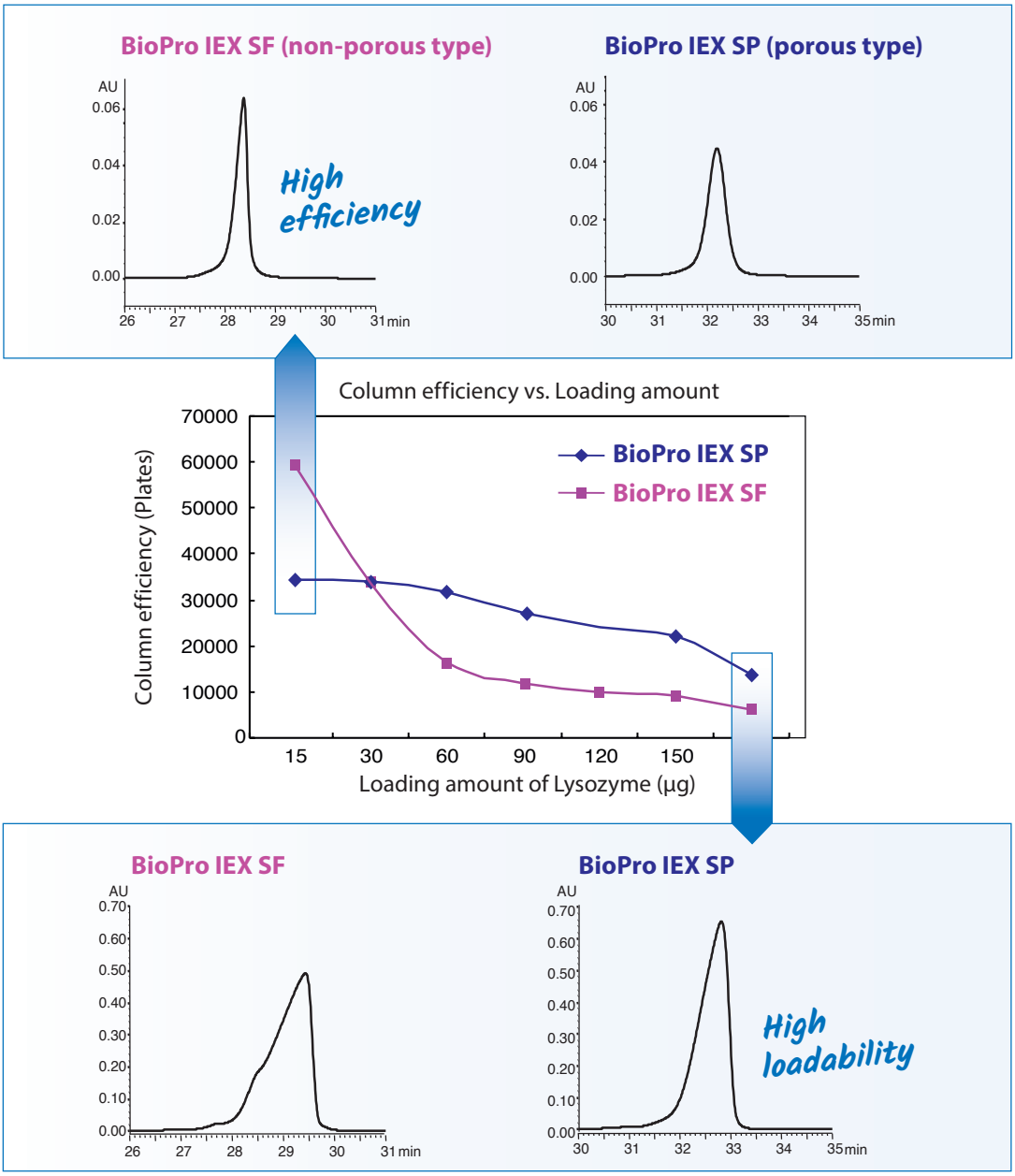


Part Nos.:	SF00S05-0346WP (non-porous)		Temperature:	25°C	
	SPA0S05-0546WP (porous)		Detection:	UV at 220 nm	
Eluent:	A) 20 mM KH_2PO_4-K_2HPO_4 (pH 6.8)		Injection:	20 µL	
	B) 20 mM KH_2PO_4-K_2HPO_4 (pH 6.8) containing 0.5 MNaCl		Sample:	1. Ribonuclease A	(0.5 mg/mL)
Gradient:	0–100%B (0–4 min) for BioPro IEX SF			2. Cytochrome *c*	(0.5 mg/mL)
	0–100%B (0–60 min) for BioProIEX SP			3. Lysozyme	(0.5 mg/mL)

The high mechanical stability of non-porous polymer beads and the short column length allow faster elution of proteins at a higher flow rate without any loss of resolution.

Column efficiency and loadability

When to use porous and non-porous BioPro IEX



Columns: (5 µm) 50 x 4.6 mm ID
Part Nos.: SF00S05-0546WP
SPA0S05-0546WP
Eluent: A) 20 mM NaH_2PO_4-Na_2HPO_4 (pH 6.8)
B) 20 mM NaH_2PO_4-Na_2HPO_4 (pH 6.8) containing 0.5 M NaCl
Gradient: 0–100%B (0–60 min)

Flow rate: 0.5 mL/min
Temperature: 25 °C
Detection: UV at 280 nm
Injection: 100 µL
Sample: Lysozyme

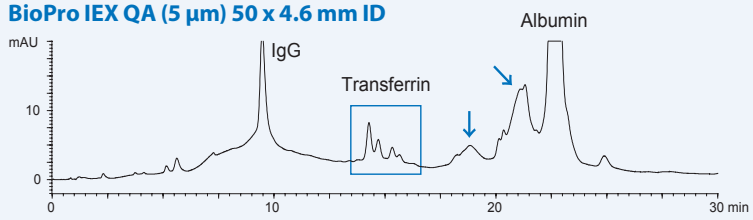
Non-porous BioPro IEX columns offer outstanding column efficiency for small sample loading amounts. These columns are especially suitable for microscale analysis, which requires higher resolution. Porous BioPro IEX columns maintain good peak shape even when the loading amount increases. These high-capacity columns are useful for high-load analytical separations and laboratory-scale purification.

IEX – BioPro IEX: Challenging separations

Protein separation in challenging matrices

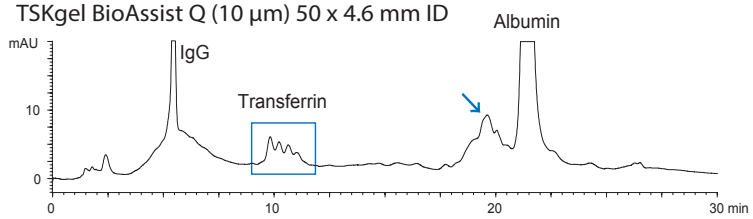
Separation of proteins in human serum on BioPro IEX QA and commercial Q-type products

BioPro IEX QA (5 µm) 50 x 4.6 mm ID

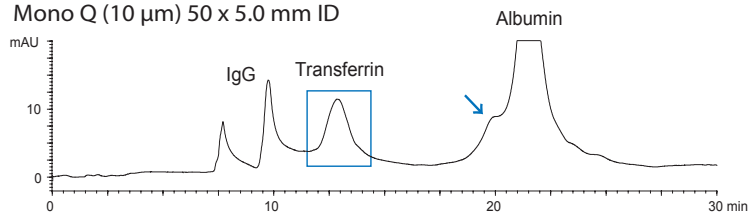


For high resolution porous BioPro IEX QA/SP is recommended!

TSKgel BioAssist Q (10 µm) 50 x 4.6 mm ID



Mono Q (10 µm) 50 x 5.0 mm ID



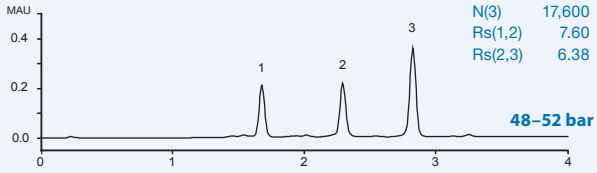
Part No.:	QAA0S05-0546WP	Temperature:	25 °C
Eluent:	A) 20 mM Tris-HCl (pH 8.6)	Detection:	UV at 280 nm
	B) 20 mM Tris-HCl (pH 8.6) containing 0.5 M NaCl	Injection:	20 µL
Gradient:	0–30%B (0–15 min), 30–100%B (15–30 min)	Sample:	Human serum (100 µL/mL)
Flow rate:	0.5 mL/min		

Better performance at lower backpressure

Comparison of standard protein separation on BioPro IEX SF and a commercial SP-type product

BioPro IEX SF (5 µm) 30 x 4.6 mm ID

N(1)	7,100
N(2)	12,100
N(3)	17,600
Rs(1,2)	7.60
Rs(2,3)	6.38

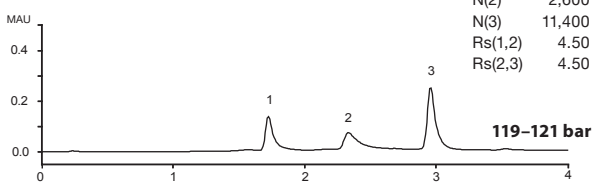


BioPro IEX SF elutes the proteins in sharper peaks without peak-tailing compared to TSKgel SP-NPR.
Despite the larger particle size, the theoretical plate count for BioPro IEX SF is higher than that for TSKgel SP-NPR.

higher plate count

TSKgel SP-NPR (2.5 µm) 35 x 4.6 mm ID

N(1)	4,400
N(2)	2,600
N(3)	11,400
Rs(1,2)	4.50
Rs(2,3)	4.50



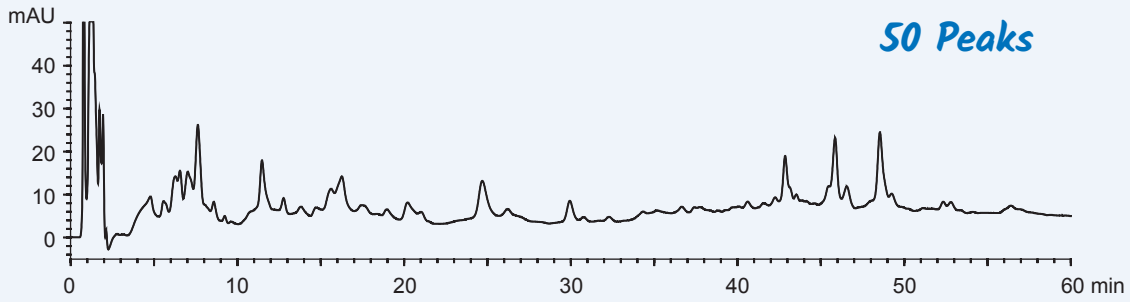
Part No.:	SF00S05-0346WP	
Eluent:	A) 20 mM KH_2PO_4-K_2HPO_4 (pH 6.8)	
	B) 20 mM KH_2PO_4-K_2HPO_4 (pH 6.8) containing 0.5 M NaCl	
Gradient:	BioPro IEX SF 0-100%B (0–4 min)	
	TSKgel SP-NPR 0-100%B (0–4.67 min)	
Flow rate:	1.5 mL/min	
Temperature:	25 °C	
Detection:	UV at 220 nm	
Injection:	20 µL	
Sample:	1. Ribonuclease A	(0.1 mg/mL)
	2. Cytochrome *c*	(0.1 mg/mL)
	3. Lysozyme	(0.1 mg/mL)

Compared to the competitor's column, BioPro IEX SF gives higher theoretical plate counts, excellent peak shapes, and lower backpressures. This makes BioPro IEX SF most suitable for high-throughput analysis.

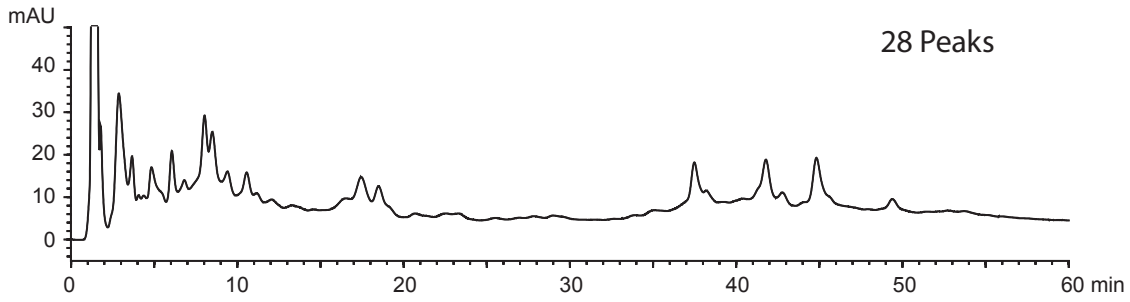
Peptide mapping

Peptide mapping of tryptic digests of BSA with enhanced sensitivity

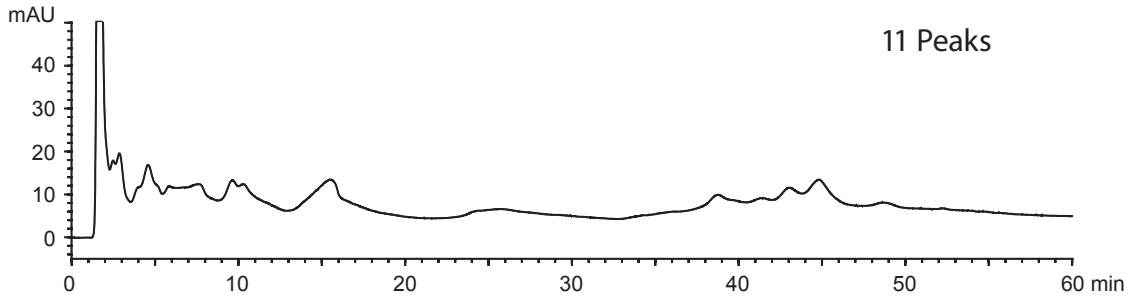
BioPro IEX QA (5 µm) 50 x 4.6 mm ID



TSKgel BioAssist Q (10 µm) 50 x 4.6 mm ID



Mono Q (10 µm) 50 x 5.0 mm ID

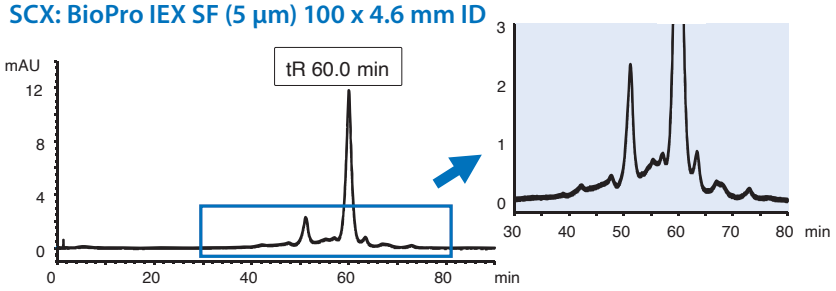


Part No.:	QAA0S05-0546WP
Eluent:	A) 20 mM Tris-HCl (pH 8.6)
	B) 20 mM Tris-HCl (pH 8.6) containing 0.5 M NaCl
Gradient:	0–15%B (0–30 min), 15–60%B (30–60 min)
Flow rate:	0.5 mL/min
Temperature:	25 °C
Detection:	UV at 220 nm
Injection:	20 µL
Sample:	Tryptic digest of BSA

IEX – BioPro IEX: Antibody analysis

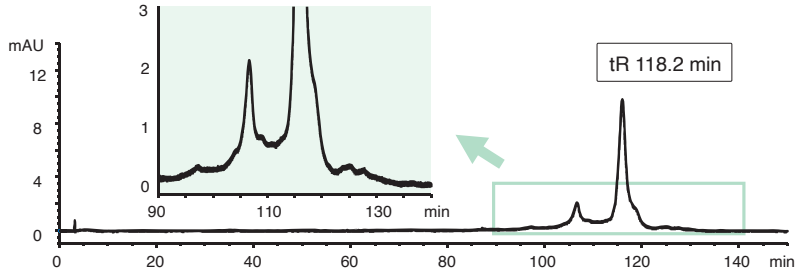
Monoclonal antibody analysis with non-porous cation exchange columns

SCX: BioPro IEX SF (5 µm) 100 x 4.6 mm ID



Higher resolution!

WCX: ProPac WCX-10 (10 µm) 250 x 4.0 mm ID

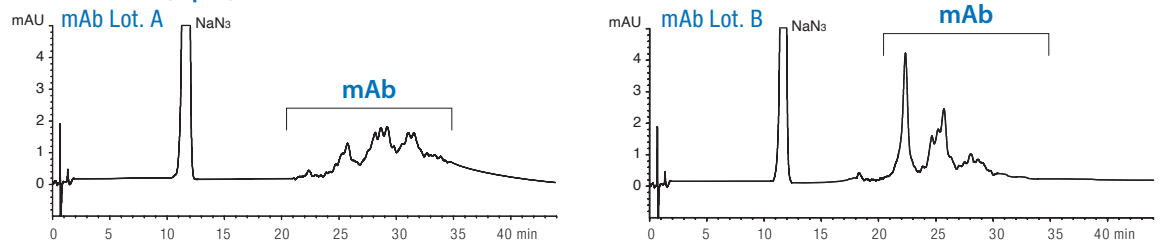


Part No.:	SF00S05-1046WP		(0.5 mL/min for 100 x 4.6 mm ID, 0.378 mL/min for 250 x 4.0 mm ID)
Eluent:	A) 20 mM MES-NaOH (pH 5.6)	Temperature:	30 °C
	B) 20 mM MES-NaOH (pH 5.6) containing 0.2 M NaCl	Detection:	UV at 280 nm
Initial ratio:	35%B (70 mM NaCl)	Injection:	10 µL
Gradient slope:	0.25%B/min (0.5 mM NaCl)	Sample:	Humanised monoclonal IgG1 (1 mg/mL)
Flow rate:	180 cm/h		

The separation of a mAb is compared using a strong cation (BioPro IEX SF) and a weak cation exchange column (ProPac WCX-10) under the same gradient conditions at pH 5.6. BioPro IEX SF can achieve a higher resolution of the mAb than the competitor's column in a shorter analysis time.

QC of monoclonal antibodies with non-porous BioPro IEX QF

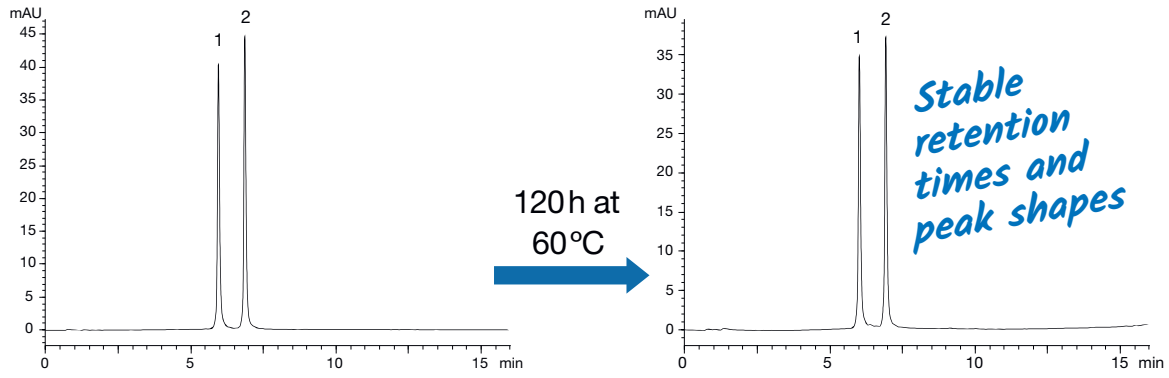
BioPro IEX QF (5 µm) 100 x 4.6 mm ID



Part No.:	QF00S05-1046WP	Temperature:	25˚C
Eluent:	A) 20 mM Tris-HCl (pH 8.1)	Detection:	UV at 220 nm
	B) 20 mM Tris-HCl (pH 8.1) containing 0.5 M NaCl	Injection:	14 µL (0.1 mg/mL)
Gradient:	10–25%B (0–60 min)	Sample:	Mouse monoclonal IgG1 anti-human IgG4
Flow rate:	1.0 mL/min (360 cm/h)		(Purified by DEAE chromatography, containing NaN_3)

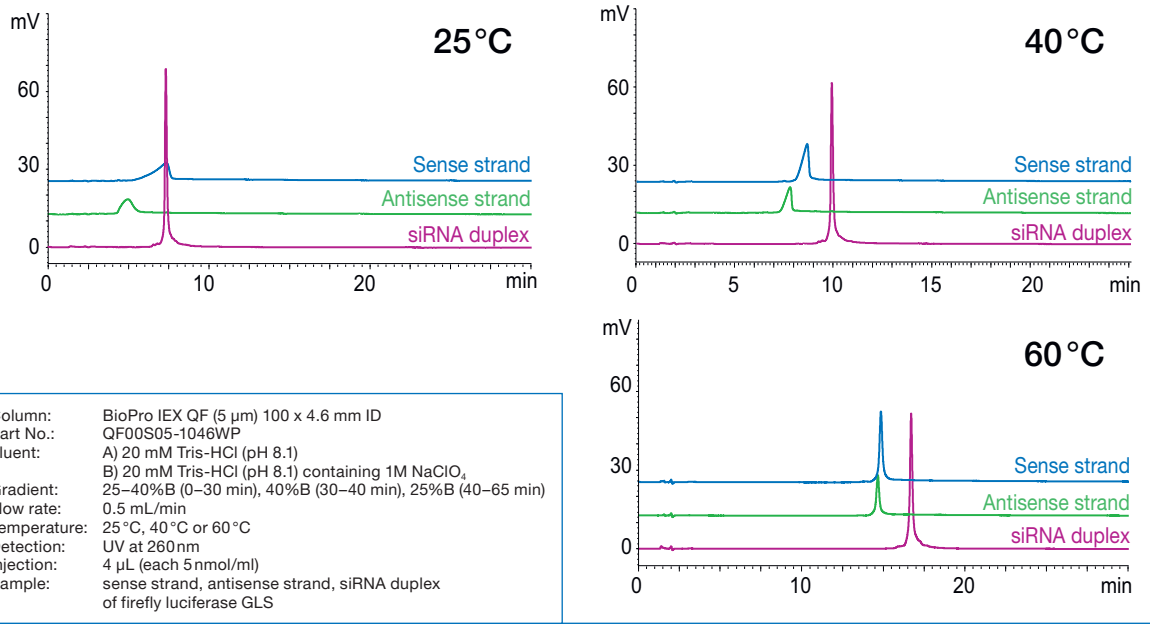
Two different batches of a commercially available mAb purified by DEAE chromatography were analysed on a BioPro IEX QF column (100 mm length).
The mAb was separated into several peaks, and the batch-to-batch variability is observed. The BioPro IEX QF/SF 100 mm length columns, which have high efficiency, are ideal for characterisation of glycoproteins, such as monoclonal antibodies, and for quality control assessment of biopharmaceuticals.

High temperature stability of BioPro IEX columns



Column:	BioPro IEX QF (5 µm) 100 x 4.6 mm ID	Temperature:	25 °C
Part No.:	QF00S05-1046WP	Detection:	UV at 260 nm
Eluent:	A) 10 mM NaOH	Injection:	4 µl (each 5 nmol/ml)
	B) 10 mM NaOH containing 1.0 M $NaClO_4$	Sample:	1) 5'-TCATCACACTGAATACCAAT-3' (DNA 20mer)
Gradient:	25–55%B (0–15 min), 100%B (15–20 min)		2) 5'-GTCATCACACTGAATACCAAT-3' (DNA 21mer)
Flow rate:	1.0 ml/min		

Influence of temperature on the analysis of a non-denaturated siRNA



Column:	BioPro IEX QF (5 µm) 100 x 4.6 mm ID
Part No.:	QF00S05-1046WP
Eluent:	A) 20 mM Tris-HCl (pH 8.1)
	B) 20 mM Tris-HCl (pH 8.1) containing 1M $NaClO_4$
Gradient:	25–40%B (0–30 min), 40%B (30–40 min), 25%B (40–65 min)
Flow rate:	0.5 mL/min
Temperature:	25 °C, 40 °C or 60 °C
Detection:	UV at 260 nm
Injection:	4 µL (each 5 nmol/ml)
Sample:	sense strand, antisense strand, siRNA duplex of firefly luciferase GLS

A higher temperature tends to show improved peak shape. Slightly better peak shapes of the ssRNAs are observed at 40 °C, while the dsRNA shows comparable and relatively good peak shape regardless of the temperature. An even higher temperature of 60 °C provides better peak shape of the sense and antisense strands. However, peak height of the siRNA duplex decreases due to partial denaturation. It is considered that the higher order structure of ssRNAs is denatured when increasing temperature. The ssRNAs as well as dsRNA retain longer on the stationary phase, as the ion exchange group can access the phosphate groups more easily.

IEX – Ordering information

3 µm non-porous analytical columns, PEEK hardware (max. pressure 18–25 MPa)

Phase	Column ID [mm]	Column length [mm]				Precolumn filter 2 µm*
		30 (25 MPa)	50 (25 MPa)	100 (25 MPa)	150 (18 MPa)	(pack of 5)
BioPro IEX QF	4.6	QF00S03-0346WP	QF00S03-0546WP	QF00S03-1046WP	QF00S03-1546WP	XRPRCP25
BioPro IEX SF	4.6	SF00S03-0346WP	SF00S03-0546WP	SF00S03-1046WP	SF00S03-1546WP	

5 µm non-porous analytical columns, PEEK hardware (max. pressure 6–12 MPa)

Phase	Column ID [mm]	Column length [mm]				Precolumn filter 2 µm*
		30 (6 MPa)	50 (10 MPa)	100 (12 MPa)	150 (12 MPa)	(pack of 5)
BioPro IEX QF	4.6	QF00S05-0346WP	QF00S05-0546WP	QF00S05-1046WP	QF00S05-1546WP	XRPRCP25
BioPro IEX SF	4.6	SF00S05-0346WP	SF00S05-0546WP	SF00S05-1046WP	SF00S05-1546WP	

5 µm porous analytical columns, PEEK hardware (max. pressure 2.5–3.5 MPa)

Phase	Column ID [mm]	Column length [mm]			Precolumn filter 2 µm*
		30 (2.5 MPa)	50 (3.0 MPa)	100 (3.5 MPa)	(pack of 5)
BioPro IEX QA	4.6	QAA0S05-0346WP	QAA0S05-0546WP	QAA0S05-1046WP	XRPRCP25
BioPro IEX SP	4.6	SPA0S05-0346WP	SPA0S05-0546WP	SPA0S05-1046WP	

* Holder required, part no. XRPRCP02

6 µm non-porous semiprep. columns, stainless steel hardware (max. pressure 3-9 MPa)**

Phase	Column ID [mm]	Column length [mm]
		100
BioPro IEX QF	10 20 30	QF00S06-1010WT QF00S06-1020WT QF00S06-1030WT
BioPro IEX SF	10 20 30	SF00S06-1010WT SF00S06-1020WT SF00S06-1030WT

** optionally bioinert coated stainless steel hardware available

6 µm porous semiprep. columns, stainless steel hardware (max. pressure 4 MPa)

Phase	Column ID [mm]	Column length [mm]
		100
BioPro IEX QA	10 20	QAA0S06-1010WT QAA0S06-1020WT
BioPro IEX SP	10 20	SPA0S06-1010WT SPA0S06-1020WT

Other dimensions on demand