Chromaflow columns

PROCESS COLUMNS

Chromaflow™ columns are a family of convenient to use, process-scale columns. A patented nozzle in the top and bottom of the column allows packing, unpacking, and cleaning when fully assembled, that is with the lid in place. Chromaflow columns simplify chromatographic procedures and offer:

- convenience
- saving of labor
- reproducibility
- contained packing
- scalability

General column description

Chromaflow low-pressure columns (Fig 1) are available in a choice of dimensions and materials. The complete range offers inner diameters (i.d.) from 300 to 2000 mm (Table 1), with column tubes manufactured from cast acrylic (Fig 1). All dimensions are available with variable bed heights, providing a wide variety of bed volumes. All columns are pressure rated for operation at 3 bar.

Chromaflow columns incorporate a patented, pack-in-place nozzle (Fig 2) through which process liquids enter and exit. Manual or automated versions of the nozzles are available. The automated nozzle is controlled from the packing station or the nozzle control unit. The nozzle has three positions to facilitate the different aspects of column operation: packing, operation, unpacking and cleaning. In addition to this pack-in-place functionality, the nozzle also contains the process liquid flow path to provide a consolidated solution to the process stream handling.

Bed supports are available in 316L stainless steel or polyethylene. The multilayer, woven stainless steel bed supports have very high chemical resistance and longevity for use in applications where salt concentrations are low and pH is above 5. Polyethylene bed supports are recommended for applications with low pH and high salt concentrations. All other wetted parts in columns with polyethylene bed supports are manufactured from plastic or noncorrodible materials for use in low pH /high salt applications.

Fig 1. A Chromaflow column, 2000 mm i.d.

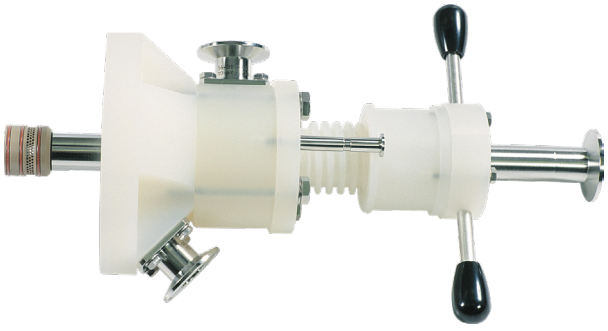


Fig 2. The Chromaflow nozzle that enables packing in place in a fully assembled column (Cytiva patent).

The construction materials include 316L stainless steel, acrylic, polypropylene, polyethylene, PEEK 450 G, EPDM rubber and FEP encapsulated silicone. These materials have high chemical resistance to the liquids typically used in process chromatography (Table 2). Furthermore, all polymeric materials are approved according to USP class VI tests for toxicity.

As an option, a dedicated packing station is available for Chromaflow columns. The packing station speeds up the packing procedure by eliminating the more time-consuming, manual maneuvers (Fig 3).

Comprehensive documentation is delivered with each column and includes a User manual, a Maintenance manual, assembly drawings, a full spare part list, materials certificates, etc.

A Validation Support File containing information on column component composition, materials of construction and toxicity studies is also available.

Fig 3. Packing Chromaflow columns with the dedicated packing station is convenient and simple.

Convenient and labor saving

Once the column is assembled and the lid in place, no lifting gear is required for packing, operation, unpacking or cleaning-in-place (CIP). This means that a single operator can perform all column operations, thereby reducing labor costs and increasing convenience in large-scale operations.

Reproducibility

Packing with the lid in place allows the packing parameters to be easily set and fixed. Manual operation is minimized and standard operating procedures can be followed, helping to give reproducible column packing and results.

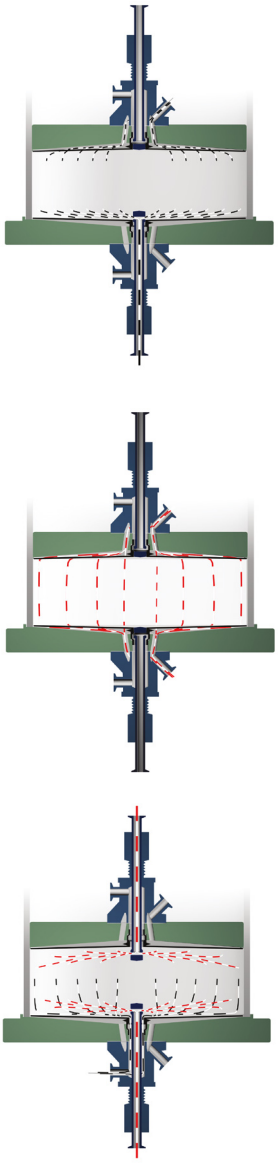
Contained packing

Improved safety is another advantage of the Chromaflow column concept. Because all the column operations are performed in a "closed system" environment, there is less risk of the operator coming into contact with hazardous chemicals and of the target product being exposed to contamination. In this way, overall safety and hygienic operation are improved.

Principle of operation

The column has a three-position nozzle located in the center of the top and bottom bed support. These three positions enable packing, unpacking, operation and cleaning to be performed without any adjustments to the assembled column, that is the lid remains in place.

Flow profiles from the two nozzles are identical. Packing direction will depend on the characteristics of the media and packing method used. The three positions are illustrated in Figure 4.



Packing position
The bottom nozzle is extended part of the way (mid position) into the column. The top nozzle is fully retracted. Slurry enters the column via the bottom nozzle and excess liquid exits via the top mobile phase outlet. After packing, the slurry lines are isolated from the mobile phase and can be cleaned independently from the rest of the column.

Running position
The bottom and top nozzles are retracted. Mobile phase enters the column directly into an annulus, immediately behind the bed support. The annulus is cut through at an angle to ensure that linear flow is kept constant during distribution of the mobile phase across the bed.

Unpacking position
In this position, both bottom and top nozzles are fully extended into the column thereby exposing a third passage through which medium leaves the column.

Cleaning solution can be pumped through the nozzles and sprayed into the column. In this way the column is easily and effectively cleaned without exposing the interior or the medium to the environment, and without dismantling the column.

Fig 4. The three positions of the Chromaflow nozzle showing packing from the top.

Scalability

Chromaflow columns are available in a wide range of dimensions, all designed and constructed around the same design principle. Standard range columns come in dimensions from 400 to 1000 mm. For more information about columns and dimensions, see Ordering information. Scaling up a chromatographic process from small to larger diameters is easily performed with maintained reproducibility, safety and convenience.

Column dimensions

A selection of Chromaflow columns in the range 400 to 2000 mm i.d. are presented in Table 1. The adapter stroke length is a standard 200 mm. Variable bed heights are available in the ranges 100 to 300 mm, 200 to 400 mm and 300 to 500 mm.

Chromaflow 400 SFP columns

Chromaflow 400 SFP (small flow path) columns are specially designed for low-flow applications. The dimensions in the mobile phase have been optimized to reduce dead volumes to a minimum and the area behind the nozzle tip has also been reduced.

Column materials and their chemical resistance

Table 2 lists the major components of Chromaflow columns in contact with process fluids (wetted parts) and Table 3 lists the chemical resistance of materials using data compiled from several published sources. It is important to note that columns with stainless steel bed supports and other stainless steel wetted components must be appropriately maintained when exposed to NaCl. Since salt can be corrosive to stainless steel over time, it is recommended that residual salt is removed by rinsing columns with at least five column volumes (CV) of clean water.

Table 1. Weights, volumes and dimensions for variable bed height Chromaflow columns

Description	Max operating pressure (bar)	Volume (L)	Column overall height (mm)	Weight, dry (kg)	Footprint (mm × mm)
Chromaflow column 400/100-300*	3	12.6–37.8	1568	230	700 × 700
Chromaflow column 600/100-300	3	28.3–84.9	1568	375	800 × 800
Chromaflow column 800/100-300	3	50.3–150.9	1572	610	1000 × 1000
Chromaflow column 1000/100-300	3	78.5–235.5	1573	930	1200 × 1200
Chromaflow column 1200/100-300	3	113.1–339.3			
Chromaflow column 1400/100-300	3	153.9–461.7			
Chromaflow column 1600/100-300	3	201.1–603.3			
Chromaflow column 1800/100-300	3	254.5–763.5			
Chromaflow column 2000/100-300	3	314.2–942.6			

* The first figure in the column name indicates the inner diameter and the second figure indicates stroke length.

Table 2. Major components and their composition

Component	Material	In contact with process stream
Column tube	Acrylic or stainless steel 316L	Yes
Column lids	Stainless steel 316L	No
Distributor	Polypropylene	Yes
Bed support	Stainless steel 316L or polyethylene	Yes
Chromaflow nozzle	Polypropylene, stainless steel 316L, PEEK 450 G	Yes
Seals	EPDM or FEP encapsulated silicone	Yes
Stand	Stainless steel 316	No

EPDM = ethylene propylene diene, FEP = fluoroethenepropene, PEEK = polyetherether ketone

Table 3. Chemical resistance of materials used in Chromaflow columns (60 days)

Chemical	Acrylic	SS 316L	EPDM	FEP	PEEK 450 G	PE	PP
Acetic acid 1.7 M	+	+	+	+	+	+	+
EtOH 20%[1]	+	+	+	+	+	+	+
EtOH 40%	–	+	+	+	+	(+)	+
Ethylene glycol 50%	+	+	+	+	+	+	+
Formaldehyde 1.7 M	+	+	+	+	+	+	+
Formic acid 10%	(+)	+	+	+	+	+	+
Glycerol 100%	+	+	+	+	+	+	+
Hydrochloric acid 0.1 M	+	–	+	+	+	+	+
Isopropyl alcohol 30%	–	+	+	+	+	(+)	+
Nitric acid 0.1 M	+	+	+	+	+	(+)	+
Phosphoric acid 25%	+	(+)	+	+	+	+	+
Sodium chloride 0.5 M	+	+[2]	+	+	+	+	+
Sodium hydroxide 2 M[3]	+	+	+	+	+	+	+
Trifluoroacetic acid 0.1%	(+)	+	+	+	+	+	+
Triton™ X-100 100%	+	+	+	+	+	+	+
Urea 8 M	+	+	+	+	+	+	+

+ Resistant (+) Limited resistance – Not recommended

[1] Do not expose acrylic to concentrations of ethanol greater than 20%. Do not exceed the following parameters during storage: 5 yr, 23°C, 0.5 bar g.
[2] NaCl can cause corrosion on stainless steel at pH <5. Do not use NaCl in storage solutions. Rinse with at least 5 CV of clean water after use with NaCl.
[3] Maximum exposure 4 h.

SS=stainless steel, EPDM=ethylene propylene diene, FEP=fluoroethenepropene, PEEK=polyetherether ketone, PE=polyethylene, PP=polypropylene.

Sanitizing Chromaflow columns

The design of Chromaflow columns facilitates cleaning-in-place. Below is a recommended cleaning protocol suitable for most applications.

1. Circulate 1.5 CV of 20% acetic acid at a low flow velocity (60 cm/h) for 15 min, upward flow. Then reverse the flow for 15 min.
2. Repeat this procedure with 1.0 M NaOH.
3. Following step 2, slowly circulate 1.0 M NaOH in the column for 60 min.
4. Re-equilibrate the column with a storing or starting buffer.

Chromaflow Packing stations

Chromaflow Packing stations make column priming and packing a simple operation, reducing the operator's time to a minimum. The packing stations consist of a control panel with pumps and valves fitted underneath (Fig 5). Valves and diaphragm pumps are actuated pneumatically from the control panel. As they are brought into operation indicators on the control panel display the relevant flow paths. For operation, packing stations only require a supply of compressed air. To select an appropriate packing station for your column and media, refer to Tables 4 and 5.

Fig 5. Chromaflow Packing station Pack 100.

Table 4. Specifications of Chromaflow packing stations

Designation*	Pump	Pump flow capacity (L/min)	Req. air supply (m^3/min)	Inlet piping/ outlet i.d. (mm)	TC connections (mm)	Weight, dry (kg)	Size W × H × D (mm)
Pack 50	Tapflo™ T53	10–50	0.5	22.1/22.1	50.5	115	810 × 1175 × 715
Pack 100	Tapflo T103	30–100	1.0	34.8/22.1	50.5	130	810 × 1175 × 715

* Packing stations, Pack 200 and Pack 400 with pump flow capacities of 60 to 200 l/min and 100 to 400 l/min are available as custom orders.

Table 5. Approximate packing flow rates for different media at two different bed heights

Column diameter (mm)	400				600				800				1000			
Bed height (mm)	**150**		**300**		**150**		**300**		**150**		**300**		**150**		**300**	
Flow	**cm/h**	**L/min**	**cm/h**	**L/min**	**cm/h**	**L/min**	**cm/h**	**L/min**	**cm/h**	**L/min**	**cm/h**	**L/min**	**cm/h**	**L/min**	**cm/h**	**L/min**
Sepharose™ Fast Flow media	500	11	250	5.5	500	24	250	12	500	42	250	21	500	66	250	33
Sepharose Big Beads media	1600	34	1200	25	1600	75	1200	57	1600	134	1200	101	1600	209	1200	157

What else do I need?

The column

The columns are supplied ready for use and are equipped with adjustable feet. Castors can be ordered separately for columns up to 1000 mm in diameter.

Isolating the column after packing

We recommend using sanitary stainless steel valves (of the appropriate inner diameter) on the mobile phase to prevent contamination of the packed bed. For storage purposes, blind flanges with a clamp and gasket can be used to seal off the column.

Connecting the column to your system and packing station

Clamps and gaskets of suitable size are required to connect the sanitary flanged inlet/outlet to either valves or tubing of the same type. Preflanged tubing is also available.

Assembly or disassembly of the column

An adequate sized wrench is needed for assembly or disassembly of the column. A hoist is needed to remove the adapter or top lid from the column.

Spare parts to keep on site

It is recommended that nozzle seals, column seals, and column bed support kits are kept as spare parts.

Useful accessories

Safety valve: Precalibrated valve which releases pressure if the calibrated value is exceeded. Recommended to install on the mobile phase inlet if no other pressure sensor is included in the chromatography system. The T-junction, clamps and gaskets must be ordered separately.

Pressure sensor: The sensor is installed inline, preferably on the mobile phase inlet. Clamps and gaskets have to be ordered separately.

Ordering information

Columns

Chromaflow columns with acrylic tubes	**Bed support 10 mm SS sinter**	**Bed support 20 mm SS sinter**	**Bed support 20 mm PE sinter**
I.d. 400 mm Man. nozzle			
Stroke length 100-300	18-1150-40	18-1159-40	18-1161-40
Stroke length 200-400	18-1157-42	18-1159-42	18-1161-42
Stroke length 300-500	18-1157-44	18-1159-44	18-1161-44
I.d. 400 mm Auto. nozzle			
Stroke length 100-300	18-1157-41	18-1159-41	18-1161-41
Stroke length 200-400	18-1157-43	18-1159-43	18-1161-43
Stroke length 300-500	18-1157-45	18-1159-45	18-1161-45
I.d. 400 mm SFP Man. nozzle*			
Stroke length 100-300	18-1170-53	18-1176-12	11-0011-85
Stroke length 200-400	11-0011-80	11-0011-83	11-0011-86
Stroke length 300-500	11-0011-82	11-0011-84	11-0011-87
I.d. 400 mm SFP Auto. nozzle			
Stroke length 100-300	11-0011-89	11-0011-91	11-0011-94
Stroke length 200-400	11-0011-88	11-0011-92	11-0011-95
Stroke length 300-500	11-0011-90	11-0011-93	11-0011-96
I.d. 600 mm Man. nozzle			
Stroke length 100-300	18-1150-60	18-1159-60	18-1161-60
Stroke length 200-400	18-1157-62	18-1159-62	18-1161-62
Stroke length 300-500	18-1157-64	18-1159-64	18-1161-64
I.d. 600 mm Auto. nozzle			
Stroke length 100-300	18-1157-61	18-1159-61	18-1161-61
Stroke length 200-400	18-1157-63	18-1159-63	18-1161-63
Stroke length 300-500	18-1157-65	18-1159-65	18-1161-65
I.d. 800 mm Man. nozzle			
Stroke length 100-300	18-1150-80	18-1159-80	18-1161-80
Stroke length 200-400	18-1157-82	18-1159-82	18-1161-82
Stroke length 300-500	18-1157-84	18-1159-84	18-1161-84
I.d. 800 mm Auto. nozzle			
Stroke length 100-300	18-1157-81	18-1159-81	18-1161-81
Stroke length 200-400	18-1157-83	18-1159-83	18-1161-83
Stroke length 300-500	18-1157-85	18-1159-85	18-1161-85
I.d. 1000 mm Man. nozzle			
Stroke length 100-300	18-1150-10	18-1160-10	18-1162-10
Stroke length 200-400	18-1158-12	18-1160-12	18-1162-12
Stroke length 300-500	18-1158-14	18-1160-14	18-1162-14
I.d. 1000 mm Auto. nozzle			
Stroke length 100-300	18-1158-11	18-1160-11	18-1162-11
Stroke length 200-400	18-1158-13	18-1160-13	18-1162-13
Stroke length 300-500	18-1158-15	18-1160-15	18-1162-15

For column specifications other than listed in the table, please contact your local Cytiva representative.
* SFP = Small Flow Path on mobile phase, only available on 400 mm i.d. columns.

Packing stations

	Min (L/min)	Max (L/min)	Code number
Pack 50	10	50	18-1163-74
Pack 100	30	100	18-1162-08
Pack 200	60	200	Custom order
Pack 400	100	400	Custom order

Accessories

Designation	Code number
Valves	
4 port 2 way, i.d. 10 mm, 25 mm TC	18-1012-56
4 port 4 way, i.d. 10 mm, 25 mm TC	18-1012-57
3 port 2 way, i.d. 15 mm, 25 mm TC	44-5499-90
4 port 4 way, i.d. 20 mm, 51 mm TC	44-2302-01
3 port 2 way, i.d. 22 mm, 51 mm TC	44-1583-01
3 port 2 way, i.d. 35 mm, 51 mm TC	44-5494-65
Valve sealing washer Fits 10 mm 2- and 4-way valves	18-1128-69
PVC tubing with sanitary fitting 25 mm TC	
i.d. 10 mm, 900 mm	18-1012-62
i.d. 10 mm, 1400 mm	18-1012-63
i.d. 10 mm, 1700 mm	18-1012-64
i.d. 10 mm, 2000 mm	18-1012-87
i.d. 14 mm, 750 mm	18-1027-28
i.d. 14 mm, 1800 mm	18-1027-29
PVC tubing with sanitary fitting 51 mm TC	
i.d. 22 mm, 900 mm	44-1616-09
i.d. 22 mm, 1400 mm	44-1616-08
i.d. 22 mm, 2000 mm	44-1616-07
i.d. 22 mm, 4000 mm	44-1616-06
Clamp gasket	
25 mm i.d., 10 mm	18-1035-79
25 mm i.d., 12 mm	18-0200-00
51 mm i.d., 22 mm	44-7133-01
51 mm i.d., 38 mm	44-0515-01
Clamp 25 mm	18-1001-31
Clamp 51 mm	44-7134-01
Blind flange 25 mm incl. gasket	18-1001-25
Blind flange 51 mm incl. gasket	44-7135-01
Safety valve, 3 bar, 51 mm TC	18-5738-01
Safety valve, 5 bar, 51 mm TC	44-5498-97
T-junction i.d., 10 mm, 2×25 mm TC, 1×51 mm TC	18-1003-63
Castors, assembly kit 400-600	18-1171-51
Castors, assembly kit 800-1000 The kit contains a complete set of wheels, fasteners and adapters for a column.	18-1171-52
Pressure sensor i.d. 10 mm, 25 mm TC	44-0507-02
Pressure sensor i.d. 22 mm, 51 mm TC	44-0507-03

Designation	Code number
Media stirrers	
Media stirrer, 80 cm	18-1149-80
Media stirrer, 150 cm	18-1149-81
Connectors	
i.d. 10, 25 mm TC-3/4"-20 UNF threaded	18-1012-68
i.d. 10, 25 mm TC-i.d. 14, 51 mm TC	18-1027-25
i.d. 14, 51 mm TC-i.d. 22, 51 mm TC	18-1027-26
Chromaflow Nozzle control unit	18-1164-61
Chromaflow Nozzle pipings	
Chromaflow Nozzle piping 400 1/2"	18-1172-01
Chromaflow Nozzle piping 400 3/4"	18-1172-00
Chromaflow Nozzle piping 400 1"	18-1171-99
Chromaflow Nozzle piping 600 1/2"	18-1172-06
Chromaflow Nozzle piping 600 3/4"	18-1172-05
Chromaflow Nozzle piping 600 1"	18-1172-04
Chromaflow Nozzle piping 800 1/2"	18-1171-94
Chromaflow Nozzle piping 800 3/4"	18-1171-93
Chromaflow Nozzle piping 800 1"	18-1171-92
Chromaflow Nozzle piping 1000 1/2"	18-1172-09
Chromaflow Nozzle piping 1000 3/4"	18-1172-08
Chromaflow Nozzle piping 1000 1"	18-1172-07

cytiva.com/bioprocess

CY13377-17Jul20-DF

cytiva