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# PREPARATION & PURIFICATION

## LC- SYSTEM BROCHURE

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Welch Materials, Inc.

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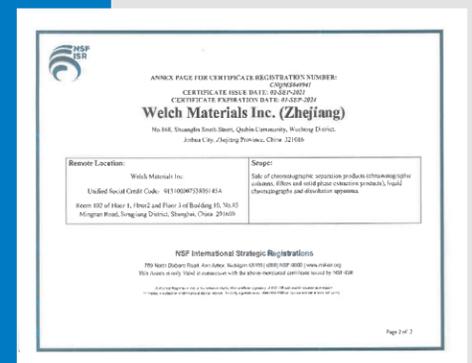


# COMPANY PROFILE

Welch Materials is a multinational company specializing in the development and manufacturing of laboratory products. Our extensive range of offerings includes HPLC columns, GC columns, chromatographic packing materials, sample preparation products, protein purification products, laboratory instruments, and general consumables.

Established in August 2003, Welch Materials, Inc. has its headquarters in Songjiang, Shanghai. In addition to our main office, we operate production and research facilities in Jinhua, Zhejiang, and Nanjing, Jiangsu. Furthermore, we have established subsidiary branches in the United States, India, and Canada.

At Welch Materials, Inc., we seamlessly integrate research, production, sales, and service to provide comprehensive laboratory solutions worldwide. Our products have wide-ranging applications in vital industries such as biomedicine, food safety testing, environmental monitoring, and fine chemicals, making a significant contribution to improving people's lives. In 2018, we proudly obtained the ISO 9001:2015 international quality management system certification, reaffirming our unwavering commitment to maintaining the highest quality standards. Through the implementation of rigorous quality inspection processes and strict adherence to standards, we ensure that each product we produce complies with the most stringent laboratory requirements.



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## WELPREP2000 PREPARATIVE HPLC SYSTEM



Welch Materials is dedicated to the research, production, and sales of liquid chromatography instruments, assisting customers in adapting to continuously updated regulatory requirements.

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# I. WelPrep2000

## 1.1 Overview of WelPrep2000 Preparative LC System



Schematic diagram of WelPrep2000 preparative liquid chromatography instrument

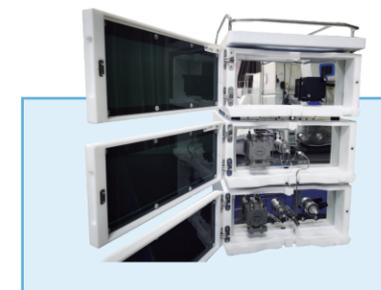
- ① Solvent Tray
- ② UV-Vis Detector
- ③ High Pressure Constant Current Pump (with mixer)
- ④ High Pressure Constant Current Pump (with manual injector)
- ⑤ Preparative Column Racks
- ⑥ Fraction Collector (optional)
- ⑦ HT1500L Preparative Autosampler (optional)

WelPrep2000 series preparative liquid chromatography system is designed and developed for laboratory or production workshop environments. It is an integrated instrument that combines software control and data management for preparative liquid chromatography. This system excels in separation and purification capabilities, supports linear scale-up, and offers advantages such as high sample loading capacity, short preparation time, and solvent savings. The analysis and preparation results are stable and reliable.

The system finds wide applications in various fields, including the separation of natural products, purification of organic synthesis products, screening of new drug compounds, and analysis of fine chemicals. It offers convenient and fast usage and can be flexibly configured according to user needs.

## 1.2 Features of WelPrep2000 Preparative LC System

The pipeline routing has been redesigned, incorporating holes and slots for routing the pipelines at the front end of each module, as well as provisions for potential liquid leakage. The main fluid path and the leakage fluid path are separated into two routes. After closing the doors and windows, the pipeline routing is situated within the internal space at the front end of the instrument, avoiding a situation where there are multiple and messy pipelines. This design ensures improved safety and facilitates easier maintenance and upkeep.



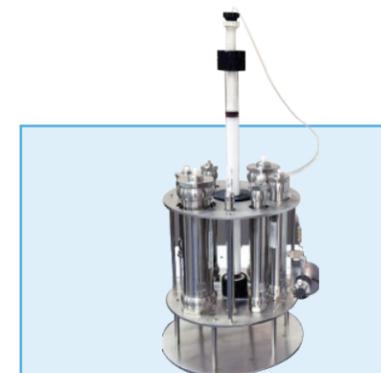
The manual injection valve has been redesigned and integrated into the front panel of the pump instead of being suspended on the outside of the module. Additionally, a liquid leakage diversion feature has been incorporated under the injection valve to separate the electrical and fluid components, thereby avoiding the exposure of numerous pipelines externally. This design enhances safety and overall integrity.



The power switch has been relocated to the front and incorporates anti-electric shock design, allowing users to safely operate the instrument. This design eliminates the inconvenience and potential danger of users reaching behind the instrument to switch it on or off, fully reflecting a user-centric design philosophy.



A specific preparative chromatography column holder has been designed for WelPrep2000, capable of accommodating various sizes of preparative chromatography columns. This design ensures a safer and more reliable placement of the chromatography columns.



The HT1500L can be used in conjunction with WelPrep2000 to achieve automated sample injection and batch analysis. It supports continuous detection of 45 positions (4mL vials) or 20 positions (40mL vials). The automated sample injection technology saves time and effort in sample pretreatment and can also be paired with an 8-channel collection system for large sample volumes.

### 1.3 High Pressure Pump

WelPrep2000 pump offers flow rate specifications of 10 mL, 50 mL, 100 mL, 200 mL, 500 mL, 1000 mL, and 3000 mL/min, providing options that meet the requirements for analysis, semi-preparative, and preparative applications.

By employing a microprocessor controller, the system utilizes a single-drive dual-plunger design for the pump heads, allowing for series connection (up to 50mL/min) or parallel connection (above 50mL/min). It incorporates solvent compression compensation and multi-point flow rate curve calibration technology to achieve high-precision fluid delivery within a wide dynamic range, from low pressure to high pressure, and from low flow rates to high flow rates. The system incorporates a binary high-pressure infusion pump that combines linear step gradients and isocratic steps, resulting in numerous gradient curves with different linear velocity gradients. This approach enhances method development capabilities, reducing analysis time and saving solvent costs, ultimately achieving the desired experimental results. In terms of safety features, the instrument is equipped to promptly alarm and follow the preset program, automatically stopping the pump operation to prevent unexpected situations.



#### High pressure pump technical parameters:

| Type               | 10mL Pump                             | 50mL Pump      | 100mL Pump     | 200mL Pump     |
|--------------------|---------------------------------------|----------------|----------------|----------------|
| Velocity Range     | 0~10.000mL/min                        | 0~50.000mL/min | 0~100.00mL/min | 0~200.00mL/min |
| Maximum Pressure   | 42MPA                                 | 30MPA          | 25 MPA         | 20 MPA         |
| Flow Accuracy      | ±0.15%                                | ±0.15%         | ±0.5%          | ±0.5%          |
| Flow Repeatability | RSD≤0.1%                              | RSD≤0.1%       | RSD≤0.2%       | RSD≤0.2%       |
| Step               | 0.001mL/min                           | 0.001mL/min    | 0.01mL/min     | 0.01mL/min     |
| Pump Head Material | 316L Stainless Steel, Hastelloy, PEEK |                |                |                |

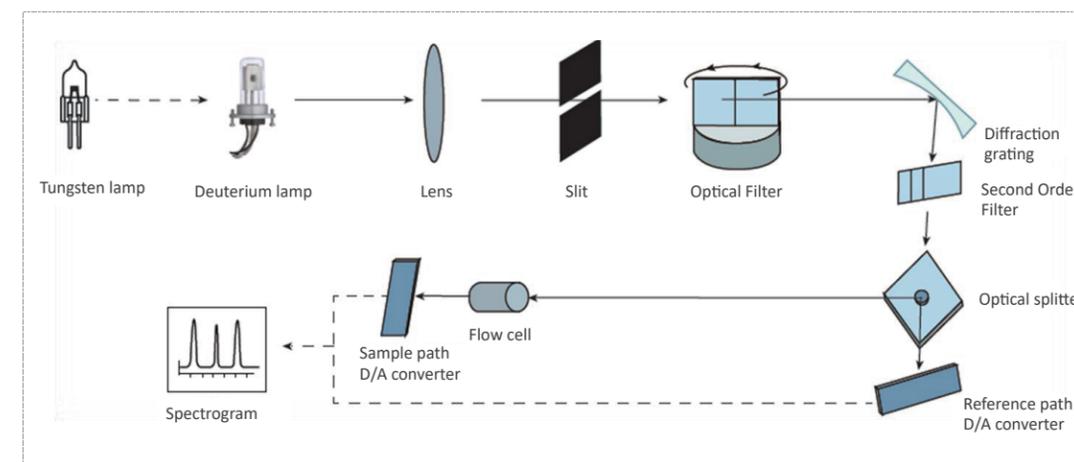
| Type               | 500mL Pump                            | 1000mL Pump     | 3000mL Pump    |
|--------------------|---------------------------------------|-----------------|----------------|
| Velocity Range     | 0~500.00mL/min                        | 0~1000.00mL/min | 0~2999.9mL/min |
| Maximum Pressure   | 15MPA                                 | 15MPA           | 10MPA          |
| Flow Accuracy      | ±0.5%                                 | ±0.5%           | ±1%            |
| Flow Repeatability | RSD≤0.3%                              | RSD≤0.3%        | RSD≤0.3%       |
| Step               | 0.01mL/min                            | 0.01mL/min      | 0.1mL/min      |
| Pump Head Material | 316L Stainless Steel, Hastelloy, PEEK |                 |                |

### 1.4 UV-Vis Detector

The deuterium lamp of WelPrep2000 UV-visible detector adopts a new generation of technology, featuring dual-wavelength high sensitivity detection. It is specifically designed for the detection of substances related to pharmaceuticals. The dual-wavelength detection function enables shorter data acquisition intervals, saving time and samples.

The universal sample cell design allows for easy interchangeability between micro-volume and macro-volume cells. It offers different optical path lengths, such as 0.5mm, 1.25mm, 2.0mm, 3.0mm, and 10.0mm, to suit different requirements. The optical path can be configured in dual-wavelength mode, enabling detection at different wavelengths.

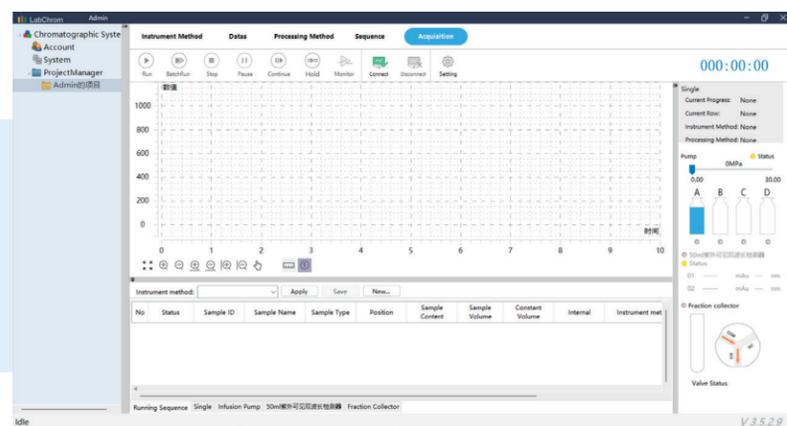
The newly designed integrated voltage module ensures a more stable power supply.



#### UV-Vis detector system configurator parameters:

| Model                           | Analytical   | Semi-preparative   | Preparation  |
|---------------------------------|--|--|--|
| Flow Cell Model                 | Analytical Flow Cell, SST or PEEK, 10mm Optical Path | Semi-preparative Flow Cell, SST or PEEK, 3mm Path Length | Preparative Flow Cell, SST or PEEK, Variable Path Length |
| Wavelength Range & Light Source | 190-400nm Deuterium Lamp, 400-700nm Tungsten Lamp    |  |  |
| Bandwidth                       | 8nm  |  |  |
| Wavelength Accuracy             | ±1nm   |  |  |
| Wavelength Repeatability        | 0.2nm  | 0.3nm  |  |
| Baseline Noise (static)         | 0.75×10 <sup>-5</sup> AU                             |  |  |
| Baseline Drift (static)         | 1×10 <sup>-4</sup> AU/h                              |  |  |
| Detection Range                 | (0~5) AU   |  |  |
| Control Mode                    | RS232 or LAN   |  |  |

## 1.5 Data Management System



- ❖ The user interface of the data processing system is user-friendly, easy to learn and use, fully functional, and convenient to operate. An English interface option is available.
- ❖ The data management system integrates instrument control, data acquisition, and data processing into one platform. It features a graphical monitoring interface that provides real-time monitoring of the operation process.
- ❖ Default report templates and user-defined report settings can be configured, allowing for rich report content.
- ❖ The system includes comprehensive audit trail functionality for methods, sample cells, sequences, chromatograms, and data output.
- ❖ Time programs can be created with wavelength changes, allowing for optimal detection wavelengths in multi-component analyses.
- ❖ The system complies with strong regulatory requirements, including GLP and FDA standards, ensuring data validity, security, and system usability.

## 1.6 Fraction Collector

- ❖ Two collection modes available: manual and automatic, both of which are simple, convenient, and user-friendly to operate.
- ❖ The system can collect samples into containers such as 15mL or 25mL glass test tubes, providing versatility in collection methods. It can also be used with an 8-channel large sample cell for more diversified collection options.
- ❖ The collection solution is separated from the circuit, ensuring safer operation.
- ❖ The system is designed with corrosion-resistant materials, making it suitable for high-solvent separation experiments.
- ❖ With the use of a high-precision three-way valve and validated cutting-edge technology, the switching process is drip-free and leak-free.



| Automatic Fraction Collector Project | Technical Parameters   |
|--------------------------------------|--|
| Capacity (Test Tube)                 | 100 Positions (15mL), 36 Positions (25mL)                                |
| Component Switching Time             | 350~530ms (according to the pipe rack size)                              |
| Collection Mode                      | Manual Collection, Automatic (time, volume, threshold, slope) collection |
| Way of Moving                        | X-Y axis   |
| Switching Valve                      | PEEK Three-way Solenoid Valve  |

| Automatic Fraction Collector Project | Technical Parameters      |
|--------------------------------------|---------------------------|
| Sample Channel                       | 8 Aisle                   |
| Collection Method                    | Time, Peak, Slope, Volume |
| Flow Range                           | 0~3000mL/min              |

## 1.7 Autosampler

- ❖ The system is equipped with advanced basic functions for automated sample injection, allowing unmanned operation and achieving higher sample throughput. Unnecessary functions have been eliminated to achieve the optimal balance between quality and cost-effectiveness.
- ❖ Compatibility: It can be used in conjunction with HPLC systems from any brand.
- ❖ Convenience: The operation is very simple, without unnecessary complicated functions.
- ❖ Continuity: It is compatible with interchangeable sample racks, making it suitable for continuous sample injection.



| Automatic Fraction Collector Project | Technical Parameters                                  |
|--------------------------------------|---|
| Sample Capacity                      | 45 Positions (4mL bottle), 25 Positions (40mL bottle) |
| Reproducibility RSD                  | ≤0.25%  |
| Linear                               | ≥0.999  |
| Residual                             | ≤0.01%  |
| Injection Mode                       | Full Loop Injection                                   |
| Supported Loops                      | 20(40, 50, 100, 200, 500)μL and 1(5, 10, 20)mL        |

### 1.8 Preparative Column Rack

- ❖ Welch Materials' Preparative Chromatography Column Rack can accommodate a variety of specifications of preparative chromatography columns, making the use and replacement of chromatography columns more convenient and safe.
- ❖ Made of 304 stainless steel material, with a brushed surface finish, it is both aesthetically pleasing and corrosion-resistant.
- ❖ It can be optionally equipped with a manual injection valve bracket, suitable for manual injection valve sampling.



| Column ID                    | Length            | Qty                |
|------------------------------|-------------------|--------------------|
| 10mm Preparative Column      | 250 or 300mm      | 2                  |
| 21.2mm Preparative Column    | 250 or 300mm      | 2                  |
| 30mm Preparative Column      | 150, 250 or 300mm | 1 (150mm)          |
| 50mm Preparative Column      | 250 or 300mm      | 1~3 (250 or 300mm) |
| 25mm Gel Purification Column | 400 or 700mm      | 1~3                |

### 1.9 WelPrep2000 System Configuration

#### WelPrep2000 10mL configuration:

| Item No.     | Description  | Qty |
|--------------|--|-----|
| P20010A      | 10mL High-pressure Pump (with manual injector, reversed phase) | 1   |
| P20010B      | 10mL High-pressure Pump (with mixer, reversed phase)           | 1   |
| D20010D      | 10mL UV Dual-Wavelength Detector (deuterium lamp)              | 1   |
| 160100000009 | HT1501L Prep-LC Autosampler (45x4mL vial/valve:ss)             | 1   |
| W20002       | Chromatography Data System (GMP)                               | 1   |
| T20000       | Solvent Tray   | 1   |
| PC           | Dell Computer  | 1   |
| 0610010001   | 1 Year Warranty Service  | 1   |

#### WelPrep2000 50mL configuration:

| Item No.      | Description  | Qty |
|---------------|--|-----|
| P20050A       | 50mL High-pressure Pump (with manual injector, reversed phase) | 1   |
| P20050B       | 50mL High-pressure Pump (with mixer, reversed phase)           | 1   |
| D20050D       | 50mL UV Dual-Wavelength Detector (deuterium lamp)              | 1   |
| 1000.3105     | Quantitative Loop 5mL  | 1   |
| 1601000000008 | HT1500L Preparative Autosampler (45x4mL vial/valve:ss)         | 1   |
| W20002        | Chromatography Data System (GMP)                               | 1   |
| T20000        | Solvent Tray   | 1   |
| WelPrepFC100  | 100 Positions Fraction Collector (0-200mL)                     | 1   |
| R20001        | Preparative Column Rack  | 1   |
| PC            | Dell Computer  | 1   |
| 0610010001    | 1 Year Warranty Service  | 1   |

#### WelPrep2000 100mL configuration:

| Item No.      | Description   | Qty |
|---------------|---|-----|
| P20100A       | 100mL High-pressure Pump (with manual injector, reversed phase) | 1   |
| P20100B       | 100mL High-pressure Pump (with mixer, reversed phase)           | 1   |
| D20100D       | 100mL UV Dual-Wavelength Detector (deuterium lamp)              | 1   |
| 1000.3111     | Quantitative Loop 10mL (1/16, for automatic sampling)           | 1   |
| 1601000000008 | HT1500L Preparative Autosampler (25x40mL vial/ Valve:SS)        | 1   |
| W20002        | Chromatography Data System (GMP)                                | 1   |
| T20000        | Solvent Tray  | 1   |
| WelPrepFC100  | 100 Positions Fraction Collector (0-200mL)                      | 1   |
| R20001        | Preparative Column Rack   | 1   |
| PC            | Dell Computer   | 1   |
| 0610010001    | 1 Year Warranty Service   | 1   |

#### WelPrep2000 200mL configuration:

| Item No.      | Description   | Qty |
|---------------|---|-----|
| P20200A       | 200mL High-pressure Pump (with manual injector, reversed phase) | 1   |
| P20200B       | 200mL High-pressure Pump (with mixer, reversed phase)           | 1   |
| D20200D       | 200mL UV Dual-Wavelength Detector (deuterium lamp)              | 1   |
| 1000.3121     | Quantitative Loop 20mL (1/16, for automatic sampling)           | 1   |
| 1601000000008 | HT1500L Preparative Autosampler (25x40mL vial/ Valve:SS)        | 1   |
| W20002        | Chromatography Data System (GMP)                                | 1   |
| T20000        | Solvent Tray  | 1   |
| WelPrepFC100  | 100 Positions Fraction Collector (0-200mL)                      | 1   |
| R20001        | Preparative Column Rack   | 1   |
| PC            | Dell Computer   | 1   |
| 0610010001    | 1 Year Warranty Service   | 1   |

**WelPrep2000 500mL configuration:**

| Item No.      | Description   | Qty |
|---------------|---|-----|
| P20500        | 500mL High Pressure Pump (reversed phase)                             | 2   |
| D20500D       | 500mL UV Dual Wavelength Detector (deuterium lamp)                    | 1   |
| M21000        | Dynamic Mixer for Preparation (200-1000mL)                            | 1   |
| P20100B       | 100mL High-pressure Pump (with mixer, reversed phase, injection pump) | 1   |
| W20002        | Chromatography Data System (GMP)                                      | 1   |
| 1302050000003 | 8-Channel Fraction Collector (500-1000)mL                             | 1   |
| 0602510019    | 316 Two-Way Ball Valve (1/16)   | 1   |
| PC            | Dell Computer   | 1   |
| 0610010001    | 1 Year Warranty Service   | 1   |

**WelPrep2000 1000mL configuration:**

| Item No.     | Description   | Qty |
|--------------|---|-----|
| P21000       | 1000mL High Pressure Pump (reversed phase)                            | 2   |
| D21000D      | 1000mL UV Dual Wavelength Detector (deuterium lamp)                   | 1   |
| M21000       | Dynamic Mixer for Preparation (200-1000mL)                            | 1   |
| P20100B      | 100mL High-pressure Pump (with mixer, reversed phase, injection pump) | 1   |
| W20002       | Chromatography Data System (GMP)                                      | 1   |
| WelPrepFC008 | 8-Channel Fraction Collector (500-1000)mL                             | 1   |
| 0602510019   | 316 Two-Way Ball Valve (1/16)   | 1   |
| PC           | Dell Computer   | 1   |
| 0610010001   | 1 Year Warranty Service   | 1   |

**WelPrep2000 3000mL configuration:**

| Item No.   | Description  | Qty |
|------------|--|-----|
| P23000     | 3000mL High Pressure Pump (reversed phase)                 | 2   |
| D23000D    | 3000mL UV Dual Wavelength Detector (deuterium lamp)        | 1   |
| P21000     | 1000mL High Pressure Pump (reversed phase, injection pump) | 1   |
| W20002     | Chromatography Data System (GMP)                           | 1   |
| 0602510020 | 316 Two-Way Ball Valve (1/8)                               | 1   |
| M23000     | Preparative Static Mixer (3000mL)                          | 1   |
| PC         | Dell Computer  | 1   |
| 0610010001 | 1 Year Warranty Service                                    | 1   |

## II. Preparative column

**Features:**

- ❖ The packing material possesses high mechanical strength and excellent pressure resistance, ensuring a long lifespan.
- ❖ It provides high column efficiency, resulting in symmetric peak shapes for acids, bases, and neutral compounds, leading to excellent separation performance.
- ❖ With a high specific surface area, it allows for a large sample loading and direct linear scaling, enabling higher sample throughput.
- ❖ Moreover, it delivers improved separation efficiency and reproducibility.



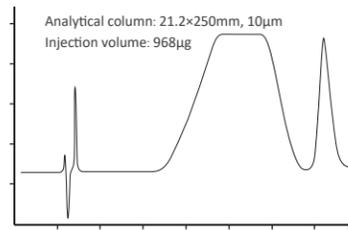
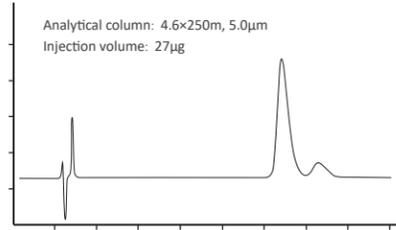
Welch Materials has successfully launched and achieved large-scale sales of various series of chromatographic columns such as Ultisil®, Welchrom®, Xtimate® and Topsisil®. The specifications of Ultisil® and Xtimate® series columns are as follows:

| Column series   | Type of bonded phase | Particle size | Pore Size               | Column specification/mm, inner diameter×column length |
|-----------------|----------------------|---------------|-------------------------|---|
| Ultisil® series | XB-C30               | 5µm           | 120Å                    | 10×100mm  |
|                 | XB-C18               |               | 120Å, 300Å              |   |
|                 | XB-C8                |               | 120Å, 300Å              |   |
|                 | XB-C4                |               | 120Å, 300Å              |   |
|                 | AQ-C18               | 10µm          | 120Å                    | 10×150mm  |
|                 | XB-Phenyl            |               | 120Å                    |   |
|                 | XB-SiO <sub>2</sub>  |               | 120Å                    |   |
|                 | XB-CN                |               | 120Å                    |   |
|                 | XB-NH <sub>2</sub>   | 15µm          | 120Å                    | 10×250mm  |
|                 | XB-Diol              |               | 120Å                    |   |
|                 | XB-SAX               |               | 120Å                    |   |
|                 | XB-SCX               |               | 120Å                    |   |
|                 | LP-C18               | 20µm          | 120Å, 300Å              | 21.2×150mm  |
|                 | Polar RP             |               | 120Å                    |   |
| phenyl-Ether    | 120Å                 |               |                         |   |
| HILIC- Amide    | 120Å                 |               |                         |   |
| Xtimate® series | F-C8                 | 20-40µm       | 120Å                    | 21.2×250mm  |
|                 | PFP                  |               | 120Å                    |   |
|                 | C18                  |               | 120Å                    |   |
|                 | C8                   |               | 120 Å                   |   |
|                 | SiO <sub>2</sub>     | 40-70µm       | 120Å                    | 30×250mm  |
|                 | NH <sub>2</sub>      |               | 120Å                    |   |
|                 | Phenyl-Hexyl         |               | 120Å                    |   |
|                 | CN                   |               | 120Å                    |   |
| Polar-RP        | 50×150mm             | 120Å          | 50×150mm                |   |
| SEC             |                      | 120Å          |                         |   |
|                 |                      |               | 120Å, 300Å, 500Å, 1000Å | 50×250mm  |

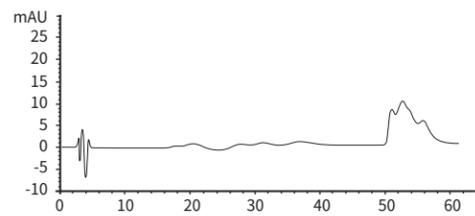
For more detailed product information, please contact Welch Materials.

### Applications:

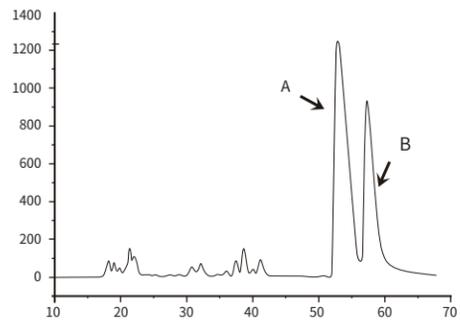
Example: high sample loading  
Separation and preparation of alkaline peptide on Ultisil® XB-C18 column



#### Sample-1:



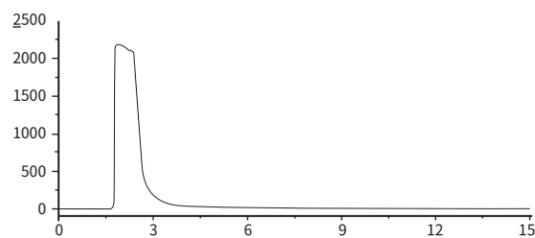
When customer 1 used other brand of Prep-LC system and chromatographic column, the target peaks were not separated.



|                                |   |
|--------------------------------|---|
| <b>Chromatographic column:</b> | Ultisil® LP-C8, 21.2x250mm, 5µm   |
| <b>Mobile phase:</b>           | 0.2% ammonium acetate buffer (adjust pH to 3.5 with acetic acid):acetonitrile=63:37 |
| <b>Injection volume:</b>       | 50mg  |
| <b>Detection wavelength:</b>   | 214nm   |
| <b>Flow rate:</b>              | 20mL/min  |

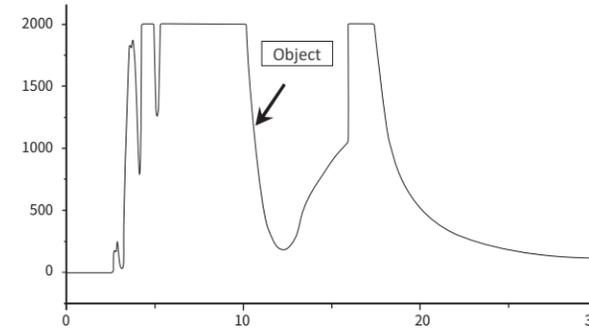
Using WelPrep2000 semi-preparative LC system (50mL) and LP-C8 column, under the same conditions, the separation effect of the target peaks A and B is significantly better.

#### Sample-2:



|                                |  |
|--------------------------------|--|
| <b>Chromatographic column:</b> | C18, 21.2x250mm from other brand                             |
| <b>Mobile phase:</b>           | A: methanol, B: water  |
| <b>Elution method:</b>         | 0~12min, 2% methanol/water<br>12.1~30min, 30% methanol/water |
| <b>Detection wavelength:</b>   | 259nm  |
| <b>Flow rate:</b>              | 20mL/min   |
| <b>Sample volume:</b>          | 420mg  |

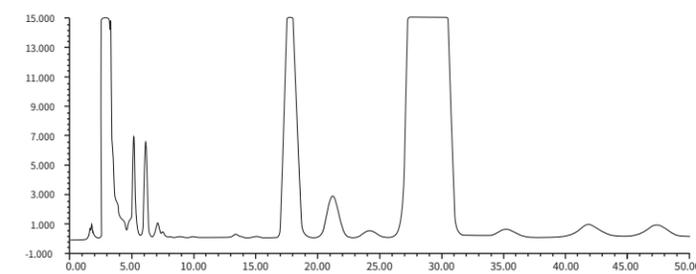
When customer 2 used other brand of Prep-LC system and chromatographic column, the sample is basically unretained on the chromatographic column.



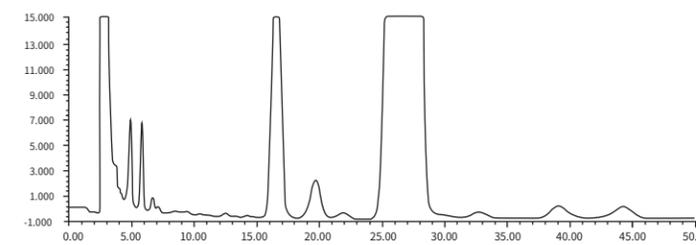
|                              |  |
|------------------------------|--|
| <b>Column:</b>               | Ultisil® XB-C18, 20µm, 21.2x250mm                            |
| <b>Mobile phase:</b>         | A: methanol, B: water  |
| <b>Elution method:</b>       | 0~12min, 2% methanol/water<br>12.1~30min, 30% methanol/water |
| <b>Detection wavelength:</b> | 259nm  |
| <b>flow rate:</b>            | 20mL/min   |
| <b>Sample volume:</b>        | 420mg  |
| <b>Adsorption ratio:</b>     | sample (g): packing materials(g)<br>= 1:120                  |

Using WelPrep2000 semi-preparative LC system (100mL) and XB-C18 chromatographic column, under the same conditions, the target and impurities were separated.

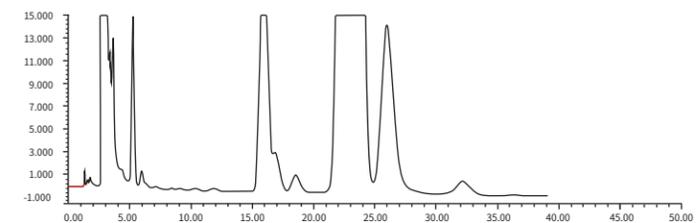
#### Sample-3 preparation:



Packing materials RP1



Packing materials RP2



Packing materials RP3

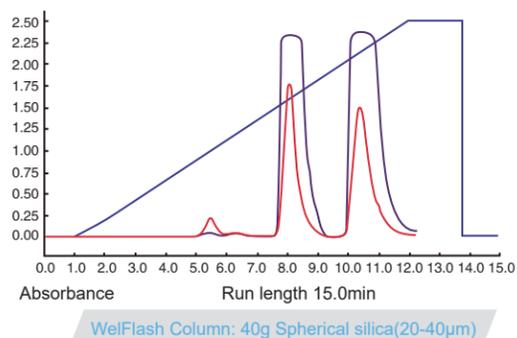
Using WelPrep2000 semi-preparative LC system (100mL) and multi-selective column from Welch, under the same conditions, the target and impurities were separated.

### III. Flash Cartridge

#### 3.1 WelFlash® Cartridge

During the process of preparative chromatographic separation and analysis, Flash Cartridge is designed for purification processes, exhibits high separation efficiency and ensures maximum separation between target compounds and impurities.

Currently, Packing materials of Flash cartridge is classified into three categories: amorphous silica-based matrix, spherical silica-based matrix, and non-silica inorganic adsorbent. The amorphous silica-based packing materials includes bare silica and C18, while the spherical silica-based packing materials offers a variety of selectivities such as bare silica, C18, phenyl, CN, NH<sub>2</sub>, SAX, SCX, and HILIC. The non-silica inorganic adsorbent packing consists of acid, neutral, and alkaline aluminum oxide with particle sizes ranging from 20 to 75µm. These packing materials undergo rigorous quality testing to ensure consistent reproducibility in terms of particle size and pore size between batches.



#### Product specification:

| 20-40µm          |             |             |             |             |             |             |             |             |
|------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| WelFlash®        | 4g, 20pk    | 12g, 18pk   | 25g, 12pk   | 40g, 10pk   | 80g, 10pk   | 120g, 10pk  | 220g, 6pk   | 330g, 4pk   |
| SiO <sub>2</sub> | 00001-03011 | 00001-03021 | 00001-03031 | 00001-03042 | 00001-03053 | 00001-03063 | 00001-03075 | 00001-03084 |
| C18              | 00002-03011 | 00002-03021 | 00002-03031 | 00002-03042 | 00002-03053 | 00002-03063 | 00002-03075 | 00002-03084 |
| Phenyl           | 00003-03011 | 00003-03021 | 00003-03031 | 00003-03042 | 00003-03053 | 00003-03063 | 00003-03075 | 00003-03084 |
| CN               | 00004-03011 | 00004-03021 | 00004-03031 | 00004-03042 | 00004-03053 | 00004-03063 | 00004-03075 | 00004-03084 |
| Diol             | 00014-03011 | 00014-03021 | 00014-03031 | 00014-03042 | 00014-03053 | 00014-03063 | 00014-03075 | 00014-03084 |

| 40-70µm          |             |             |             |             |             |             |             |             |
|------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| WelFlash®        | 4g, 20pk    | 12g, 18pk   | 25g, 12pk   | 40g, 10pk   | 80g, 10pk   | 120g, 10pk  | 220g, 6pk   | 330g, 4pk   |
| SiO <sub>2</sub> | 00001-04011 | 00001-04021 | 00001-04031 | 00001-04042 | 00001-04053 | 00001-04063 | 00001-04075 | 00001-04084 |
| C18              | 00002-04011 | 00002-04021 | 00002-04031 | 00002-04042 | 00002-04053 | 00002-04063 | 00002-04075 | 00002-04084 |

| 40-63µm          |             |             |
|------------------|-------------|-------------|
| WelFlash®        | 800g, 1pk   | 1600g, 1pk  |
| SiO <sub>2</sub> | 00001-05097 | 00001-05107 |

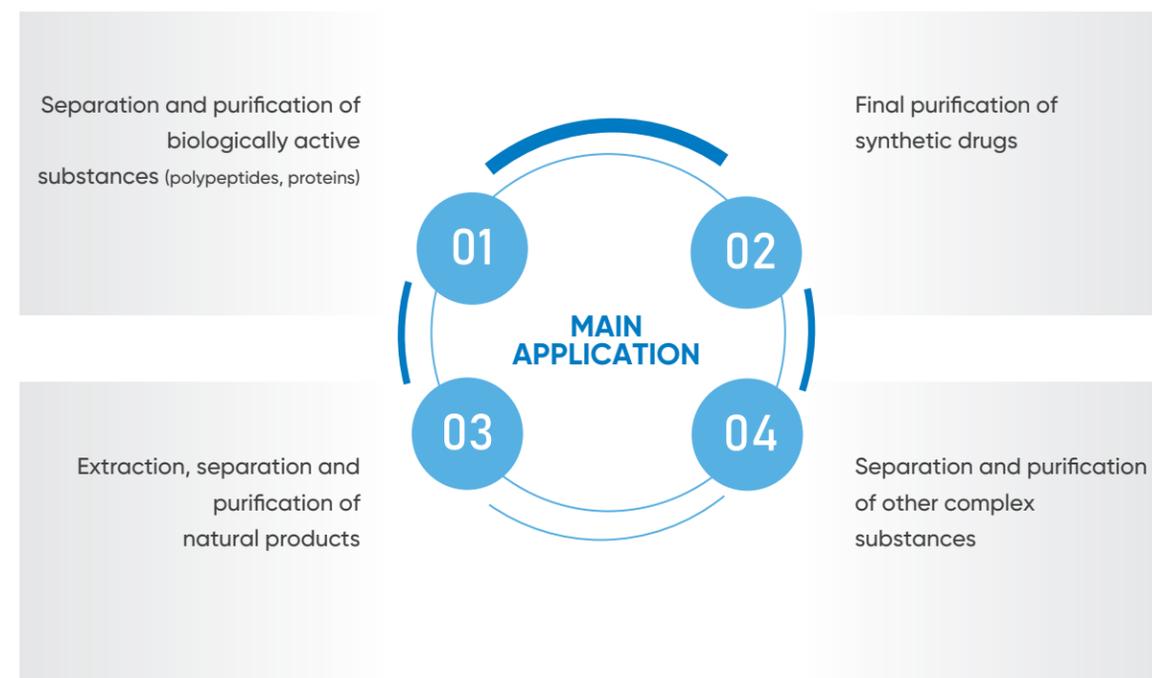
### IV. WelPacker DAC

#### 4.1 Overview of WelPacker DAC

Dynamic Axial Compression Column (DAC) is a chromatographic column developed for high-pressure preparative chromatography. It is a self-packed column that combines the functions of a column packing machine and a chromatographic column. After the column packing process, the column bed is subjected to a constant external mechanical force, which ensures uniform, compact, and stable bed conditions. This system configuration meets the needs of large-scale separation and purification of pharmaceutical and chemical products.

The system is equipped with a high-pressure constant flow pump, which provides stable and reliable performance for long-term uninterrupted operation. Depending on the compatible chromatographic columns in the system, pump systems with different flow rates ranging from 100mL/min to 3000mL/min can be provided. It is equipped with a preparative-scale UV-Vis detector that allows selection of different detector specifications based on the flow rate of the detection method.

Additionally, it can be used in conjunction with inline filters and fraction collectors to form a complete preparative purification chromatography system. The entire system can be controlled and monitored centrally through workstation software, ensuring convenient operation and reliable performance.



## 4.2 Features

### ❖ High column efficiency

WelPacker DAC utilizes a unique design and processing method for column distribution. The chromatographic column cylinder is oriented vertically, and precision inner wall polishing and concentricity techniques are applied. This minimizes the wall effect during column packing and usage, resulting in high column efficiency. When combined with Welch Materials' packing materials, it ensures the chromatographic column achieves optimal performance during column packing.

### ❖ Simple and Convenient Operation:

The use of column filling funnels and piston rod design enables quick and flexible column packing and unpacking operations.

### ❖ Compact and Portable Design:

The sleek and compact industrial design significantly reduces the size and weight of the instrument. The oil lock technology allows WelPacker DAC to maintain column pressure during brief air supply interruptions, facilitating DAC transfer.

### ❖ Broad Applicability:

WelPacker DAC offers a range of options from DAC50 to DAC800, allowing for the packing of various types of packing materials. With the equipped  $3\mu\text{m}$  pore size frit, it can accommodate  $5\mu\text{m}$  packing materials. It can be widely used in fields such as extraction, separation, and purification of natural products, final purification of synthetic drugs, and separation and purification of bioactive components.

### ❖ Perfect after-sales service and technical support

Welch Materials integrates R&D, production, sales and service, and is committed to providing customers with chromatographic separation analysis technology, products and overall solutions, and can develop and establish preparative liquid chromatography separation process methods for you.

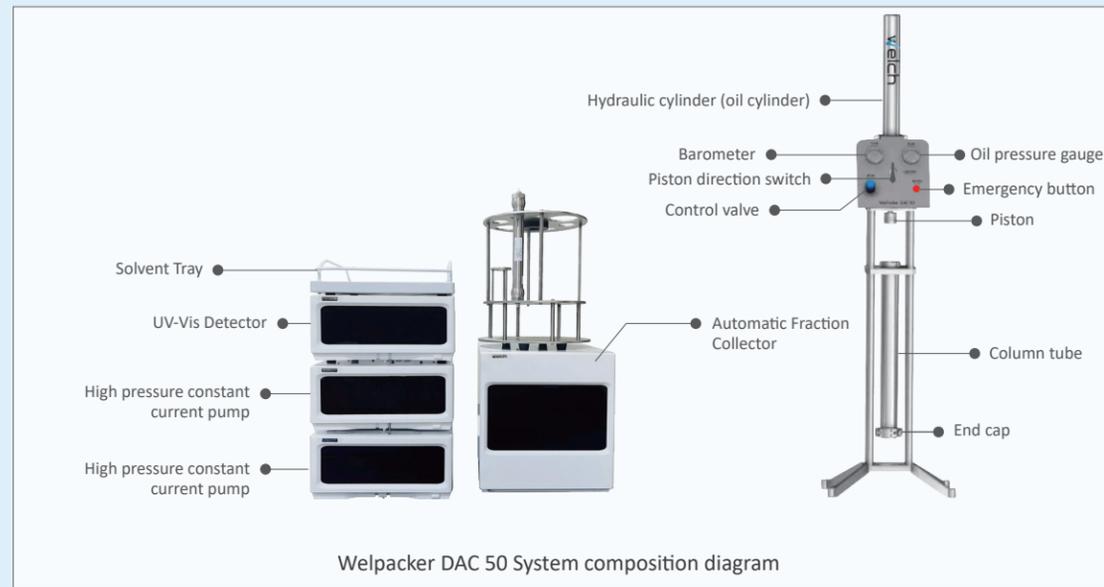


### Relevant regulatory compliance:

- Chinese Drug Administration Law
- ChP Chinese Pharmacopoeia (2020 Edition)
- ICH Good Manufacturing Practice Guidelines (GMP) for APIs
- Environmental Health Safety (EHS)
- ISPE's Pharmaceutical Engineering Design Guidelines
- GAMP Good Automated Manufacturing Practice
- International Electrotechnical Commission Certification System for Explosion-proof Electrical Products
- American Society for Testing and Materials Standards (ASTM)

### 4.3 System Design

The principle of system instrumentation and pipeline P&ID is as follows. The system design is divided into DAC column, liquid circuit control and fraction collection system, detection and electrical control system, etc.



#### Detailed system control flow path:

| Project               | Describe  | Marking in P&ID Drawings |
|-----------------------|---|--------------------------|
| Infusion Pump         | For mobile phase and sample delivery  | PumpA, PumpB, PumpC      |
| Flow Meter            | Used for system flow detection and feedback adjustment  | F1, F2                   |
| Valve                 | V1-V9 Switches for switching mobile phases and samples<br>V10 Inline or bypass for selection of filters<br>V11-V12 Selection for toggling filters<br>V13 Used to remove air bubbles and waste liquid from system piping<br>V14-V15 is used for switching between online/bypass and forward/reverse flow modes for column preparation.<br>MV3 For determination of column efficiency and small volume injection<br>V16-V23 for 8-channel fraction collection | V1-V23                   |
| Pressure Transmitters | PT01 and PT02 are used to detect the pressure before and after the filter and before the column. The system can automatically switch the filter selection according to the pressure. If the pressure is too high, it will automatically alarm PT03 to detect the pressure after the column. The pressure difference with PT02 can show whether the preparation column is blocked.   | PT01-PT03                |

### 4.4 Software Components Introduction

#### 4.41 High pressure sealing ring

The DAC column tube is sealed with a sealing ring on the frit. The sealing ring consists of a spring-energized high-pressure sealing ring and an O-ring coated with polytetrafluoroethylene for enhanced safety and reliability.

#### 4.42 Column tube

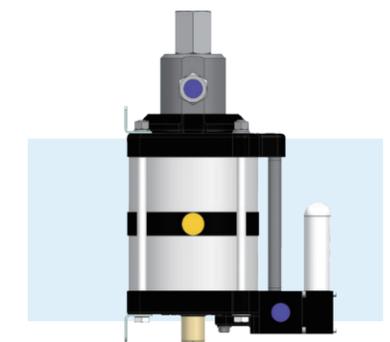
The column tube processing adopts the most advanced honing technology, which enables the inner wall roughness to reach <math><0.2\mu\text{m}</math>. This reduces the wear of the sealing ring, improves the lifespan, and reduces column wall effects, thereby enhancing the performance of the chromatographic column.

#### 4.43 Distributor:

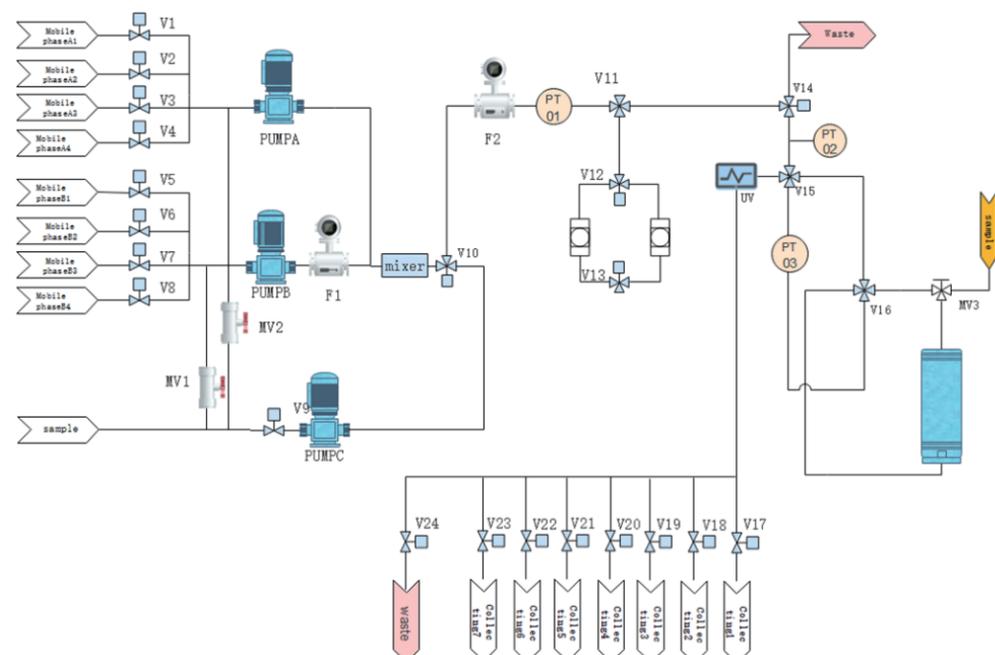
In the design of the distributor for large-diameter preparative chromatography columns, a new distributor has been developed. Due to the constant number of forced distribution nodes per unit area, the diffusion effect of the sample in the distributor remains unchanged. Therefore, the radial distribution of the sample in the column does not increase as the column diameter increases, ensuring that the diffusion effect of the sample on the distributor and its radial distribution remain unchanged even with an increase in column diameter.

#### 4.44 Hydraulic station

The gas-driven hydraulic pump used in the hydraulic station is selected from top-tier suppliers such as Haskel and MAXIMATOR. The gas-driven hydraulic pump consists of three parts: the gas-driven section, the hydraulic section, and the directional control valve. The piston of the gas-driven section is connected to the plunger of the hydraulic section and undergoes automatic reciprocating motion controlled by the directional valve. By utilizing a large area piston and a small area plunger, the pressure of the driving gas acting on the piston is transferred to the plunger, thereby increasing the outlet pressure of the liquid.



Pneumatic Hydraulic Pump Schematic



Schematic flow chart of Welpacker systems (P&ID)

#### 4.45 Adjustable Piston stand:

The stand is made of 304L stainless steel material, which facilitates the assembly and disassembly of pistons of different sizes for preparative columns. It is recommended to use the adjustable piston stand for DAC(≥400) configuration.



Schematic diagram of adjustable piston stand

#### Adjustable piston stand order information:

| Item No.      | Description                     |
|---------------|---------------------------------|
| 1701000000088 | DAC 400 adjustable piston stand |
| 1701000000089 | DAC 500 adjustable piston stand |

#### Adjustable piston stand Parameters:

| Item No.      | Description                    | Size Parameters |
|---------------|--------------------------------|-----------------|
| 1701000000088 | DAC400 adjustable piston stand | 1000×700×580    |
| 1701000000089 | DAC500 adjustable piston stand | 1100×800×620    |

#### 4.46 Preparative inline filter

The preparative inline filter consists mainly of a frit, sealing ring, and clamp. When the liquid passes through the inline filter, particles larger than the pore size of the frit are retained, ensuring that the outgoing liquid is free from large particles and preventing them from entering the chromatographic column and detector. This helps prevent clogging of the preparative column caused by large particles, thereby extending the lifespan of the preparative column. Additionally, it also helps reduce wear and tear on the sealing components.



Preparative inline filter schematic diagram

#### 20mm preparative inline filter order information:

| Item No.      | Description           |
|---------------|-----------------------|
| 1701000000064 | 20mm Inline Filter    |
| 1701000000065 | 20mm Filter Frit      |
| 1701000000066 | 20mm Filter Seal Ring |
| 1701000000073 | 20mm Filter Ferrule   |

#### 20mm Preparative inline filter parameters:

| Serial Number | Project  | Parameter or Method |
|---------------|--|---------------------|
| 1             | Design Pressure                                | 10MPa               |
| 2             | Ferrule Material                               | 316L/PEEK           |
| 3             | Frit Material                                  | 316L                |
| 4             | Filter Holder Material                         | 316L/904L/C276      |
| 5             | Supporting LC System Specification (flow rate) | 100-250mL           |
| 6             | Preparative Column Size (inner diameter)       | 50-80mm             |
| 7             | Connection Method                              | Thread snap button  |

#### 47mm Preparative inline filter order information:

| Item No.      | Description              |
|---------------|--------------------------|
| 1701000000058 | 47mm Inline Filter       |
| 1701000000059 | 47mm Filter Frit         |
| 1701000000060 | 47mm Filter Seal Ring    |
| 1701000000074 | 47mm Filter Ferrule      |
| 0602510041    | 1/8 PEEK Pipe            |
| 0602110002    | 1/8 PEEK Split Connector |

#### 47mm Preparative inline filter parameters:

| Serial Number | Project  | Parameter or Method |
|---------------|--|---------------------|
| 1             | Design Pressure                                | 10MPa               |
| 2             | Ferrule Material                               | 316L/PEEK           |
| 3             | Frit Material                                  | 316L                |
| 4             | Filter Holder Material                         | 316L/904L/C276      |
| 5             | Supporting LC System Specification (flow rate) | 500-1000mL          |
| 6             | Preparative Column Size (inner diameter)       | 100-150mm           |
| 7             | Connection Method                              | Thread Snap Button  |

#### 100mm Preparative inline filter order information:

| Item No.      | Description                              |
|---------------|--|
| 1701000000061 | 100mm Inline Filter                      |
| 1701000000076 | 100mm Filter Frit                        |
| 1701000000077 | 100mm Filter Seal Ring                   |
| 1701000000075 | 100mm Filter Ferrule                     |
| 1701000000071 | High Pressure Hose (1/4 ferrule, 2m/pcs) |
| 1701000000079 | High Pressure Hose (1/4 ferrule, 2m/pcs) |
| 1701000000078 | High Pressure Hose (6mm ferrule, 2m/pcs) |
| 1701000000080 | High Pressure Hose (6mm ferrule, 2m/pcs) |
| 1701000000072 | Manual Switching Valve (1/4 ferrule)     |

100mm Preparative inline filter parameters:

| Serial Number | Project   | Parameter or Method   |
|---------------|---|-----------------------|
| 1             | Design Pressure                                   | 10MPa                 |
| 2             | Ferrule Material                                  | 316L/PEEK             |
| 3             | Frit Material                                     | 316L                  |
| 4             | Filter Holder Material                            | 316L/904L/C276        |
| 5             | Supporting LC System Specification (flow rate)    | 1000-3000mL           |
| 6             | Preparative Column Size (inner diameter)          | 150-300mm             |
| 7             | Supporting Liquid Phase Specification (flow rate) | Quick Open Tank Chain |

4.47 Homogenizer system

The homogenization system consists of a homogenization tank and related equipment, which is used to facilitate the packing of chromatography columns and complete the homogenization process of the packing material before packing. During homogenization, the packing material medium for packing the chromatography column is thoroughly mixed with the packing solvent in the homogenization tank by the motor-driven stirring paddle. It is then rapidly transported into the column tube, effectively avoiding the hazards of dust and volatile solvents, and ensuring the health and safety of laboratory personnel. The homogenization tank provides functions for homogenization stirring, homogenization circulation, and delivery of homogenization liquid. It can be customized in different volumes to meet the filling requirements of various specifications of chromatography columns.



Homogenizer tank diagram

Homogenization tank order number:

| Item No.      | Description           |
|---------------|-----------------------|
| 1701000000087 | 50L Homogenizer Tank  |
| 1701000000085 | 120L Homogenizer Tank |

| Project                       | Parameter or method                                       |   |
|-------------------------------|---|---|
| Homogenizer Tank Material     | 316L  | 316L  |
| Homogenizer Tank Volume       | 50L   | 120L  |
| Homogenate Mixing Method      | Explosion-proof Motor (with frequency converter)          | Explosion-proof Motor (with frequency converter)          |
| Stirring Speed                | (80-120) rpm  | (80-120) rpm  |
| Homogenate Delivery Flow Rate | ≥2m <sup>3</sup> /h                                       | ≥2m <sup>3</sup> /h                                       |
| Composition                   | Tank, Motor and Reducer, Infusion Pump, Infusion Pipeline | Tank, Motor and Reducer, Infusion Pump, Infusion Pipeline |
| Others                        | Inner Wall Polishing Ra≤0.4μm                             | Inner Wall Polishing Ra≤0.4μm                             |

4.5 System Configuration Parameters of WelPacker DAC



DAC 50 schematic diagram

WelPacker DAC50:

| Serial Number | Configuration                    | Parameter                        |
|---------------|----------------------------------|----------------------------------|
| 1             | Column Specification             | 50×650mm                         |
| 2             | Maximum Column Height            | 350mm                            |
| 3             | Column Tube Design Pressure      | ≤10Mpa                           |
| 4             | Cylinder Design Pressure         | ≤15Mpa                           |
| 5             | Normal Setting Pressure          | ≤10Mpa                           |
| 6             | Column Tube Inner Wall Roughness | ≤0.2μm                           |
| 7             | Frit Size                        | 3μm                              |
| 8             | Wetted Material                  | 316L Stainless Steel, PTFE, PEEK |
| 9             | Overpressure Protection          | Safety Valve                     |

Column tube length and column tube design pressure can be customized according to customer needs.

WelPacker DAC80:

| Serial Number | Configuration                    | Parameter                        |
|---------------|----------------------------------|----------------------------------|
| 1             | Column Specification             | 80×650mm                         |
| 2             | Maximum Column Height            | 350mm                            |
| 3             | Column Tube Design Pressure      | ≤10Mpa                           |
| 4             | Cylinder Design Pressure         | ≤16Mpa                           |
| 5             | Normal Setting Pressure          | ≤10Mpa                           |
| 6             | Column Tube Inner Wall Roughness | ≤0.2μm                           |
| 7             | Frit Size                        | 3μm                              |
| 8             | Wetted Material                  | 316L Stainless Steel, PTFE, PEEK |
| 9             | Overpressure Protection          | Safety Valve                     |

Column tube length and column tube design pressure can be customized according to customer needs.



DAC 80 schematic diagram



DAC 100 schematic diagram

WelPacker DAC100:

| Serial Number | Configuration                    | Parameter                        |
|---------------|----------------------------------|----------------------------------|
| 1             | Column Specification             | 100×650mm                        |
| 2             | Maximum Column Height            | 350mm                            |
| 3             | Column Tube Design Pressure      | ≤10Mpa                           |
| 4             | Cylinder Design Pressure         | ≤20Mpa                           |
| 5             | Normal Setting Pressure          | ≤10Mpa                           |
| 6             | Column Tube Inner Wall Roughness | ≤0.2μm                           |
| 7             | Frit Size                        | 3μm                              |
| 8             | Wetted Material                  | 316L Stainless Steel, PTFE, PEEK |
| 9             | Overpressure Protection          | Safety Valve                     |

Column tube length and column tube design pressure can be customized according to customer needs.



DAC 150 schematic diagram

**WelPacker DAC150:**

| Serial Number | Configuration                    | Parameter                        |
|---------------|----------------------------------|----------------------------------|
| 1             | Column Specification             | 150×650mm                        |
| 2             | Maximum Column Height            | 350mm                            |
| 3             | Column Tube Design Pressure      | ≤10Mpa                           |
| 4             | Cylinder Design Pressure         | ≤30Mpa                           |
| 5             | Normal Setting Pressure          | ≤10Mpa                           |
| 6             | Column Tube Inner Wall Roughness | ≤0.2μm                           |
| 7             | Frit Size                        | 3μm                              |
| 8             | Wetted Material                  | 316L Stainless Steel, PTFE, PEEK |
| 9             | Overpressure Protection          | Safety Valve                     |

Column tube length and column tube design pressure can be customized according to customer needs.



DAC 500 schematic diagram

**WelPacker DAC300:**

| Serial Number | Configuration                    | Parameter                        |
|---------------|----------------------------------|----------------------------------|
| 1             | Column Specification             | 500×650mm                        |
| 2             | Maximum Column Height            | 350mm                            |
| 3             | Column Tube Design Pressure      | ≤10Mpa                           |
| 4             | Cylinder Design Pressure         | ≤30Mpa                           |
| 5             | Normal Setting Pressure          | ≤10Mpa                           |
| 6             | Column Tube Inner Wall Roughness | ≤0.2μm                           |
| 7             | Frit Size                        | 3μm                              |
| 8             | Wetted Material                  | 316L Stainless Steel, PTFE, PEEK |
| 9             | Overpressure Protection          | Safety Valve                     |

Column tube length and column tube design pressure can be customized according to customer needs.

**WelPacker DAC200:**

| Serial Number | Configuration                    | Parameter                        |
|---------------|----------------------------------|----------------------------------|
| 1             | Column Specification             | 200×650mm                        |
| 2             | Maximum Column Height            | 350mm                            |
| 3             | Column Tube Design Pressure      | ≤10Mpa                           |
| 4             | Cylinder Design Pressure         | ≤30Mpa                           |
| 5             | Normal Setting Pressure          | ≤10Mpa                           |
| 6             | Column Tube Inner Wall Roughness | ≤0.2μm                           |
| 7             | Frit Size                        | 3μm                              |
| 8             | Wetted Material                  | 316L Stainless Steel, PTFE, PEEK |
| 9             | Overpressure Protection          | Safety Valve                     |

Column tube length and column tube design pressure can be customized according to customer needs.



DAC 200 schematic diagram

**WelPacker DAC300:**

| Serial Number | Configuration                    | Parameter                       |
|---------------|----------------------------------|---------------------------------|
| 1             | Column Specification             | 300×650mm                       |
| 2             | Maximum Column Height            | 350mm                           |
| 3             | Column Tube Design Pressure      | ≤10Mpa                          |
| 4             | Cylinder Design Pressure         | ≤30Mpa                          |
| 5             | Normal Setting Pressure          | ≤10Mpa                          |
| 6             | Column Tube Inner Wall Roughness | ≤0.2μm                          |
| 7             | Frit Size                        | 3μm                             |
| 8             | Wetted Material                  | 316LStainless Steel, PTFE, PEEK |
| 9             | Overpressure Protection          | Safety Valve                    |

Column tube length and column tube design pressure can be customized according to customer needs.



DAC 300 schematic diagram

## V. Customer Service

Welch Materials, Inc. is dedicated to the research and development of separation and purification. In addition to offering top-notch chromatography instruments and consumables, we leverage our strong product development and technical application teams to provide comprehensive one-stop separation and purification solutions. Catering to diverse industry users, Welch Materials, Inc. offers a full range of multi-dimensional technical services.

### Advantages:

- ❖ Welch Materials, Inc. offers a wide range of chromatographic stationary phases, encompassing over a hundred choices, to cater to various separation modes and sample types.
- ❖ For different levels of separation, we provide preparative liquid chromatography systems of varying scales, ranging from analytical-level (0.00–10.0mL/min) to preparative-level (50mL/min, 100mL/min, 200mL/min, 500 mL/min, 1000mL/min, 3000mL/min) with inline UV detection for real-time monitoring, fulfilling your amplification and preparative needs.
- ❖ From low-pressure to high-pressure separations, and from small-scale fractionation to pilot-scale extraction, we offer reliable technical support to meet your requirements.
- ❖ Welch Materials, Inc. upholds the business philosophy of "Quality, Innovation, Competitive price" making us your most loyal partner.

