

Instructions for Use

# CIMmultus<sup>®</sup> C4 HLD 400 mL Monolithic Column (HLD Butyl) (2 µm channels)

CIM Convective Interaction Media<sup>®</sup>  
814.8136-2



SARTORIUS

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# 1. About These Instructions for Use

These instructions are part of the device. They apply to the device product number indicated on the cover page.

## 1.1. Accompanying Documents

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Column integrity test



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Starting conditions for purification of mRNA with C4  
HLD



## 2. Safety

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### WARNING

Denotes a hazard that may result in death or severe injury if it is not avoided.

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### CAUTION

Denotes a hazard that may result in moderate or minor injury if it is not avoided.

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### NOTICE

Denotes a hazard that may result in property damage if it is not avoided.

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## 2.1. Intended Use

CIMmultus<sup>®</sup> Monoliths are reusable chromatography devices for scalable high-resolution purification of complex biological samples. Inside the custom designed housing is a single-piece stationary phase with homogeneous channel size and surface chemistry. Without the need for column packing, CIMmultus<sup>®</sup> Monoliths are ready for use out of the box.

This high-performance column is primarily intended for fast and efficient purification or polishing of biomolecules

such as proteins, viral particles, and pDNA under hydrophobic conditions. The following information is being provided to ensure proper product care and optimal product performance.

## 2.2. Safety Note

Follow the guidelines in this Instructions for Use. Improper use may result in malfunction, personal injury, or damage of the product or material. Follow safety instructions, wear gloves, safety glasses, and a lab coat during operation.

## 3. Technical Data

|                       |                                                                                                                                                                                                                                                                                                                                                |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Column chemistry      | C4 HLD (hydrophobic; butyl – high ligand density)                                                                                                                                                                                                                                                                                              |
| Channel radius        | 1050 nm (950 nm – 1150 nm)                                                                                                                                                                                                                                                                                                                     |
| Support matrix        | Poly(butyl methacrylate –co– ethylene dimethacrylate)                                                                                                                                                                                                                                                                                          |
| Monolith dimensions   | Outer diameter: 105.0 mm; inner diameter: 65.0 mm; length: 75 mm; bed volume (CV): 400 mL                                                                                                                                                                                                                                                      |
| Connector             | TC 1 in. (25 mm), 8 mm ID bore                                                                                                                                                                                                                                                                                                                 |
| Ligand density        | N.D.                                                                                                                                                                                                                                                                                                                                           |
| Operating flow rates  | Up to 2 CV/min   800 mL/min   245 cm/h. Do not go below 0.1 CV/min                                                                                                                                                                                                                                                                             |
| Maximum pressure      | 1.4 MPa, 14 bar, 200 psi                                                                                                                                                                                                                                                                                                                       |
| Operating temperature | 4 °C (39 °F) to 40 °C (104 °F)                                                                                                                                                                                                                                                                                                                 |
| Chemical stability    | All commonly used aqueous buffers, such as 1 M NaOH, 0.1 M HCl, 3 M ammonium sulphate, 8 M urea and 6 M guanidine hydrochloride. Avoid oxidising agents and organic solvents, such as methanol, ethanol, acetonitrile, 2-propanol. Avoid prolonged use of concentrated acids (more than 0.5 M) such as hydrochloric, sulphuric or acetic acid. |
| Recommended pH        | Working range 3–13, cleaning in place 1–14                                                                                                                                                                                                                                                                                                     |
| Storage conditions    | 2 °C (36 °F) to 25 °C (77 °F); store in 10 mM NaOH.                                                                                                                                                                                                                                                                                            |
| Shelf life            | 7 years                                                                                                                                                                                                                                                                                                                                        |

The linear flow rate can be calculated with the following equation and supporting data, which is available in the Technical Data.

$$\text{Average linear velocity, } u_{av} = \frac{F}{\pi \times L} \frac{\ln\left(\frac{D_o}{D_i}\right)}{(D_o - D_i)}$$

F is the flow rate in mL/min, Do and Di are the outer and inner diameter of the column and L is the column length.

## 4. Device Overview | Description

The housing of this CIMmultus<sup>®</sup> column is made of epoxy thermoset material. Its surface is coated pinhole-free with biocompatible (USP Class VI) Parylene C.

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### NOTICE

Do not expose the column housing to pure acetone.

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## 5. Installation

Remove the product from its shipping box or crate and place on a flat surface. Carefully inspect the product for any damage that may have occurred during shipping. Immediately report any such damage to your vendor and the courier. The product is shipped in the designated storage solution at ambient temperature and should be stored upon receiving as stated under Technical Data.

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### NOTICE

Larger columns are shipped in a wooden crate, and a suitable stand is provided in the packaging. The columns have either a stand (400 | 800 mL columns) or wheels (4 | 8 | 40 L columns). Place them in an upright position on a flat surface. The 40 L column should be lifted from its crate by attaching straps to the lifting eye bolts on the housing.

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### NOTICE

Do not store the product below 0 °C (32 °F).

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## 6. Getting Started

Set the pressure relief valve to the maximum pressure allowed on the CIM column as indicated in Technical Data. Before using the column, an integrity test must be performed. Guideline 'Column integrity test' ([biaseparations.com/en/library/guidelines](https://biaseparations.com/en/library/guidelines)) should be followed. It is advised to repeat this procedure regularly or when deviations in performance are observed.

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### NOTICE

The column should be equilibrated to working temperature for optimal results. Allow at least 12 h for the column to reach working temperature.

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### 6.1. General Recommendations

The following are general guidelines to consider when working with chromatography. The guidelines may not apply to specific column chemistry or sample properties.

- Treat loading material appropriately (e.g. pre-treat, filter, concentrate / dilute, etc.). For more details, please refer to the Guideline 'Pre-treatment of complex biological samples before column purification and regeneration procedures for columns with increased back pressure' ([biaseparations.com/en/library/guidelines](https://biaseparations.com/en/library/guidelines)).
- Always use freshly prepared mobile phases, filtered through 0.2 µm filter, compatible with mobile phases.
- Air bubbles will not disturb the stationary phase and can be washed out of the column. However, drying the monolith risks damaging the stationary phase.
- Surfactants can improve recoveries in virus purification. Non-ionic surfactants will not interact with ion exchange chromatography media. Non-UV-absorbing (at working wavelengths) surfactants will improve the baseline signal.
- Ensure all components of the system used are compatible with the working solutions (e.g. sodium hydroxide, organic solvents, high salt concentrations, etc).

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#### NOTICE

Always ensure mobile phases are compatible before mixing them or applying consecutively on the column. Examples of in-compatible buffers are: magnesium ion-containing buffers and sodium hydroxide (forms precipitate), acetonitrile and sodium hydroxide (forms ammonia and acetate), ammonium acetate and sodium hydroxide (potential formation of explosive atmosphere), ethanol and sodium hydroxide (forms ethoxides). Wash the column with water or another compatible solution when using two incompatible solutions consecutively.

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## 7. Operating the Column

### 7.1. Connecting the Column

Position the column with the inlet at the bottom and outlet at the top by placing the 400 | 800 mL column on its stand. The 4000 | 8000 mL columns should stand upright on its wheels. Connect the column to the system with flow turned off in the following order:

1. Carefully remove the blind fitting on the inlet side and connect the inlet tubing.
2. Carefully remove the blind fitting on the outlet side and connect the outlet tubing.

Disconnect by reversing the steps above.

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#### NOTICE

Do not open both inlet and outlet simultaneously to avoid leaking of mobile phase. Changing the order of the above procedure might cause leakage of the mobile phase from the column and affect its performance!

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#### NOTICE

Reversing the flow direction will damage the column. Make sure the column is connected according to the flow direction indicated by the arrow. The 40 L housing has an integrated non-return valve at the column outlet to prevent reversing the flow direction. Do not remove or disassemble the valve. **Note:** Software specific settings which regulate the flow direction should be checked. Ensure the correct flow mode is selected so that flow can go only in the

direction indicated on the monolith.

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#### NOTICE

Spikes in pressure generated during sudden pump fluctuations (e.g. immediate application of maximum flow rate or sudden pump stop at high operating pressure) can generate a backpressure shock, which can damage the monolith.

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## 7.2. Equilibration

The column should be equilibrated before use. Equilibration mobile phase should be of same or similar composition to the sample.

1. If needed, wash the column with 10 CV of water to prevent mixing of incompatible buffers.
2. Wash the column with at least 10 CV of elution mobile phase.
3. Wash the column with at least 10 CV of binding mobile phase.

Use system detectors as indication of successful equilibration. Conductivity and pH at the outlet should match buffer specifications.

## 7.3. Strip | Regeneration

A strip step with water can be used to regenerate the column. A regeneration step can be included into the operating method to improve reproducibility, to detect the resulting peak, or collect the eluted material.

1. Wash the column with at least 20 CV of low ionic strength mobile phase.
2. Re-equilibrate the column with at least 20 CV of binding mobile phase.

# 8. Cleaning | Maintenance

Cleaning and maintenance of the column may improve its lifetime and increase reproducibility. Sample properties should be taken into account for column cleaning.

## 8.1. Cleaning in Place (CIP)

In some cases, a simple regeneration of the monolithic column is insufficient. Sample molecules may not completely elute from the column or may even precipitate on the column. This build-up of contaminants on the monolithic column may cause loss of resolution and binding capacity, increased back pressure, or a complete blockage of the column. A specific CIP procedure should be designed for the type of contaminants present in the sample. An example of a general CIP procedure is presented below.

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#### CAUTION

In case of pressure increase during cleaning, adjust flow rate to remain below the maximum pressure allowed over the column.

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Perform the following procedure at up to half the maximum operating flow rate. This will ensure sufficient contact time between the monolith and cleaning solution.

1. Wash the column with at least 10 CV of deionized water.
2. Wash the column with at least 10 CV of 1 M NaOH.
3. Wash the column with at least 10 CV of deionized water.
4. Wash the column with at least 10 CV of a concentrated buffer (e.g. 0.1 M–0.5 M buffer) to restore the appropriate pH. **Note:** Binding buffer may be used for this step. Wash until the pH value at the outlet of the column corresponds to the buffer's pH.

**Note:** If CIP does not restore column performance completely, consider performing sanitisation of the column (see below for further instructions).

## 8.2. Sanitisation

Pump at least 10 CV of a cleaning solution (1 M NaOH) through the column at up to half the maximum operating flow rate. Stop the pump and leave the column in contact with the cleaning solution for at least 2 h (up to 12 h if necessary) at room temperature. If needed, the column can be disconnected from the system and closed with blind fittings. Re-connect the column, flush with another 5 CV of cleaning solution and follow steps 3 and 4 of the 'Cleaning In Place (CIP)' Procedure.

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### CAUTION

Ensure that the chromatography system and auxiliary components are compatible with NaOH at the concentrations used. Follow all safety instructions when handling NaOH solutions.

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## 9. Storage

Clean and equilibrate the column before storage. The column can be stored in working buffers overnight.

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### NOTICE

NaOH-ethanol mixtures at any concentration form ethoxide anions that are highly destructive to biomolecules, and ligands on chromatography media. Neutralise the column environment before introducing ethanol.

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1. Wash the column with 10 CV deionised water.
2. Wash the column with 10 CV of storage solution. **Note:** Reduce the flow rate when using viscous solvents (such as ethanol) to avoid a pressure increase.
3. Seal the column with blind fittings and store at the temperature specified in Technical Data. If there is a possibility of biological contamination from the sample it is recommended to store the column between 2 °C (36 °F) and 8 °C (46 °F).

## 10. Troubleshooting

Problems arising during the analysis are usually related to the column, sample, mobile phase, or the instrumentation. It is advisable to use an elimination approach to exclude possible causes. Please refer to our troubleshooting guide ([biaseparations.com/en/library/guidelines](https://biaseparations.com/en/library/guidelines)).

## 11. Decommissioning | Transportation

If there is reason to return the product, complete a Return Form ([biaseparations.com/en/terms-conditions](https://biaseparations.com/en/terms-conditions)) and contact [help.bia@sartorius.com](mailto:help.bia@sartorius.com).

Contaminated samples used during the process that could cause biological or chemical hazards are potentially hazardous substances. If the product has come into contact with hazardous substances, steps must be taken to ensure proper decontamination and declaration.

### Procedure

Decontaminate the product. The operator of the product is responsible for adhering to local government regulations on the proper decontamination and declaration for transport and disposal.

## 12. Ordering Information

Transferring the workflow to a different scale or format (analytical, screening) is simple with CIM®. Contact your local support to find the appropriate products.

### Purification Scale Products cGMP Compliant

| Catalog number | Product name                                                                           |
|----------------|----------------------------------------------------------------------------------------|
| 901.8136-2     | CIMmultus® C4 HLD 8 mL cGMP Compliant Monolithic Column (HLD Butyl) (2 µm channels)    |
| 914.8136-2     | CIMmultus® C4 HLD 40 mL cGMP Compliant Monolithic Column (HLD Butyl) (2 µm channels)   |
| 911.8136-2     | CIMmultus® C4 HLD 80 mL cGMP Compliant Monolithic Column (HLD Butyl) (2 µm channels)   |
| 924.8136-2     | CIMmultus® C4 HLD 400 mL cGMP Compliant Monolithic Column (HLD Butyl) (2 µm channels)  |
| 921.8136-2     | CIMmultus® C4 HLD 800 mL cGMP Compliant Monolithic Column (HLD Butyl) (2 µm channels)  |
| 934.8136-2     | CIMmultus® C4 HLD 4000 mL cGMP Compliant Monolithic Column (HLD Butyl) (2 µm channels) |
| 931.8136-2     | CIMmultus® C4 HLD 8000 mL cGMP Compliant Monolithic Column (HLD Butyl) (2 µm channels) |

## Purification Scale Products non-cGMP Compliant

| Catalog number | Product name                                                            |
|----------------|-------------------------------------------------------------------------|
| 311.8136-2     | CIMmultus® C4 HLD 1 mL Monolithic Column (HLD Butyl) (2 µm channels)    |
| 414.8136-2     | CIMmultus® C4 HLD 4 mL Monolithic Column (HLD Butyl) (2 µm channels)    |
| 411.8136-2     | CIMmultus® C4 HLD 8 mL Monolithic Column (HLD Butyl) (2 µm channels)    |
| 614.8136-2     | CIMmultus® C4 HLD 40 mL Monolithic Column (HLD Butyl) (2 µm channels)   |
| 611.8136-2     | CIMmultus® C4 HLD 80 mL Monolithic Column (HLD Butyl) (2 µm channels)   |
| 814.8136-2     | CIMmultus® C4 HLD 400 mL Monolithic Column (HLD Butyl) (2 µm channels)  |
| 811.8136-2     | CIMmultus® C4 HLD 800 mL Monolithic Column (HLD Butyl) (2 µm channels)  |
| 1014.8136-2    | CIMmultus® C4 HLD 4000 mL Monolithic Column (HLD Butyl) (2 µm channels) |
| 1011.8136-2    | CIMmultus® C4 HLD 8000 mL Monolithic Column (HLD Butyl) (2 µm channels) |



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Masculine or feminine forms are used to facilitate legibility in these instructions and always simultaneously denote the other gender as well.

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