
Manual

Medium Pressure Chromatography Columns ECO Series



These instructions should be read prior to using the column!

Operating instructions

This manual ensures the safe and efficient use of the medium pressure ECO series of chromatography columns. The manual is part of the product and is available to download at <http://ymc.de/eco-glass-columns.html>.

The user must read this manual carefully and have fully understood its content before attempting to use the column. A prerequisite for the safe operation is the compliance with all the specified safety and operating instructions in this manual. The safety instructions are described in Section 1.

In addition, all the local occupational health and safety and general safety regulations applying to the use of the product must be complied with.

The following laws and standards were taken into account in the creation of the manual:

- 2001/95/EG
- DIN EN 82 079-1
- VDI 4500 Section 1

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Contents

1. Safety	5
1.1. Hazard Symbols	5
1.2. Composition of operating instructions	6
1.3. Areas of application	6
1.4. Intended Use	7
1.5. Operator requirements	7
1.6. Personal protective equipment	7
2. Delivery	8
2.1. Quantities delivered	8
2.2. Delivery inspection	11
3. Start-up	12
3.1. Precautions for use	12
3.2. Column construction	13
3.3. Specifications	14
3.4. Dismantling	15
3.5. Cleaning	15
3.6. Assembly	16
3.6.1. Installing the plungers	16
3.6.2. Column connections	17
3.6.3. Connection to LC systems	19
3.7. Pressure test	20
3.8. Chemical resistance	22
4. Operation	24
4.1. Notes on operation	24
4.2. Packing operations	26
4.2.1. Preparing the column	26
4.2.2. Preparing the slurries	28
4.2.3. Packing the column	28
A. Slurry packing with applied flow	28
B. Sedimentation process	30
4.2.4. Column test and acceptance criteria	31
4.3. Packing adaptor	32
4.4. Information for cleaning packed columns (CIP)	34
4.5. Unpacking	35
5. Maintenance	36
5.1. Maintenance schedule	36
5.2. Frit replacement	37

... continued p. 4

Contents

6. Troubleshooting	40
6.1. Troubleshooting guide.....	41
7. Storage, packaging and transport	42
7.1. Storage.....	42
7.2. Packaging and transport.....	42
8. Disposal	42
9. Spare and replacement parts	43
9.1. Spare parts list	43
9.2. Column versions available.....	47
10. Product cross-references	48
11. Index	50
12. Appendix	51

1. Safety

This section gives an overview of all important safety aspects for the protection of users and the safe and trouble-free operation of ECO columns. Other task-specific safety requirements are included in the sections for the specific operations. In addition, please also comply with your national legislation and other applicable safety regulations.

1.1. Hazard Symbols

Hazard symbols are highlighted by a combination of symbols and keywords. For your safety always read the complete text of the symbol.

Safety information is given in these instructions by use of a combination of symbols and key words that describe the nature and severity of the hazard:

 **DANGER**

This combination of symbol and key words indicates a potentially hazardous situation that may result in death or serious injury if ignored.

 **WARNING**

This combination of symbol and key words indicates a potentially hazardous situation that may result in serious or fatal injury if ignored.

 **CAUTION**

This combination of symbol and key words indicates a potentially hazardous situation that may result in minor or moderate injury if ignored.

ATTENTION

Failure to observe this warning may result in property damage.

All symbols are constructed in the same way. They include the signal word, type and source of danger, results of ignoring them as well as actions to prevent or avoid the danger.

1.2. Composition of operating instructions

Operating instructions require specific actions. Always follow each single action step in the prescribed order.

Operating instructions are designed in the following way and are characterised with the relevant symbols:

► Aim of the operating instruction

1. Action step

✓ Impact of the action step to control if the step was performed correctly

2. Next action step

☑ Result of the whole operation instruction

1.3. Areas of application

By careful selection of high-quality inert materials, ECO glass columns can be used in all areas of biochromatography in either normal phase (SR version) or reversed phase (AB version) modes, for analytical and preparative scale. ECO glass columns are frequently used for biochromatography separations with the appropriate stationary phases. They allow high recovery of the analytes due to their low interaction with such biomolecules (e.g. proteins, nucleic acids or oligosaccharides).

The columns are easy to operate and have very adjustable volumes due to the one or two adjustable plungers, depending on the version.

With a wide range of diameters, volumes, lengths and frit porosities, a wide variety of applications can be performed with ECO glass columns.

ECO glass columns meet the highest criteria for professional use in the laboratory.

Special emphasis has been placed on the wide range of volumes possible (0 to 5 liter) and high pressure resistance (up to 30 bar), so that high flow rates and throughput / efficiency can be achieved.

1.4. Intended Use

The ECO series of medium pressure chromatography columns is designed for the chromatographic separation of compounds using liquid chromatographic techniques. Their routine use requires no tools. Their correct use requires compliance with all information contained in this guide. If used outside the scope of their intended purpose, this will be considered as misuse.

1.5. Operator requirements

The various tasks described in this manual make different demands on the people who carry them out and require different levels of training.

WARNING

**Insufficiently trained people may cause dangerous situations.
People with insufficient training cannot accurately estimate the dangers of using the product and therefore could expose themselves and others to the risk of serious or fatal injuries.**

Technically ECO glass columns technically are pressure vessels with variable volume. The user must therefore be trained in dealing with pressure equipment. Also, the glass columns are used essentially for the purification of chemical substances. Therefore, the user must also be laboratory trained. Every user must have read and understood this manual before using the glass columns.

1.6. Personal protective equipment

Personal protection equipment serves to protect people from health and safety risks at work. Staff must wear personal protective equipment during work on and with the column according to national and internal laboratory safety regulations required for such work, for example safety goggles and lab coats.

2. Delivery

2.1. Quantities delivered



Fig. 2.1: An ECO column in its packaging as delivered

i Please take the complete glass column from the packaging. Compare the column label on the glass body with the details in the delivery note (part number (Pr.-No.), inner diameter (ID), maximum bed length (Length), maximum pressure (Pressure) and serial number (Ser.-No.)). This information must match. If this is not the case, please immediately contact YMC Europe GmbH.

YMC EUROPE GMBH	D-46539 Dinslaken
Pr.-No.:	ECO15/120V3V
ID/Length:	15 x 120 mm
Pressure:	25 bar
Ser.-No.:	ECO123456

Fig. 2.2: Example of a column label

The ECO glass columns are transported as pre-assembled units. Each ECO column is supplied with the appropriate accessories (see table 2, p. 10-11), a certificate of pressure resistance and information material (quick guide).

Based on the column label on the glass body, the actual version can be identified so that you will receive individual support for a special column, if necessary.

The part number (Pr.-No.) of the column contains information about the inner diameter, the maximum length of the bed, the plunger type, the frit material, the porosity of the frit and the column type. The part number is generated from these parameters. An overview of this information, as well as examples of how to interpret the exact type of column, is shown on page 9. The examples give the information for a solvent resistant ECO column with an inner diameter of 10 or 15 mm, a maximum bed length of 120 mm, adjustable plungers and stainless steel frits with a porosity of 16-40 or 10 microns and a Viton O-ring (i.e. the AB version, Aqueous Buffer), without and with a heating jacket.

Table 1: Column versions and part numbers

Combination possibilities	ECO10/ (10 mm ID)	120 (120 mm max. bed length)	V Vario (1 adjustable plunger)	0 (10 µm)	V Viton® / EPDM (AB version)	
	ECO15/ (15 mm ID)	200 (200 mm max. bed length)		3 (16-40 µm)		
	ECO25/ (25 mm ID)	450 (450 mm max. bed length)	M Multivario (2 adjustable plungers)	4 (40-100 µm)	K Kalrez® (SR version)	
	ECO50/ (50 mm ID)	750 (750 mm max. bed length)		-K heating jacket (only Multivario)		
		999 (1000 mm max. bed length)				
Example 1 Pr.-No. (part number)	ECO15/	120	V	3	V	
ID	15 mm					
Max. bed length		120 mm				
Type of plunger			Vario			
Frit porosity				16-40 µm		
O-Ring					Viton® / EPDM	
Heating jacket						-
Example 2 Pr.-No. (part number)	ECO10/	120	M	0	K	-K
ID	10 mm					
Max. bed length		120 mm				
Type of plunger			Multivario			
Frit porosity				10 µm		
O-Ring					Kalrez®	
Heating jacket						Heating jacket


2.2. Delivery inspection

Delivery check

- ▶ This is how you proceed during delivery inspection:
 1. Compare the column label on the glass body with the details on the delivery note.
 2. Check the completeness of the delivery using the "Checklist Scope of Supply" ▶ *Chapter 2.1, p. 8.*
 3. Check the delivery for externally identifiable transport damage.

Transportation damage

- ▶ In case of visible damage, proceed as follows:
 1. Do not accept the delivery or accept only conditionally.
 2. Record the extent of damage on the transport documents or on the delivery note of the carrier.
 3. Inform YMC Europe GmbH and/or the responsible distribution partner about the damage.

 *If any transportation damage is noted, claim as soon as it is detected.*


 *We recommend that you keep and use the original packaging and the accompanying foam pads (e.g. polystyrene, foam, etc.) for storage to ensure safe transport of the column is possible.*

Table 2: Check list for quantity of parts delivered

	Delivered	Number	Description
For ID 10-15 mm columns		1 m	PT0.8FE1.6 1/16 inch FEP tubing (0.8 x 1.6 mm, 40700)
		4	JR-55050 1/4 inch-28G fixing screw for 1/16 inch ferrule For connections to ECO column
		4	JR-CFL-CB1KF-S Ferrule for 1/16 inch tubing + JR-55050
		2	K.P207 M6 fixing screw for 1/16 inch tubing For the connection to a GE-ÄKTA systems
		2	K.P200N Ferrule for 1/16 inch tubing + K.P207
		2	JR-58000 Fixing screw 10-32 thread
		1	Frit removal tool
		2	K.P316 Plug for 1/4 inch-28G fitting
		1	Quick guide
		1	Certificate of pressure resistance

Table 2: Check list for quantity of parts delivered

	Delivered	Number	Description
For ID 25-50 mm columns		1 m	PT1.6FE3.2 1/8 inch FEP tubing (1.6 mm x 3.2 mm)
		4	JR-55051 1/4 inch-28 G fixing screw for 1/8 inch ferrule For connections to ECO column
		4	JR-CFL-CB2KF-S Ferrule for 1/8 inch tubing + JR-55051
		2	K.P307 M6 fixing screw for 1/8 inch ferrule For the connection to a GE-ÄKTA systems
		2	K.P300N Ferrule for 1/8 inch tubing + K.P307
		1	Frit removal tool
		2	K.P316 Plug for 1/4 inch-28G fitting
		1	Quick guide
		1	Certificate of pressure resistance

Table 2: Check list for quantity of parts delivered

	Delivered	Number	Description
For ID 70-80 mm columns		2 m	PT2,4FE3,2 1/8 inch FEP tubing (2.4 x 3.2 mm)
		4	JR-55051 1/4 inch-28G fixing screw for 1/8 inch ferrule For connections to ECO column
		4	JR-CFL-CB2KF-S Ferrule for 1/8 inch tubing + JR-55051
		2	K.P307 M6 fixing screw for 1/8 inch tubing For the connection to a GE-ÄKTA systems
		2	K.P300N Ferrule for 1/8 inch tubing + K.P307
		2	K.P316 Plug for 1/4 inch-28G fitting
		1	Strap wrench
		1	Quick guide
		1	Certificate of pressure resistance

3. Start-up

3.1. Precautions for use

⚠ WARNING

Use the appropriate protective clothing when working with the glass column, to ensure the safety of the user.

⚠ WARNING

The column must never be used under gas pressure.

⚠ CAUTION

Only operate the column at pressures corresponding to the published specifications. Otherwise there is a risk of material damage and even injury to the user.

⚠ CAUTION

The temperature range used must not exceed the specified limits.
(► *Chapter 3.3, Specifications*).

⚠ CAUTION

Take care when working in the immediate vicinity of the column.



Do not use column with chemicals that are not suitable for use with the wetted materials. (see table 5, p. 23).

3.2. Column construction

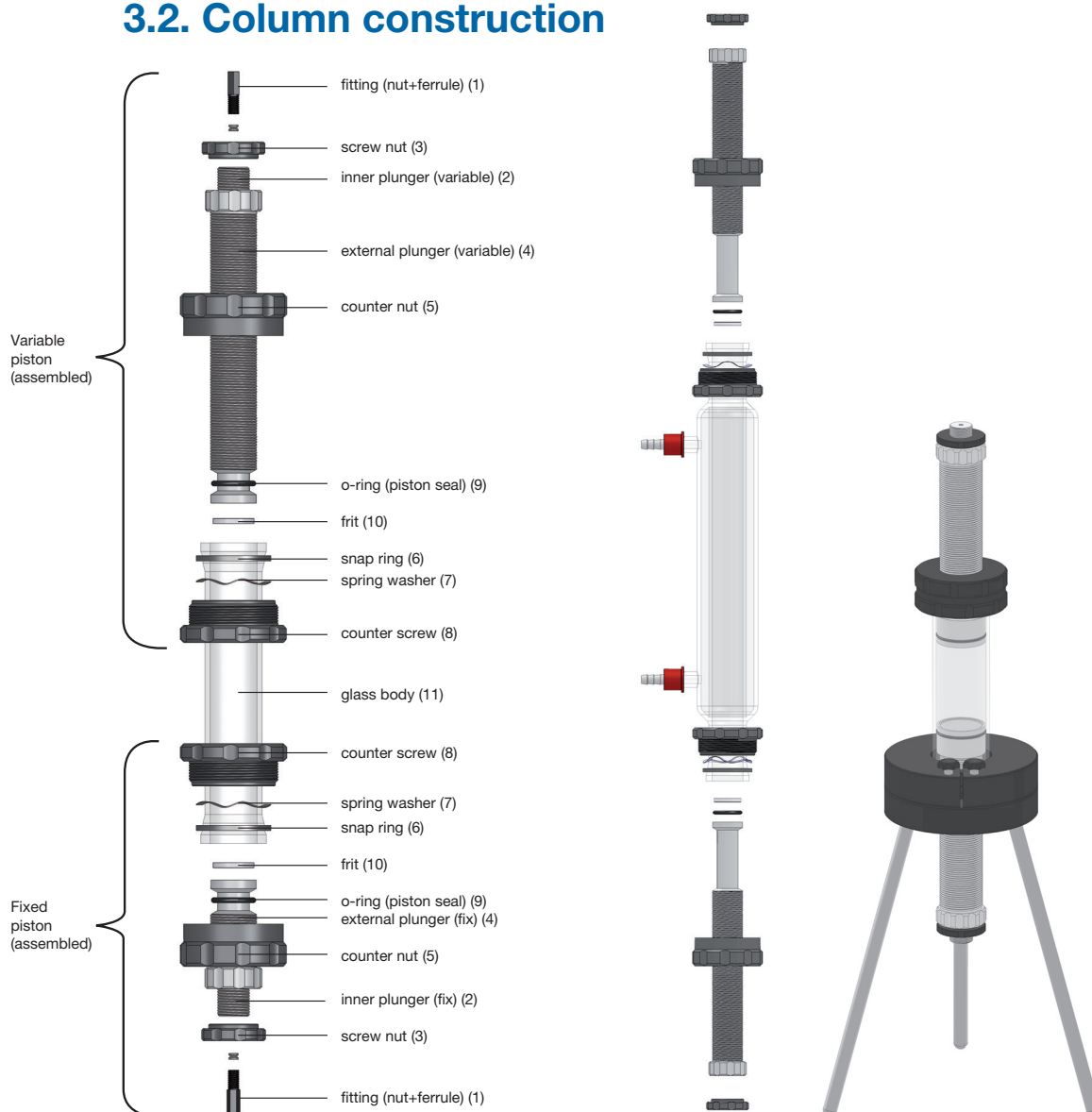


Figure 3.1: Detail drawing of the ECO column. Left side – Column version without water jacket, centre – Column version with water jacket, right side – 70 and 80 mm column version with tripod.

The ECO chromatographic column consists of a glass body (11), into which plungers are fitted at both ends. These plungers are attached to a counter screw (8) and counter nut (5) held in place by the snap rings and spring washer (6; 7). The plungers consist of an internal central screw and a sealing nut, to fix the improved O-Ring. The frits (10) are inserted in the end recesses of the plungers.

The ECO columns are available in two versions. The Aqueous Buffer (AB) version and the Solvent Resistant (SR) differ only by materials of construction, not by design.

Columns with a water jacket have a double-wall system, which includes an inlet and outlet for water (figure 3.1, centre).

3.3. Specifications

Aqueous buffer (AB) version

Temperature range	4 - 40 °C
Plunger	POM (Polyoxymethylene)
Seals	ID 10-50 mm: O-ring, Viton® ID 70-80 mm: O-ring, EPDM (ethylene propylene diene monomer rubber)
Frit	ID 10-50 mm: Sintered glass ID 70-80 mm: PE (polyethylene)
Height adjustment	ID 10-50 mm: Vario (120 mm on one side) or Multivario (120 mm on both sides) ID 70-80 mm: Multivario (180 mm on both sides)
Connection for tubing	1/4 inch-28G female screw thread
Tubing	FEP tubing
Optional	water-jacket (only Multivario)

Solvent resistant (SR) version

Temperature range	4 - 40 °C
Plunger	PVDF (polyvinylidene fluoride)
Sealing	O-ring, Kalrez®
Frit	ID 10-50 mm: sintered glass ID 70-80 mm: stainless steel
Height adjustment	like AB-version
Connection for tubing	1/4 inch-28G female screw thread
Tubing	FEP tubing
Optional	water-jacket (only Multivario)

Table 3: Pressure specifications, bed lengths, volumes

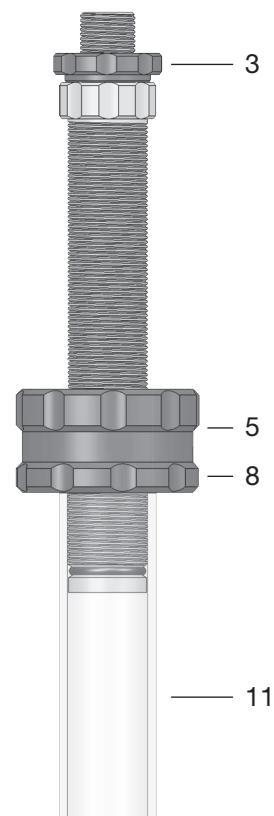
ID* [mm]	Pressure limit [bar]	Vario		Multivario	
		Bed length [mm]	Volume [ml]	Bed length [mm]	Volume [ml]
10	30	0 - 120	0 - 9	0 - 120	0 - 9
		80 - 200	7 - 15	0 - 200	0 - 15
		330 - 450	28 - 35	220 - 450	19 - 35
		630 - 750	54 - 58	520 - 750	44 - 58
		880 - 1000	75 - 78	780 - 1000	66 - 78
15	25	0 - 120	0 - 19	0 - 120	0 - 19
		80 - 200	14 - 32	0 - 200	0 - 32
		330 - 450	58 - 73	210 - 450	37 - 73
		630 - 750	111 - 122	510 - 750	90 - 122
		880 - 1000	156 - 163	760 - 1000	134 - 163
25	15	0 - 120	0 - 60	0 - 120	0 - 60
		80 - 200	50 - 100	0 - 200	0 - 100
		330 - 450	190 - 230	220 - 450	130 - 230
		630 - 750	365 - 390	520 - 750	300 - 390
		880 - 1000	510 - 520	770 - 1000	445 - 520
50	10	0 - 120	0 - 235	0 - 120	0 - 235
		80 - 200	180 - 390	0 - 200	0 - 390
		330 - 450	730 - 885	230 - 450	510 - 885
		630 - 750	1390 - 1480	530 - 750	1170 - 1480
		880 - 1000	1945 - 1970	780 - 1000	1725 - 1970
70	5	—	—	0 - 120	0 - 430
		—	—	0 - 200	0 - 725
		—	—	70 - 450	290 - 1630
		—	—	370 - 750	1510 - 2720
		—	—	620 - 1000	2530 - 3630
80	5	—	—	0 - 120	0 - 570
		—	—	0 - 200	0 - 950
		—	—	70 - 450	370 - 2140
		—	—	370 - 750	1960 - 3580
		—	—	620 - 1000	3280 - 4770

* Columns with an ID of 20 mm and 32 mm on request.

3.4. Dismantling

► Procedure for dismantling:

1. Turn the screw nut (3) one-half turn clockwise, so that the plunger moves in the column away from the packed bed.
2. Only now open the counter nut (5) – turn the counter screw (8) a quarter-turn counter-clockwise and then disconnect the counter nut from the counter screw (8).
3. Remove the plunger together with the counter nut (5) from the column body (11).
4. Remove the snap ring (6) and the spring washer (7) carefully from the glass column ends.
5. The counter screw (8) can now also be removed from the glass body (11).



3.5. Cleaning

► When cleaning the ECO column please follow these steps in sequence:

1. Disassemble the column (broken down into column tube (11), outer plunger (4), inner plunger (2), counter screws (8) and counter nuts (5)).
2. Clean column tube and plungers in an ultrasonic bath using doubly distilled water. After use, please wash the column body and plungers in 0,5 M sodium hydroxide solution or 0.1 - 0.5% sodium hypochlorite solution (in water, v/v).
3. Clean the plunger frits by flushing with 0.1 - 0.5% sodium hypochlorite solution or 0.5% M sodium hydroxide for 30 - to 60 - minutes through the plunger.



We recommend you record when the cleaning procedure has been performed. For this purpose, we have provided you with the logbook in the Appendix. More documents for download at <http://ymc.de/eco-glass-columns.html>.

3.6. Assembly

i Before this step, please first take the column apart and clean its component parts thoroughly (►Chapter 3.4, Dismantling the column and ►Chapter 3.5, Cleaning the chromatography columns).

ATTENTION

Please do not use any parts with the ECO column that were not provided by YMC (►Chapter 2.1, included), or are not listed in the spare parts list (►Chapter 9.1, spare parts lists). Otherwise there is a risk of damage to the column. Only when using the specified parts will YMC Europe GmbH accept any warranty claim.

3.6.1. Installing the plunger

i Before inserting the plunger into the glass tube, clean the seals.

- The plunger should be installed using the following sequence of steps:
 1. Fit the counter screws (8) onto the glass body (11) with the threads in the direction of the respective tube end, and attach the snap rings (6) to the glass body.
 2. Introduce the plunger with the counter screw attached carefully into the glass tube without tilting.

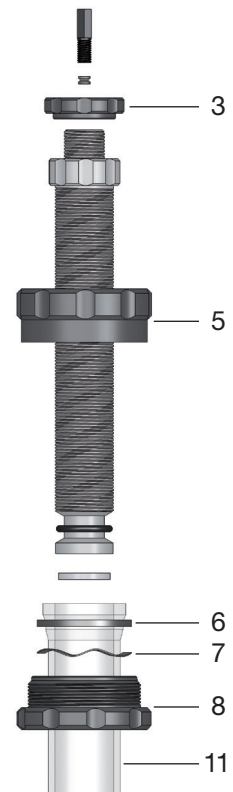
ATTENTION

Please make sure that the O-ring seal is released. Otherwise, loosen the O-ring by turning the screw nut (3).

3. Align the counter screw (8) and counter nut by rotating them.

ATTENTION

The column must be operated only with securely tightened end pieces. Otherwise, the plunger can be forced out of the column due to the pressure inside.



4. The plunger can be adjusted to the preferred position by turning the counter screw (8).
5. By turning the screw nut (3) clockwise, the O-ring is pressed against the glass body and the seal is made.

ATTENTION

Please make sure that the O-ring fits tight against the glass body to seal.

3.6.2. Column to tubing connections

ATTENTION

Only the 1/4 inch-28G screws should be used for the connection of tubing to ECO glass columns. Use of other screw threads will cause damage to the threads in the plungers.

ATTENTION

Ensure the appropriate tubing is used! The internal diameter must be suitable for the desired flow rate and the tubing resistant to the solvent used. The use of unsuitable tubing may cause compression of the column bed (dead volume). Please check the compatibility of the tubing used before connecting the column to the chromatography system or pump with the fixing screws.

ATTENTION

Always cut the tubing with the tube cutter (► *Chapter 9.1, Spare Parts Lists*) and never use scissors, as this will squash the tubing. It is important that the tubing is cut at 90°, since the cut surface is an integral part of the sealing surface.

For connection of tubing to the column 1/4 inch-28G screws are used. 4 pieces are supplied. Depending on the diameter of the column the appropriate fixing screws are supplied. Screw fittings with other types of threads are not suitable for connection to the glass column and will damage the threads in the plungers.

The following fixing screws supplied for the different versions:

ECO10/ECO15

For tubing with 1.6 mm outer diameter

JR-55050 Fixing screw 1/4 inch-28 G (4 pieces in accessory pack)

JR-CFL-CB1KF-S Collapsible Ferrule (4 pieces in accessory pack)



ECO25/ECO50

For tubing with 3.2 mm outer diameter

JR-55051 Fixing screw 1/4 inch-28 G (4 pieces in accessory pack)

JR-CFL-CB2KF-S Collapsible Ferrule (4 pieces in accessory pack)



► When assembling the fittings please follow these instructions:

1. Cut tubing at 90° with a tubing cutter (e.g. Clean-Cut Tubing Cutter, ► *Chapter 9.1, Spare Parts Lists*).
2. Insert the tubing through fixing screw (see above).
3. Insert the ferrule with the tapered side against the fixing screw onto the tubing (see above). If the ferrule does not fit on the tubing gently expand the tapered end with a suitable pointed tool (such as a tack or nail).

ATTENTION

Be careful to make sure that the fixing screws are straight and properly seated when screwing them into the Teflon threads. Otherwise you will destroy the Teflon threads of the plunger.

4. Insert the fitting into the plunger. Tighten the screw until pressure is felt, then tighten further approximately half a turn.

3.6.3. Connection to LC Systems

ATTENTION

Please observe the notes on tubing handling from the previous section to connect the column to the system!

The accessories supplied include additional fixing screws. These include two each 1/4 inch-28G, M6 and 10-32 fixing screws and corresponding ferrules. (► *Chapter 2.2, Delivery inspection*). These fixing screws can be used to connect the tubing attached to the column to a chromatographic system. Please check the technical specifications of the system used. According to these technical specifications, you can use the appropriate fixing screws from the YMC accessory pack.

3.7. Pressure test

This test procedure should be used to check the tightness of both the seals of the ECO column and also the tubing connections. Before using the column for chromatographic applications, it is recommended that a pressure test is performed to demonstrate correct assembly. Prior to delivery of the column, this test has been carried out according to the standard procedure listed below. The corresponding certificate has been included.

⚠ WARNING

Any rupture of the glass body under liquid pressure is of no danger because liquids are not compressible. Please comply with the specified pressure limits of columns and accessories.

Standard operating procedure

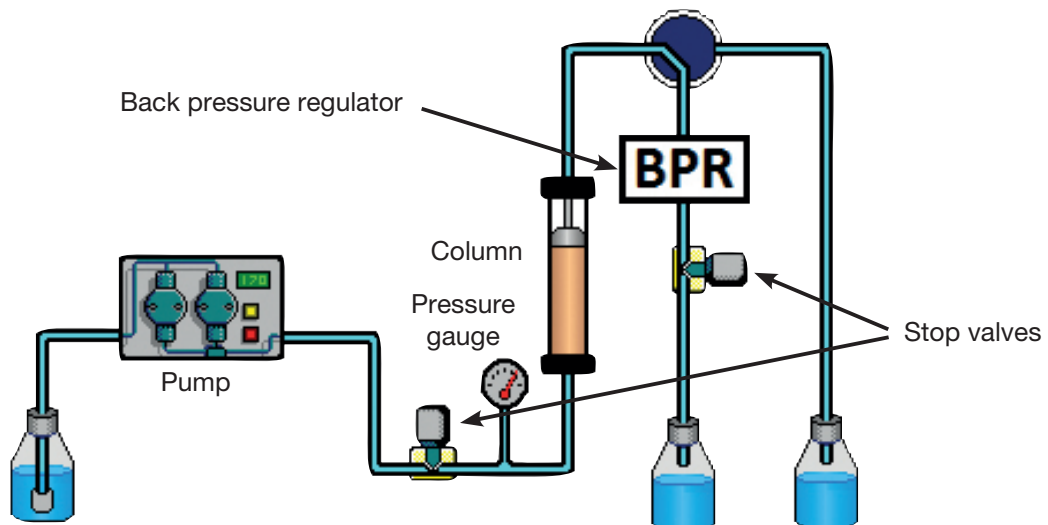


Fig. 3.2: Schematic overview of a system for a pressure test

- This is how to perform the pressure test:
1. Take the appropriate safety measures to protect the user in the event that the test fails.
 2. Place the column and suitable pump in a closed cabinet (fume hood) and attach a pressure gauge before the column (Fig. 3.2).
 3. Fill the column with isopropanol.
The AB version of ECO columns is inert to isopropanol, so that the pressure test can also be performed safely on the AB version with isopr panol.

ATTENTION

Check on the label and / or the delivery documents for the maximum allowable pressure of the column. Exceeding the maximum pressure can result in damage to the column body and plungers.

4. Now increase the pressure in the column up to the maximum permissible value by slow, gradual adjustment of the flow rate of the pump. Close the stop valves in order to maintain the appropriate maximum pressure.
5. Hold the maximum pressure constant for 10 min. This is to test for leaks or damage.
Document the test with respect to the duration and the initial and final pressures.



If leaks arise, please check the connections and replace tubing, fittings or locking screws.



Leaking seals are usually due to particulate contamination between the seals and the column walls.

3.8. Chemical resistance

The chemical resistance is dependent on the wetted materials. The chemical stability of the column can be worked out from the chemical resistance of the respective materials used. These materials can be found by correlating the ending of the column part number with tables 4 and 5.

ATTENTION

The AB version has only limited resistance to organic solvents. Before you use organic solvents with ECO AB version columns, check the resistance of the materials used against the corresponding solvent.

Table 4: used materials (►Chapter 3.3, Specifications)

Ending of part number		Materials used						
		POM	PVDF	Viton® EPDM	Kalrez®	FEP	Sintered glass PE*	Stainless steel*
Possible combinations	V (AB: aqueous buffer)	✓		✓		✓	✓	
	K (SR: solvent resistant)		✓		✓	✓	✓	✓

* ECO70 and ECO80

ATTENTION

In solvent mixtures, the resistance may differ considerably from those of the pure solvent.

ATTENTION

Such statements are based on our current technical knowledge and experience, as well as on the existing literature and information provided by the raw material manufacturer. However, these do not free the user of our products from their own testing. Certain properties or uses may not be derived either directly or implied from our information.

Table 5: Chemical resistance of materials

Solvent	POM	PVDF	Viton®	EPDM	Kalrez®	FEP	PE	Sintered glass	Stainless steel
Acetone	✓	✗	✗	✓	✓	✓	✓	✓	✓
Acetonitrile	✗	○	○	○	✓	✓	✓	✓	✓
Ammonium dihydrogen phosphate	✓	✓	○	✓	✓	✓	✓	✓	✓
Cyclohexane	✓	✓	✓	✗	✓	✓	○	✓	✓
Dichloromethane	○	✓	○	✗	✓	✓	○	✓	✓
EDTA	✓	✓	✓	✓	✓	✓	✓	✓	✓ _L
Acetic acid (5%)	✓	✓	✓	✓	✓	✓	✓	✓	✓ _L
Ethanol	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ethyl acetate	✓	✓	✗	○	✓	✓	✓	✓	✓
n-Hexane	✓	✓	✓	✗	✓	✓	✓	✓	✓
Isopropanol	✓	✓	✓	✓	✓	✓	✓	✓	✓
Methanol	✓	✓	○	✓	✓	✓	✓	✓	✓
(45%) Sodium hydroxide	✓	✓	○	✓	✓	✓	✓	✓	✓ _L
1 M hydrochloric acid	✗	✓	✓	✓	✓	✓	✓	✓	✗

✓ = stable ○ = limited ✗ = unstable L = crevice corrosion possible

References: Goodfellow – “Comparative Properties of Polymers” and “Chemical Resistance of Plastics” Bürkle GmbH, D-79540 Lörrach



If the desired solvent is not listed, please contact YMC for assistance.

Contact information:

YMC Europe GmbH
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4. Operation

Chromatography columns can be packed by various methods. This is dependent on the column, packing material and solvents used.

Two different methods can be distinguished. The so-called sedimentation method, in which the column material is poured into the column as a slurry, which is then allowed to settle under gravity (sedimentation).

The other method, referred to as slurry packing, uses flow under pressure with solvent. The slurry packing method is described as a general recommendation. Both methods are described below.

4.1. Notes on operation

⚠ WARNING

The glass column must never be used under gas pressure! Please do not exceed the recommended pressure limits of columns and accessories.

⚠ CAUTION

Particles in the solvent can lead to clogging of the frits or destruction of the column packing.

- **Use only degassed and pre-filtered solvents!**
- **Ensure that the particle size of the chromatography media used is significantly larger than the pore size of the frit used.**

ATTENTION

Follow the packing instructions from the manufacturer of the packing material!

Adjust the packing procedure from the information from manufacturer of the packing material. Using incorrect packing conditions can damage or completely destroy the materials.

ATTENTION

Avoid the use of a magnetic stirrer! Depending on the nature of the packing material this can cause mechanical damage to the material. Please contact the manufacturer of the packing material.

ATTENTION

Always use the column within the permissible pressure range! The pressure limits can be found on the delivery note and on the column label. Exceeding the limit will damage the column.

ATTENTION

Use the column only within the permitted working temperature range! Otherwise you will damage the seals.

(► *Chapter 3.3, Specifications*).

ATTENTION

Only use chemicals in the column, which the column is resistant to. Otherwise, the column may be damaged. (► *Chapter 3.8, Chemical resistance*).

4.2. Packing operations

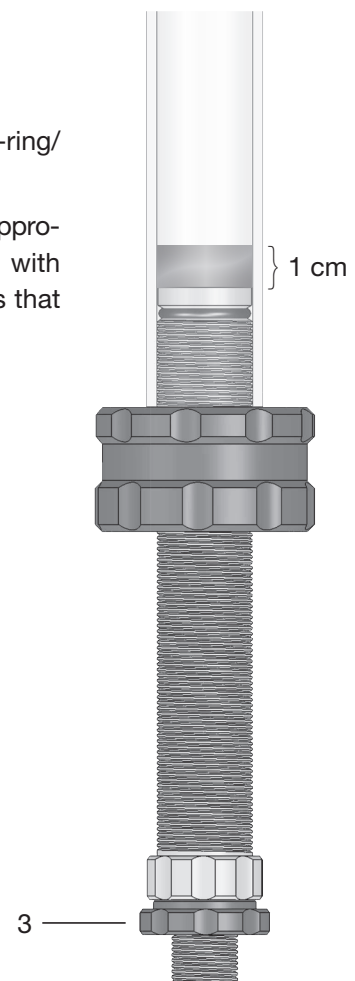
When packing please follow the numbered steps below:

If desired, the packing adapter (available separately) should be assembled. More information about the packing adapter can be found in section 4.3 (Packing adapter). Next, the slurry for the final column packing is prepared. Packing of the column may be carried out by various methods. Two procedures are described in this manual. After packing the column, a column test should be carried out to determine performance criteria.


4.2.1. Preparing the column

► Preparing the column:

1. Adjust the plunger (correct height)!
2. By turning the screw nut (3) clock-wise, the lower O-ring/ seal is fixed.
3. The column outlet is connected to the pump and an appropriate solvent (or buffer) is added to a depth of 1 cm with appropriate solvents or buffer is present. This ensures that there is no air trapped under or within the frit.
4. The column outlet is sealed with the plug supplied.



Optional: Assembly of the packing adapter if required

 Do not forget the O-rings! The packing adapter should be firmly locked to prevent material getting trapped between the seals and glass body!

► Assembly of the packing adapter:

1. Assemble the packing tube and coupling unit. For this, put the counter screw (8) for the coupling unit (12), the spring washer (7) and the column coupler snap ring (13) over the glass body (see Figure 4.1).
2. Next, connect the counter screw (8) with the pre-assembled coupling unit (12) and fix it.
3. At the other end of the packing adapter the counter screw (8), the spring washer (7) and the column coupler snap ring (13) are attached to the glass body (14).
4. The packing adapter is then attached to the glass body (14) and locked in place by the counter screw (8) on the column tube.
5. At the upper end of the glass body (14), the upper plunger from the column body is inserted.
6. Now the packing adapter can be used to pack the column according to the packing instructions in Section 5.2.

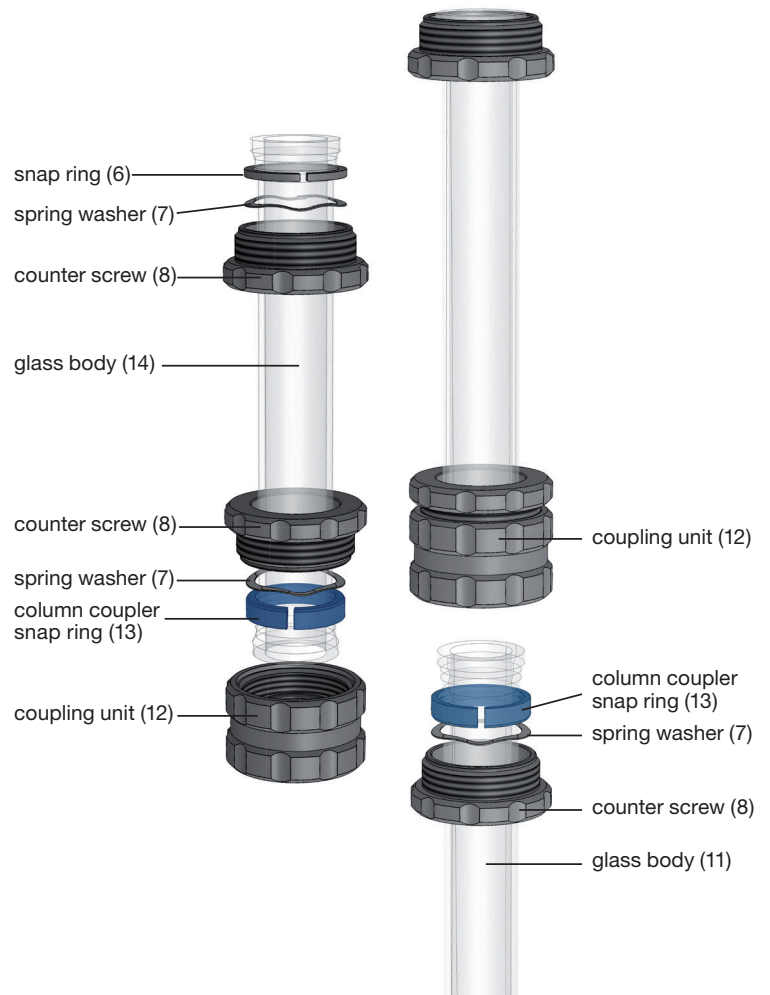


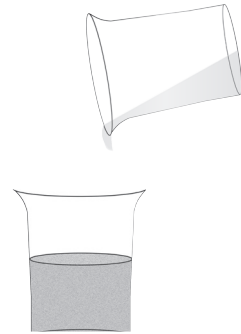
Fig. 4.1: Packing adapter - drawing

4.2.2. Preparing the slurry

► Preparing the slurry:

1. Add the appropriate solvent or the buffer to the required amount of packing material (see information for the packing material). The amount of packing material used determines the final height of the packed bed.

Note: The total volume of the slurry must not exceed the maximum volume of the column plus packing adapter.

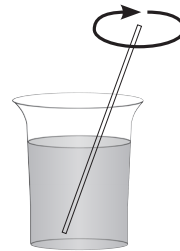


i *The packing is best performed using a slurry as dilute as possible. Always try to adjust the total volume of the slurry to the maximum volume of the column (plus packing adapter if used).*

ATTENTION

Avoid the use of a magnetic stirrer! Depending on the nature of the packing material a magnetic stirrer can cause mechanical damage to the material. Please ask the manufacturer of the packing material if you need more information.

2. Mix the slurry homogeneously with a spoon or spatula (or similar) avoiding air bubble formation.
3. Degas the homogeneous slurry in an ultrasonic bath.
4. Allow the slurry to settle. If particles (so-called fines) appear on the liquid surface, please remove them.



i *The removal of fines improves the properties of the packed column with respect to lower back pressures.*

5. Before pouring the slurry into the column you should mix again gently to create a homogeneous suspension.

4.2.3. Packing the column

► **A. Slurry packing with applied flow**

i *You can use this method to pack ECO columns with rigid packing materials (e.g. silica- or alumina- based materials).*

1. Make sure the column is exactly vertically to avoid the formation of dead volumes!
2. Pour the homogeneous, degassed slurry into the column quickly and without air bubbles. The column wall should then be rinsed with a minimal amount of solvent or buffer.

ATTENTION

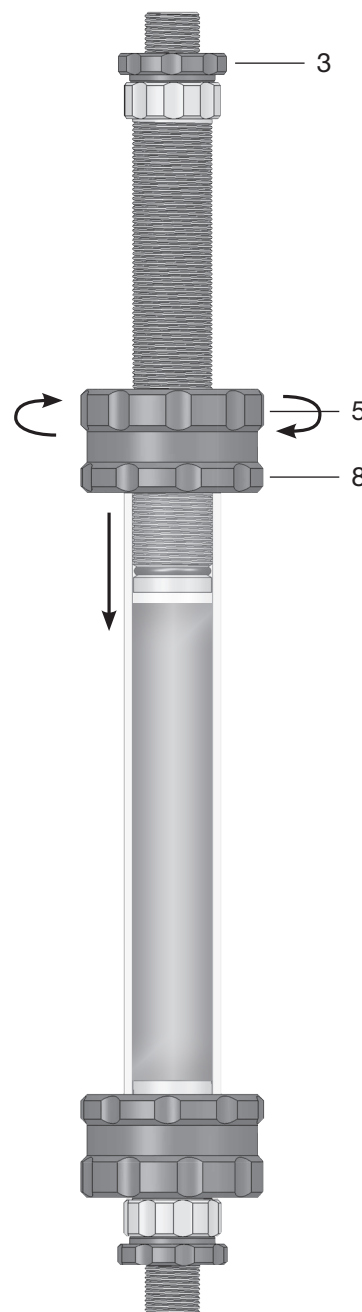
Make sure that no particles get between the seal and glass wall.

3. Gently, but carefully insert the upper plunger and move it down into the column by turning the counter screw (8).
4. Lower the plunger into the column until the first solvent exits through the upper plunger. Make sure that no air is left in the system. By turning the counter screw (8) clock-wise, fix the O-ring slightly first until it fits completely against the glass wall. Now, the plunger can be lowered again until the remaining air is removed from the system. Then tighten the O-ring to seal the column.
5. As quickly as possible, connect the pump, remove the plug from the column outlet and then start the flow.
6. Slowly increase the flow rate to the desired pressure. At each increase in flow rate allow the solvent or the buffer to pass through the column until a constant pressure is reached. Only then should the flow rate (the pressure) be increased. The column bed will be visibly compressed.

i *The pressure is controlled up to the pressure limit of the column by the pump. If necessary the column should be packed with the maximum flow rate of the pump. The pressure limit depends both on the specification of the ECO glass column, as well as the packing material used (See packing material and column).*

i *The flow rate used for packing should ideally be at least 20% higher than the flow rate used for subsequent separations.*

7. After switching off the pump, the plunger should be moved by turning the counter screw (8) down until it touches the column bed. This should be done quickly, as evenly as possible without shaking.
8. Turn the pump on again and check for any dead volume. In accordance with paragraph 6, the upper plunger can be readjusted to the top of the column bed again after switching off the pump. This procedure should be repeated as many times as required until no more dead volume is present.
9. Finally, equilibrate the column with the desired eluent and test.
▶ Chapter 4.2.4., p. 31.



► **B. Sedimentation process**

i *ECO columns can be packed with rigid gels (e.g., silica- or alumina-based particles) or soft gels (e.g. polymer gels or soft gels and agarose- or styrene-divinylbenzene- based particles) with this method.*

1. With the column outlet sealed with a plug, pour the homogeneous and degassed slurry rapidly and as far as possible without air bubbles into the glass column. Add a small amount of solvent or buffer to the column to rinse the walls.
2. Allow the gel to settle (sedimentation).

ATTENTION

The column packing must not run dry.

3. Drain the liquid to approx. 3 cm above the gel bed, by removing the plug at the outlet of the lower column.
4. Close the column outlet again with the plug to prevent the packing to running dry.

ATTENTION

Make sure that there are no particles between the seal and glass wall.

5. Gently, but carefully insert the upper plunger and move it down into the column by turning the counter screw.
6. Lower the plunger into the column until the first solvent exits through the upper plunger. Make sure that no air is left in the system.
7. Fix the O-ring with the screw nut.

i *Make sure that there is no air in the system. By lowering the plunger in step 8, the remaining air can be removed from the column through the frit.*

8. The plunger is adjusted by turning the counter screw down until it touches the column bed. For pressure-labile materials no pressure must be generated by the plunger on the column bed. Please refer to the packing instructions from the manufacturer of the packing material.
9. Finally, equilibrate the column with the desired eluent and test it.
► *Chapter 4.2.4., p. 31.*



4.2.4. Column test and acceptance criteria

The column test and the acceptance criteria should be designed with regard to the subsequent application. The preparation of the necessary specifications for the subsequent application of a method or the purification of a target compound requires customisation. The expected values for the achievable theoretical plate number can be found within the manufacturer specifications of the bulk media (see the example on this page).

Example for YMC-Triart Prep bulk media

After finishing the packing procedure, the theoretical plate number (N) and the peak symmetry should be evaluated.

Example conditions of column performance evaluation for YMC-Triart Prep C18-S:

Column size:	250 x 50 mm ID
Eluent:	methanol/water (85/15, v/v)
Flow rate:	50 mL/min
Detection:	UV at 254 nm
Sample:	1. Uracil (0,6 mg/mL) 2. Methyl benzoate (0,6 mg/mL) 3. Toluene (40 µL/mL)
Injection:	1 mL
Evaluation:	Theoretical plate number (N) of toluene

Expected theoretical plate number (N/m)*

	10 µm	15 µm	20 µm
C18	25,000/m	16,000/m	12,000/m
C8	23,000/m	15,000/m	11,000/m

* Values might be influenced by column or LC system

For a successful packing 90% of the theoretical plate number should be reached (e.g. C18, 10 µm, 22,500) and the peak symmetry should be in between 0.7 and 1.3.

YMC Europe GmbH would be pleased to help you technically.

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4.3. Packing adapter

The packing adapter is designed for non-pressure (sedimentation) packing of the column and for packing with applied flow (slurry packing). When packing with applied flow, the specification must be considered with the pressure stability (see table on page 14).*

- To assemble the packing adapter, please follow the numbered steps:

i Do not forget the O-rings! The packing adapter should be firmly locked to prevent material getting trapped between the seals and glass body!

1. Assemble the packing tube and coupling unit. For this, put the counter screw (8) for the coupling unit (12), the spring washer (7) and the column coupler snap ring (13) over the glass body (see Figure 4.1).
2. Next, connect the counter screw (8) with the pre-assembled coupling unit (12) and fix it.
3. At the other end of the packing adapter the counter screw (8), the spring washer (7) and the column coupler snap ring (13) are attached to the glass body (14).
4. The packing adapter is then attached to the glass body (14) and locked in place by the counter screw (8) on the column tube.
5. At the upper end of the glass body (14), the upper plunger from the column body is inserted.
6. Now the packing adapter can be used to pack the column according to the packing instructions in Section 4.2.3.

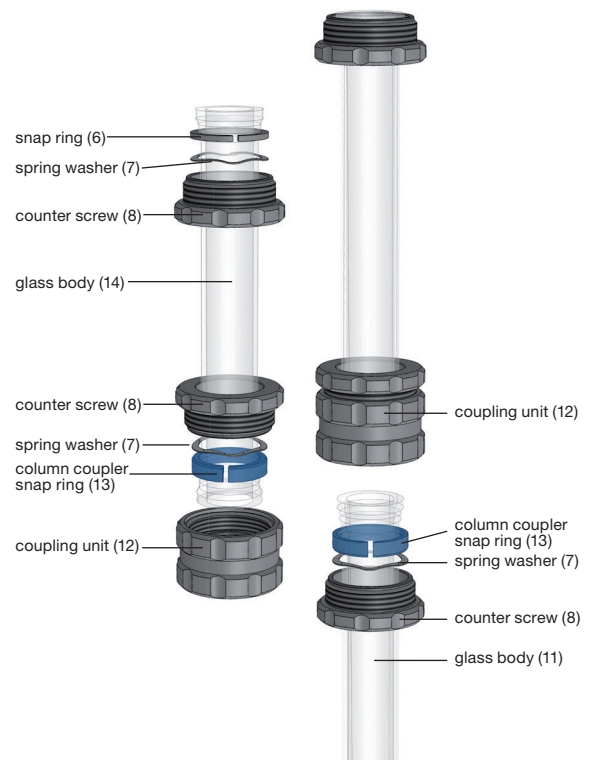


Fig. 5.1: Packing adapter - drawing

We recommend the use of a packing adapter for an easier and improved packing process. Ordering numbers can be found in table 6 on the following page. The glass body of the packing adapter is not supplied as part of the packing adapter. This must be ordered with the required length separately.

The part numbers for the ECO coupling unit are in table 7 and the ECO glass bodies in table 8 and 9 on the following page.

* For ECO70 and ECO80, the maximum pressure is 1 bar. Only the snap ring (6) is necessary, not the pack-snap ring (13).

Table 6: Packing adapter

Number	Article	Special features
1	Glass body (same ID as the column)	Must be ordered separately from the column coupler unit
1	ECO coupling unit with Teflon insert (assembled)	
2	Column coupler counter screw with column coupler snap ring and 1 spring washer	
2	Viton® O-Ring or EPDM O-Ring (70+80)	for AB Version
2	Kalrez® O-Ring	for SR Version

Table 7: ECO coupling unit

Column ID [mm]	Coupling unit AB-Version Part number	Coupling unit SR-Version Part number
10	ECO10KU/V-3	ECO10KU/K-3
15	ECO15KU/V-3	ECO15KU/K-3
25	ECO25KU/V-3	ECO25KU/K-3
50	ECO50KU/V-3	ECO50KU/K-3
70	ECO70KU/E-2	—
80	ECO80KU/E	—

Table 8: ECO glass body

Column ID [mm]	Max. bed length 120 mm Part number	Max. bed length 200 mm Part number	Max. bed length 450 mm Part number	Max. bed length 750 mm Part number	Max. bed length 1000 mm Part number
10	ECO10/120	ECO10/200	ECO10/450	ECO10/750	ECO10/999
15	ECO15/120	ECO15/200	ECO15/450	ECO15/750	ECO15/999
25	ECO25/120	ECO25/200	ECO25/450	ECO25/750	ECO25/999
50	ECO50/120	ECO50/200	ECO50/450	ECO50/750	ECO50/999
70	ECO70/120	ECO70/200	ECO70/450	ECO70/750	ECO70/999
80	ECO80/120	ECO80/200	ECO80/450	ECO80/750	ECO80/999

Table 9: ECO glass body with water-jacket

Column ID [mm]	Max. bed length 120 mm Part number	Max. bed length 200 mm Part number	Max. bed length 450 mm Part number	Max. bed length 750 mm Part number	Max. bed length 1000 mm Part number
10	ECO10/120/K	ECO10/200/K	ECO10/450/K	ECO10/750/K	ECO10/999/K
15	ECO15/120/K	ECO15/200/K	ECO15/450/K	ECO15/750/K	ECO15/999/K
25	ECO25/120/K	ECO25/200/K	ECO25/450/K	ECO25/750/K	ECO25/999/K
50	ECO50/120/K	ECO50/200/K	ECO50/450/K	ECO50/750/K	ECO50/999/K

4.4. Information for Cleaning-In-Place (CIP)

The cleaning in place (CIP) procedure allows the cleaning of a packed ECO column, without having to unpack it.

► The cleaning of a packed chromatography column involves three steps:

1. Regeneration of the column packing
2. Sterilization
3. Depyrogenation.

Regeneration removes inorganic and organic contamination, which has become non-specifically bound to the chromatography matrix and substantially reduces the capacity and resolution of the column. This contamination is usually caused by lipids and pyrogens, protein aggregates, pigments, polyphenols or metal complexes.

Sterilization is the removal and/or denaturing of micro-organisms and spores that can contaminate the purified product. Most common method of treatment is the use of chemicals such as sodium hydroxide, acetic acid or ethanol solutions containing these chemicals.

Depyrogenation involves break-down of endotoxins that have become attached to the chromatographic packing material or to the column hardware (frits, tubing, etc.) and which can contaminate the product during purification. Often, the methods to sterilize the equipment destroy the pyrogens at the same time.

ATTENTION

Before cleaning the packed column with the CIP methods below, please check whether the column packing is compatible with the treatment. Otherwise, you will damage the stationary phase.

Table 10: cleaning methods for CIP

Treatment	Contamination	Sterilization	Depyrogenation
Pepsin, pH 1.5 - 2	Proteolysis of adsorbed proteins	no	no
Non-ionic detergents (Triton X-100; Tween 80)	Removal of hydrophobic proteins and lipids	no	no
Cationic detergents, pH 9 - 11	Removal of hydrophobic proteins and lipids	no	partially
Urea, 6 - 8 M	Removal of protein aggregates	no	unknown
1 - 100 mM EDTA, pH depends on the stationary phase	Removal of metal complexes	no	no
0.1 - 1 M NaOH	Removal of bonded hydrophobic proteins and lipopolysaccharides	good	good
0.5 - 1 M acetic acid in 60% ethanol	Removal of lipids, pigments, lipopolysaccharides and other lipophilic substances	very good	good
Organic solvents up to 100% (e.g. THF, isopropanol)	Removal of hydrophobic impurities	unknown	unknown

References:

De Bernardez Clark, E. (1998) Refolding of recombinant proteins. *Current Opinion Biotechnol.* 9, 157 - 163

Grönberg A et al. (2011) A tool for increasing the lifetime of chromatography resins. *mABS*, Vol 3, Issue 2, 192 - 202

Hagel L, Jagschies G, Sofer G, *Cleaning and Sanitization In: Handbook of Process Chromatography–Development, Manufacturing, Validation and Economics. Second edition, London, UK: Academic Press 2008*

Lillie, H., Schwarz, E. & Rudolph, R. (1998) Advances in refolding of proteins produced in *E. coli*. *Current Opinion Biotechnol.* 9, 497 - 501

Romney AJD (1990) CIP: *Cleaning In Place*, 2nd edition, *Int J Dairy Technol*, Vol. 43, Issue 2, p. 59

Sofer GK, Nyström LE, *Process Chromatography - A Guide to Validation*, London, UK: Academic Press 1991


Tamime AY, *Cleaning in Place: Dairy, Food and Beverage Operations. 3rd Edition, Oxford, UK: Backwell Publishing 2008*


 We recommend that you document all CIP processes. For this purpose, we have provided a log in the Appendix.

4.5. Unpacking


ATTENTION

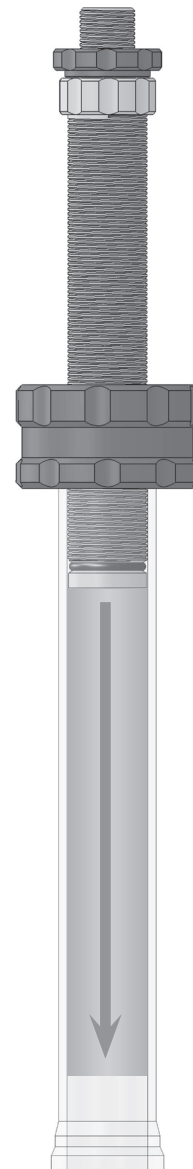
Please do not dig out the packing material out of the ECO column with tools because the inner wall and the packing material will be damaged! We recommend the use of a pump to push the stationary phase.

 Please collect the unpacked material in a container and dispose of it according to the manufacturer's instructions!


 The solvents used should be disposed of in accordance with national standards.

- ▶ When unpacking the column please follow these steps:
 1. Connect the column to the pump.
 2. Remove the lower plunger from the outlet of the column and place a suitable container below the outlet.
 3. Start the pump and push the material out from the open glass tube.

 It is strongly recommend that the column is complete disassembled and the glass body cleaned after unpacking. (▶ Chapter 3.4, Dismantling and Chapter 3.5, Cleaning).



5. Maintenance

 If you need to replace any parts of the column, you will find the spare parts lists in ►Chapter 9.1, spare parts list.

WARNING

Some chemicals used for cleaning can cause serious injury. The cleaning process for the chromatography columns should be performed in a fume cupboard or in a well-defined place.

ATTENTION

Before cleaning it is essential to check that the parts of the column are resistant to the chemicals used. Otherwise there is a risk of damage to the wetted parts. (►Chapter 3.8, Chemical resistance)


ATTENTION

You should periodically clean the column otherwise you jeopardize the performance of the column. Check and replace the following parts if necessary (frits, glass body, O-ring seals).

5.1. Maintenance schedule

The specified maintenance plan here should be regarded as a general recommendation. The actual maintenance items and intervals should be designed depending on the frequency and type of use the column receives.

Interval	Maintenance
daily	<ul style="list-style-type: none"> • Check column bed height and tighten plunger sealing mechanism (►Chapter 3.6.1, Installing the plunger). • Check all tubes and connections for leaks and retighten fixing screws if necessary. Alternatively replace the corresponding tubes or connectors (►Chapter 3.6.2, Column to tubing connections).
every 3 months	<ul style="list-style-type: none"> • Check plunger rod and seals (O-rings or lamellae seals). If necessary replace the O-rings or plunger (►Chapter 3.4, Disassembly of the column).
every 6 months	<ul style="list-style-type: none"> • Check frits seating, if necessary replace the frit (►Chapter 5.2, Frit replacement)

 We recommend that you record all maintenance. For this purpose, we have provided a logbook in the Appendix.

5.2. Frit replacement

The frits can be changed for most column types using common laboratory equipment. Instructions are given in this manual for the various column types. However, frit replacement can also be carried out by YMC Europe GmbH if required, please contact:-

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The part numbers for the corresponding frits can be found in ►Chapter 9.1, Spare parts list.

Frit replacement at ECO10 to ECO50:

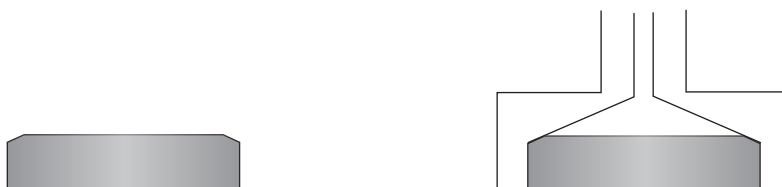


Fig. 5.1: Schematic illustration of a frit

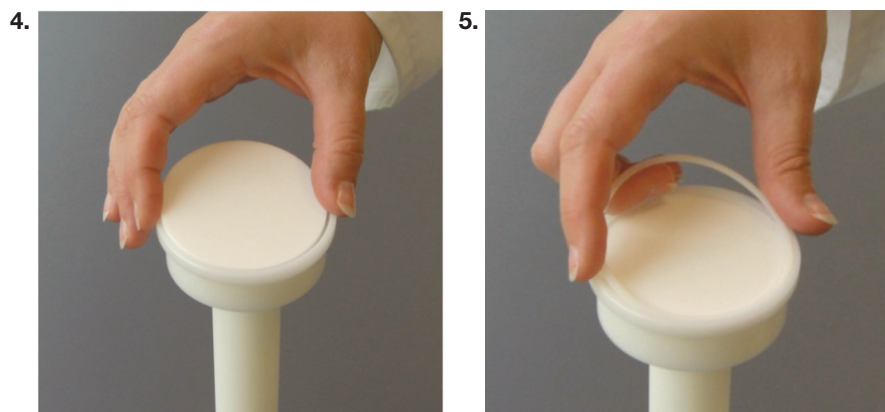
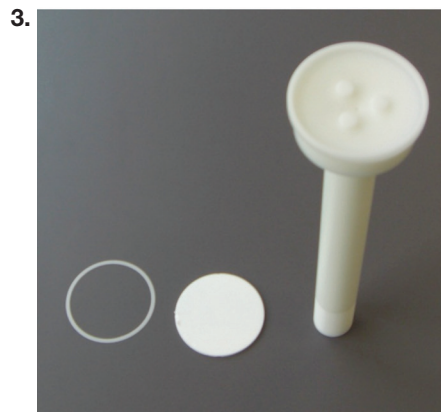
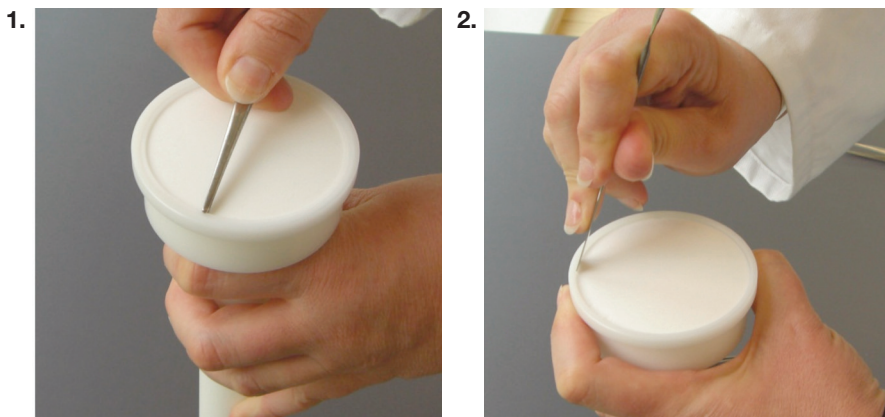
- To replace the frit please proceed in the following order:
1. Remove the old frit from the plunger using the frit removal tool supplied.
 2. Place the new frit on a smooth, clean surface with the wide side facing down. Place the plunger with the opening over the frit and press vertically down, with care, until the frit is fully located in the plunger.

ATTENTION

When pushing the frit in, a strong resistance will be observed but the frit will only locate into the opening at the plunger with strong pressure. Make sure that the frit fits into opening exactly, otherwise the plunger or the frit may be damaged.

► Frit replacement at ECO70 up to ECO80:

1. The support ring is removed using a tweezers. As soon as the ring is released on one side, it can be pulled completely out.
2. The frit can then be lifted with a spatula from the socket. Alternatively, the frit may also be cut, before it is removed.
3. When replacing the frit both a new frit and a new O-ring should be inserted.
4. The frit is placed by hand in/on the plunger.
5. The support ring is then pressed into the gap between frit and plunger edge. The support ring can be easily pressed with the thumb into the plunger edge.



6. Troubleshooting guide

6.1. Troubleshooting table

Description of error	Possible reason	Remedial action
1. Dead volumes occur	Exceeding of the maximum allowable pressure for the column packing Pressure on the column packing	1. Switch off the pump 2. Turn column counter screw counter-clockwise 3. Adjust the plunger onto the packing material surface. Do not force! ATTENTION Danger of destroying the packing and the frit!
2. Peak shape of the eluted substances deteriorates	1. Dead volume at the column inlet 2. Partially clogged entry frit 3. Partially clogged outlet frit 4. Separation performance of the stationary phase changed by contamination 5. Stationary phase mechanically destroyed	1. ►Point 1 "Dead volumes occur" 2. ►Chapter 5.2 Frit replacement 3. ►Chapter 5.2 Frit replacement 4. Rinse and consult the manufacturer of the packing material ►Chapter 4.4, CIP 5. Replace packing material
3. Air (gas) in the column	Solvent has degassed or evaporated during storage	Recondition the column; maybe replacement packing is necessary
4. Abnormal pressure increase during use	1. Valve incorrectly switched 2. Blocked frit 3. Fittings over tightened	1. Check valve positions 2. ►Chapter 5.2 Frit replacement 3. Renew fixing screws and ferrules, re-cut the end of the tube
5. Pressure drop during use	1. Leak in the tube pipe or fittings between the pump and column 2. Solvent reservoir empty	1. Check tubing and connections 2. Refill solvent
6. Solvent drips from the column	1. Plunger leaking 2. Connection tube leaking	1. Visual inspection, is solvent past the seal? Tighten the screw nut again, remove plunger -> clean glass body and seals -> insert new plunger/ replace O-rings -> re-condition column 2. Tighten fixing screw -> check connecting tubing for leaks -> re-condition column

7. Storage, packaging and transport

7.1. Storage

ATTENTION

Store the glass column body securely! This will avoid the column falling and the glass breaking.



For storage of packed columns, we recommend that you consider the chemical resistance of the wetted materials (►Chapter 3.8, Chemical resistance), and chemical resistance of the packed stationary phase (please check with the manufacturer).

7.2. Packaging and transport

ATTENTION

Damage can occur with improper packaging at a high altitude.

We encourage you to always use the original packaging for transportation (►Chapter 2.2, Delivery inspection). If you no longer have the original packaging, please pack the column in a similar manner. For this purpose, please make sure the chromatography column or other component parts are not in direct contact with the outer packaging. Allow at least 50 mm distance between the chromatographic column and packaging by using foam padding (eg polystyrene, etc.) as a spacer.

- Attach appropriate warnings (e.g. "Caution Glass").

8. Disposal

To dispose of the ECO column, it must be dismantled and each part disposed of according national and other applicable rules for environmentally safe disposal.

9. Spare and replacement parts

9.1. Spare parts list

ECO glass bodies

Part No.	ID [mm]	max. bed length [mm]
ECO10/120	10	120
ECO10/200	10	200
ECO10/450	10	450
ECO10/750	10	750
ECO10/999	10	1000
ECO15/120	15	120
ECO15/200	15	200
ECO15/450	15	450
ECO15/750	15	750
ECO15/999	15	1000
ECO25/120	25	120
ECO25/200	25	200
ECO25/450	25	450
ECO25/750	25	750
ECO25/999	25	1000
ECO50/120	50	120
ECO50/200	50	200
ECO50/450	50	450
ECO50/750	50	750
ECO50/999	50	1000
ECO70/120	70	120
ECO70/200	70	200
ECO70/450	70	450
ECO70/750	70	750
ECO70/999	70	1000
ECO80/120	80	120
ECO80/200	80	200
ECO80/450	80	450
ECO80/750	80	750
ECO80/999	80	1000

ECO glass bodies with water-jacket

Part No.	ID [mm]	max. bed length [mm]
ECO10/120/K	10	120
ECO10/200/K	10	200
ECO10/450/K	10	450
ECO10/750/K	10	750
ECO10/999/K	10	1000
ECO15/120/K	15	120
ECO15/200/K	15	200
ECO15/450/K	15	450
ECO15/750/K	15	750
ECO15/999/K	15	1000
ECO25/120/K	25	120
ECO25/200/K	25	200
ECO25/450/K	25	450
ECO25/750/K	25	750
ECO25/999/K	25	1000
ECO50/120/K	50	120
ECO50/200/K	50	200
ECO50/450/K	50	450
ECO50/750/K	50	750
ECO50/999/K	50	1000
ECO70/120/K	70	120
ECO70/200/K	70	200
ECO70/450/K	70	450
ECO70/750/K	70	750
ECO70/999/K	70	1000
ECO80/120/K	80	120
ECO80/200/K	80	200
ECO80/450/K	80	450
ECO80/750/K	80	750
ECO80/999/K	80	1000

End piece AB - variable, complete

(Counter screw, spring washer and snap ring, inner plunger and external plunger, screw nut, O-ring and frit)

Part No.	ID [mm]	frit porosity [µm]
ECO10END/V0V	10	10 - 16
ECO15END/V0V	15	10 - 16
ECO25END/V0V	25	10 - 16
ECO50END/V0V	50	10 - 16
ECO70END/V0V	70	10 - 16
ECO80END/V0V	80	10 - 16
ECO10END/V3V	10	16 - 40
ECO15END/V3V	15	16 - 40
ECO25END/V3V	25	16 - 40
ECO50END/V3V	50	16 - 40
ECO70END/V3V	70	16 - 40
ECO80END/V3V	80	16 - 40
ECO10END/V4V	10	40 - 100
ECO15END/V4V	15	40 - 100
ECO25END/V4V	25	40 - 100
ECO50END/V4V	50	40 - 100
ECO70END/V4V	70	40 - 100
ECO80END/V4V	80	40 - 100

End piece SR - variable, complete

(Counter screw, spring washer and snap ring, inner plunger and external plunger, screw nut, O-ring and frit)

Part No.	ID [mm]	frit porosity [µm]
ECO10END/V0K	10	10 - 16
ECO15END/V0K	15	10 - 16
ECO25END/V0K	25	10 - 16
ECO50END/V0K	50	10 - 16
ECO70END/V0K	70	10 - 16
ECO80END/V0K	80	10 - 16
ECO10END/V3K	10	16 - 40
ECO15END/V3K	15	16 - 40
ECO25END/V3K	25	16 - 40
ECO50END/V3K	50	16 - 40
ECO70END/V3K	70	16 - 40
ECO80END/V3K	80	16 - 40
ECO10END/V4K	10	40 - 100
ECO15END/V4K	15	40 - 100
ECO25END/V4K	25	40 - 100
ECO50END/V4K	50	40 - 100
ECO70END/V4K	70	40 - 100
ECO80END/V4K	80	40 - 100

End piece AB - fixed, complete

(Counter screw, spring washer and snap ring, inner plunger and external plunger, screw nut, O-ring and frit)

Part No.	ID [mm]	frit porosity [µm]
ECO10END/F0V	10	10 - 16
ECO15END/F0V	15	10 - 16
ECO25END/F0V	25	10 - 16
ECO50END/F0V	50	10 - 16
ECO70END/F0V	70	10 - 16
ECO80END/F0V	80	10 - 16
ECO10END/F3V	10	16 - 40
ECO15END/F3V	15	16 - 40
ECO25END/F3V	25	16 - 40
ECO50END/F3V	50	16 - 40
ECO70END/F3V	70	16 - 40
ECO80END/F3V	80	16 - 40
ECO10END/F4V	10	40 - 100
ECO15END/F4V	15	40 - 100
ECO25END/F4V	25	40 - 100
ECO50END/F4V	50	40 - 100
ECO70END/F4V	70	40 - 100
ECO80END/F4V	80	40 - 100

End piece SR - fixed, complete

(Counter screw, spring washer and snap ring, inner plunger and external plunger, screw nut, O-ring and frit)

Part No.	ID [mm]	frit porosity [µm]
ECO10END/F0K	10	10 - 16
ECO15END/F0K	15	10 - 16
ECO25END/F0K	25	10 - 16
ECO50END/F0K	50	10 - 16
ECO70END/F0K	70	10 - 16
ECO80END/F0K	80	10 - 16
ECO10END/F3K	10	16 - 40
ECO15END/F3K	15	16 - 40
ECO25END/F3K	25	16 - 40
ECO50END/F3K	50	16 - 40
ECO70END/F3K	70	16 - 40
ECO80END/F3K	80	16 - 40
ECO10END/F4K	10	40 - 100
ECO15END/F4K	15	40 - 100
ECO25END/F4K	25	40 - 100
ECO50END/F4K	50	40 - 100
ECO70END/F4K	70	40 - 100
ECO80END/F4K	80	40 - 100

Viton®/EPDM O-rings, AB-version
2 pieces per package

Part No.	ID [mm]
ECO1011V/P2	10
ECO1511V/P2	15
ECO2511V/P2	25
ECO5011V/P2	50
ECO70AB100E/P2	70
ECO80AB100E/P2	80

Kalrez® O-rings, SR-version
2 pieces per package

Part No.	ID [mm]
ECO1011K/P2	10
ECO1511K/P2	15
ECO2511K/P2	25
ECO5011K/P2	50
ECO7011K/P2	70
ECO8011K/P2	80

Coupling unit AB-version

Part No.	ID [mm]
ECO10KU/V-3	10
ECO15KU/V-3	15
ECO25KU/V-3	25
ECO50KU/V-3	50
ECO70KU/E-2	70
ECO80KU/E	80

O-ring (Viton®) for coupling unit
AB-version, 2 pieces per package

Part No.	ID [mm]
ECO10KU/V/P2	10
ECO15KU/V/P2	15
ECO25KU/V/P2-2	25
ECO50KU/V/P2-2	50

Glass frits, 2 pieces per package

Part No.	ID [mm]	frit porosity [µm]
ECO10G10/P2	10	10 - 16
ECO15G10/P2	15	10 - 16
ECO25G10/P2	25	10 - 16
ECO50G10/P2	50	10 - 16
ECO10103/P2	10	16 - 40
ECO15103/P2	15	16 - 40
ECO25103/P2	25	16 - 40
ECO50103/P2	50	16 - 40
ECO10104/P2	10	40 - 100
ECO15104/P2	15	40 - 100
ECO25104/P2	25	40 - 100
ECO50104/P2	50	40 - 100

Coupling unit SR-version

Part No.	ID [mm]
ECO10KU/K-3	10
ECO15KU/K-3	15
ECO25KU/K-3	25
ECO50KU/K-3	50

O-ring (Kalrez®) for coupling unit
SR-version, 2 pieces per package

Part No.	ID [mm]
ECO10KU11K/P2	10
ECO15KU11K/P2-2	15
ECO25KU11K/P2-2	25
ECO50KU11K/P2-2	50

Accessories for glass columns

Part No.	Description
FA	frit removal tool
K.P316-5	plugs PTFE (1/4 inch-28G), 5 pieces per package
K.P620-5	coupling unit (double-ended ID 1/4 inch-28G), 5 pieces per package
K.P621-5	adapter 1/4 inch-28G to M6, 5 pieces per package
K.P627	adapter 10-32 to 1/4 inch-28G (incl. 1 F-300 fitting for 1/16 inch tubing)

Tubing

Part No.	Description
PT0,8FE1,6/M5	FEP tubing 0.8 x 1.6 mm (1/16 inch), 5 m per package
PT1,6FE3,2/M5	FEP tubing 1.6 x 3.2 mm (1/8 inch), 5 m per package
JR-T-082-M3	Tefzel tubing 1/16 inch (for ID 5 mm), 3 m per package

Fittings (fixing screw and ferrules)

Part No.	Description
JR-55050-10	Fixing screw, 1/4 inch-28, PPS, for collapsible ferrule for 1/16 inch tubing, 10 pieces per package
JR-CL-CB1KF	Ferrule, collapsible, for 1/16 inch tubing, 10 pieces per package
K.P201X	Fixing screw 1/4 inch-28G for 1/16 inch tubing, 10 pieces per package
K.P200NX	Ferrule for 1/16 inch tubing, 10 pieces per package
K.P207X	M6 fixing screw, for 1/16 inch tubing, 10 pieces per package
K.P200NX	M6 Ferrule, for 1/16 inch tubing, 10 pieces per package
JR-55051-10	Fixing screw, 1/4 inch-28, PPS, for collapsible ferrule for 1/8 inch tubing, 10 pieces per package
JR-CL-CB2KF-10	Ferrule, collapsible, for 1/8 inch tubing, 10 pieces per package
K.P301X	Fixing screw 1/4 inch-28G for 1/8 inch tubing, 10 pieces per package
K.P300NX	Ferrule for 1/8 inch tubing, 10 pieces per package
K.P307X	M6 fixing screw, for 1/8 inch tubing, 10 pieces per package
K.P300NX	M6 Ferrule, for 1/8 inch tubing, 10 pieces per package

Part No.	Description
JR-58000-5	10-32 fixing screw/ferrule for 1/16 inch tubing, 5 pieces per package

Part No.	Description
JR-797	Clean-Cut Tubing Cutter

9.2. Column versions available


ECO columns are available in different versions. These versions are derived from the combinations of inner diameter, maximum bed length, plunger type, frit material, frit porosity and the column variant (AB or SR). Any combination gives an individual part number, from which the column parameters are derived. The part number can be found on the label on the column glass body. The label also contains information about the maximum pressure that can be used with the column.

YMC EUROPE GMBH	D-46539 Dinslaken
Pr.-No.:	ECO15/120V3V
ID/Length:	15 x 120 mm
Pressure:	25 bar
Ser.-No.:	ECO123456

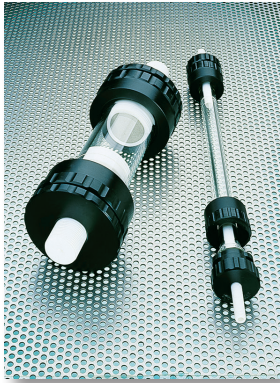
In Table 11, the column parameters are listed, from which the different part numbers (column versions) are generated. Their combination (from left to right) gives the part number. For a better understanding in the lower half of the table is an example of the generation of the Part No. ECO15/120V3V. This contains the information for a ECO column with a maximum bed length of 120 mm, one height-adjustable plunger and frit porosity of 16-40 microns.

Table 11: Column versions and part numbers

Combination possibilities	ECO10/ (10 mm ID)	120 (120 mm max. bed length)	V Vario (1 height-adjustable plunger)	0 (10 µm)	V Viton® (AB-version)	
	ECO15/ (15 mm ID)	200 (200 mm max. bed length)				
	ECO25/ (25 mm ID)	450 (450 mm max. bed length)	M Multivario (2 height-adjustable plungers)	3 (16-40 µm)	K Kalrez® (SR-version)	
	ECO50/ (50 mm ID)	750 (750 mm max. bed length)				
		999 (1000 mm max. bed length)				
Example 1	ECO15/	120	V	3	V	
Co. No. (part number)						
ID	15 mm					
Max. bed length		120 mm				
Plunger type			Vario			
Frit porosity				16-40 µm		
O-ring seal					Viton®	
Water-jacket						-

 On request, special versions of the columns can be manufactured. YMC Europe GmbH would be happy to discuss your requirements.

10. Product cross-references



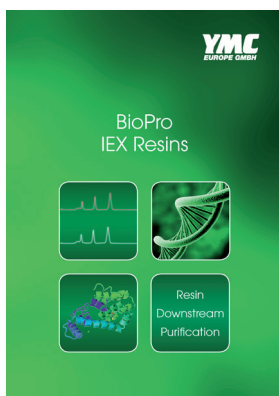
ECO^{PLUS} laboratory glass columns:

- special pressure resistant alternative to ECO columns (up to 80 bar)
- easy-to-use bayonet closure
- 5 to 50 mm ID
- strong and robust construction



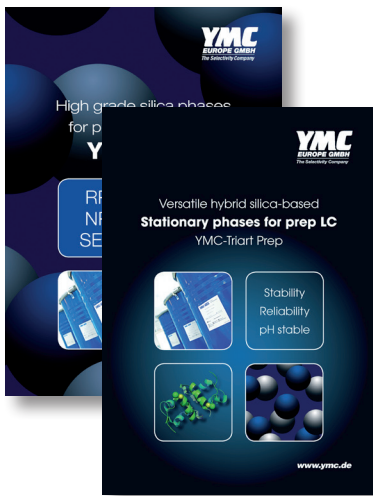
Pilot columns:

- for the scale up to process scale
- 60 mm to 450 mm inner diameter
- biocompatible AB-version
- SR-version with plungers of stainless steel available
- custom sizes on demand
- FDA certification, declaration of freedom from TSE/BSE, USP Class VI certification



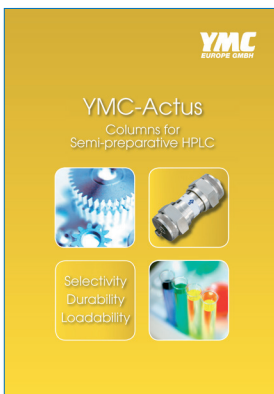
BioPro:

- polymeric ion exchange material for biochromatography
- available as strong anion- or cation-exchanger
- excellent flow properties and high dynamic binding capacity
- extremely economic for industrial scale applications
- particle sizes: 10 µm; 20 µm; 30 µm; 75 µm



YMC*Gel / YMC-Triart Prep:

- general purpose preparative phases on high grade silica base
- available as silica or with C18, C8, C4, C1, phenyl, cyano, amino or diol bonding
- particle sizes: 10 μm ; 15 μm ; 20 μm ; 50 μm
- pore sizes: 8 nm; 12 nm; 20 nm; 30 nm
- YMC-Triart Prep: pH- and temperature- stable hybrid material
- robust, flexible and economic



YMC-Actus:

- columns packed for high pressure applications
- dynamic axial compression for an improved chromatographic performance
- robust performance for easy handling with complete reliability
- inner diameters from 20 mm to 1000 mm
- lengths from 250 mm to 1000 mm

11. Index

A	
Assembly	16
C	
Cleaning	15
Cleaning in Place (CIP)	34
Chemical resistance	22
Column construction	13
Column coupler	32
Column test	31
D	
Delivery	8
Dismantling	15
F	
Frit replacement	37
M	
Maintenance	36
P	
Packing	28
Packing adapter	32
Packing procedure	26
Pressure test	20
S	
Sedimentation process	30
Slurry	28
Specifications	14
Storage	40
T	
Troubleshooting	39
U	
Unpacking	35

12. Appendix

Logbook

Activity No.	Date	Activity (e.g. maintenance, cleaning, etc.) and / or error description	Action taken	Conducted by	Result / commentary

Activity No.	Date	Activity (e.g. maintenance, cleaning, etc.) and / or error description	Action taken	Conducted by	Result / commentary

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