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Device	HPLC purification system Type: GL3000	Alternative versions	New
File code	GELAI-0014-012	Execution Date	

## GL3000 型純化分離系統設計 GL3000 Chromatography System Design

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#### 1. 設計概述 : Design Overview

GL3000 型純化分離系統，是一款製備型的高效液相層析純化分離系統。

由幫浦液體輸送系統，紫外檢測器，製備層析分離管柱系統，餾分收集器，軟體控制系統所構成。

其工作原理為：

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儲液器中的移動相 A 與移動相 B 分別被幫浦 A 及幫浦 B 輸送進入系統，經過混合器的混合。

樣品溶液經進樣幫浦 C 輸送，合併載入到層析分離管柱(固定相)前端。

樣品在兩相中經過連續的吸附-解吸附的分配過程。

由於樣品溶液中的各組分在兩相中具有不同的分配係數，使得各組分在分離管柱中

的往前移動的速度上產生差異，因而被分離成單個組分，依次從分離管柱內流出。

各組分在經過紫外檢測器時，其最大紫外吸收波長的吸收值，被連續轉換成數位信號，

成為工作站所記錄的層析圖。

餾分收集器依據時間位置或電壓信號高度的設定，

收集所需要的樣品組分至指定的容器通道。

The GL3000 type purification and separation system is a preparative high performance liquid chromatography separation systems. It is constituted by the pump liquid delivery system, UV detector, preparative chromatography column system, fraction collector, and control software system.

Its working principle is:

The mobile phase A and mobile phase B in containers are pumped respectively by pump A and B to delivery into system, and mixed in the mixer.

Sample solution is transmitted by the injection pump C, that combine and load into it into the front end of chromatography column (stationary phase).

The sample experiences continuous adsorption-desorption partition process between the two phases.

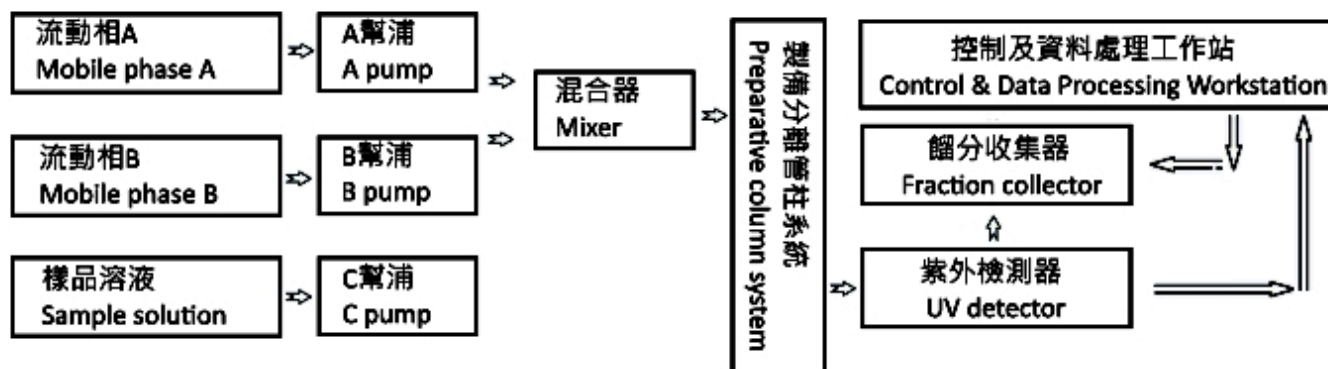
Since the various components of the sample solution have different distribution coefficients between the two phases, so they are separated into individual components that flows out of the chromatography column without overlapping.

The component absorption value, when passing the UV detector that is set to the maximum UV absorption wavelength for the

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component, is converted into a digital signal continuously, and became workstation recorded chromatogram. The Fraction collector will collect the desired sample component into specified container channel, according to the time position or peak signal voltage setting.

層析儀的連接示意圖如下：The chromatography instrument connection diagram is as follows:

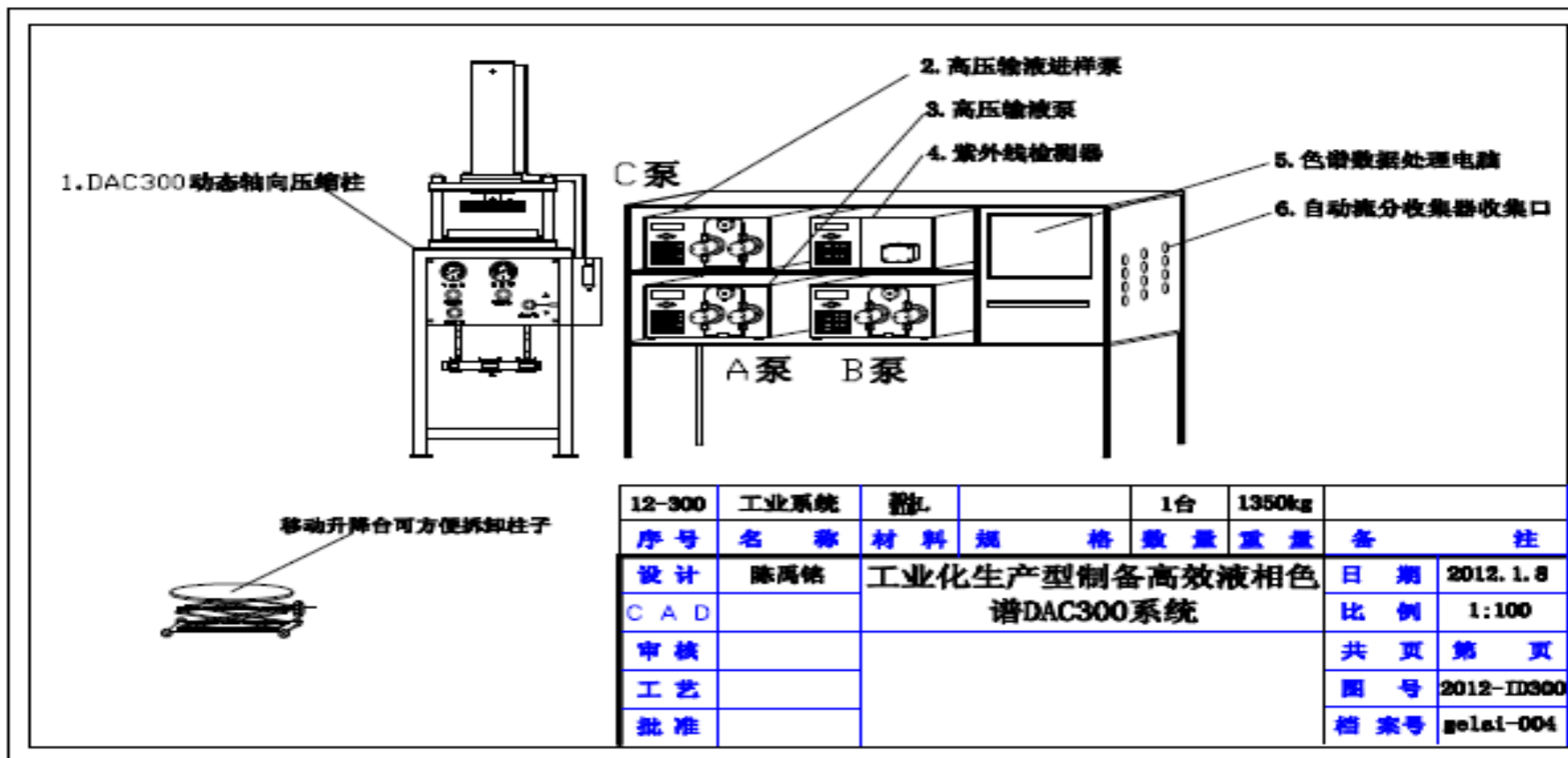


層析儀的連接示意圖

The chromatography instrument connection diagram

系統整體設計圖紙如下：Overall system design drawings as follows:

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## 2. 系統構件設計功能及材質 Design features and material of system components

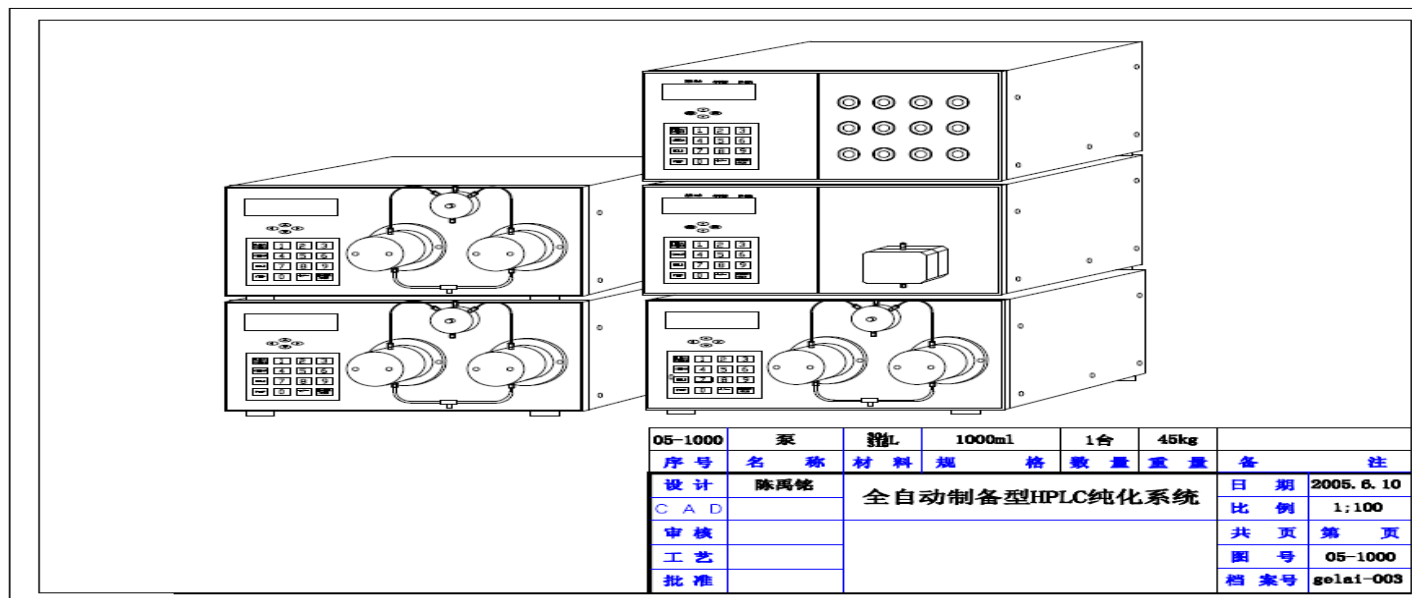
2.1 幫浦系統：這個幫浦系統由三台高壓液體輸送幫浦組成，設計最高流量為 3000ml/min.

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Pump System: This pump system consists of three high-pressure liquid delivery pumps, designed with 3000ml / min maximum flow rate.

幫浦系統設計圖如下：

Pump system design diagram is as follows:



每台幫浦由 1 套微電腦單片機主機板, 2 台電機, 2 套螺桿, 2 個幫浦頭, 4 個單向閥, 1 套面板, 1 套機架構成.

直接接觸移動相的幫浦頭材質為 316L 不銹鋼.

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單向閥殼體材質為 316L 不銹鋼，閥芯材質為二氧化鋯。

Each pump is composed of 1 microprocessor control board, 2 motors, 2 screw drivers, 2 pump heads, 4 check valves, 1 panel, and 1 frame.

Pump head material that directly contact with the mobile phase is made of 316L stainless steel.

The check valve housing is made of 316L stainless steel, with valve core made of zirconium dioxide.

微電腦單片機程式控制電機使螺桿旋轉，

螺桿帶動幫浦頭活塞形成推拉運動。

每個活塞 1 個行程為 12.86ml ; 2 個幫浦頭協調往復運動，使流體脈衝最小化。

移動相經由聚四氟乙烯(PTFE)管路被活塞運動產生的負壓經由入口單向閥吸入幫浦腔體，再經由出口單向閥推入幫浦頭上的連結管路。

由於單向閥的作用，移動相只能朝一個方向流入系統。

兩個幫浦頭的推拉動作協調交替，使移動相流速特別穩定。

分離管活塞桿以高壓斜紋彈簧密封圈和低壓聚四氟乙烯(PTFE)密封圈密合，密封圈設計耐高壓為?6000psi.

The microprocessor control board is programmed to control the motor to drive the screw rotation, and the screw will drive to push forward or pull backward the pump piston head movement.

A stroke of each piston is 12.86ml. The two pump heads move reciprocally in coordination enabling minimized fluid pulse.

The mobile phase is suctioned by the negative pressure generated by movement of the piston with a polytetrafluoroethylene (PTFE)

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tube through the inlet check valve into the pump cavity, and then through the outlet check valve · pulled into pipelines linked to pump head.

Due to the action of the check valve, the mobile phase flow into the system in one direction only.

The two pump heads push forward or pull backward alternately in coordination, so that the flow rate of the mobile phase is particularly stable.

The column piston is sealed with high pressure oblique-line seal ring and low pressure polytetrafluoroethylene (PTFE) seal ring, with the high pressure seal ring designed to tolerate 6000psi.

系統組態: 3 台高壓液體輸送幫浦

儲液器中的移動相 A 與移動相 B 分別被幫浦 A 及幫浦 B 輸送進入系統, 經過混合器的混合.

樣品溶液經進樣幫浦 C 輸送, 合併載入到層析分離管柱(固定相)前端,

樣品在兩相中經過連續的吸附-解吸附的分配過程.

由於樣品溶液中的各組分在兩相中具有不同的分配係數, 使得各組分在分離管柱中

的往前移動的速度上產生差異, 因而被分離成單個組分, 依次從分離管柱內流出.

各組分在經過紫外檢測器時, 其最大紫外吸收波長的吸收值, 被連續轉換成數位信號,

成為工作站所記錄的層析圖.

餾分收集器依據時間位置或電壓信號高度的設定,

收集所需要的樣品組分至指定的容器通道.

System configuration: 3 sets of high pressure liquid delivery pump

Its working principle is:

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The mobile phase A and mobile phase B in containers are pumped respectively by pump A and B to delivery into system, and mixed in the mixer.

Sample solution is transmitted by the injection pump C, that combine and load into it into the front end of chromatography column (stationary phase).

The sample experiences continuous adsorption-desorption partition process between the two phases.

Since the various components of the sample solution have different distribution coefficients between the two phases, so they are separated into individual components that flows out of the chromatography column without overlapping.

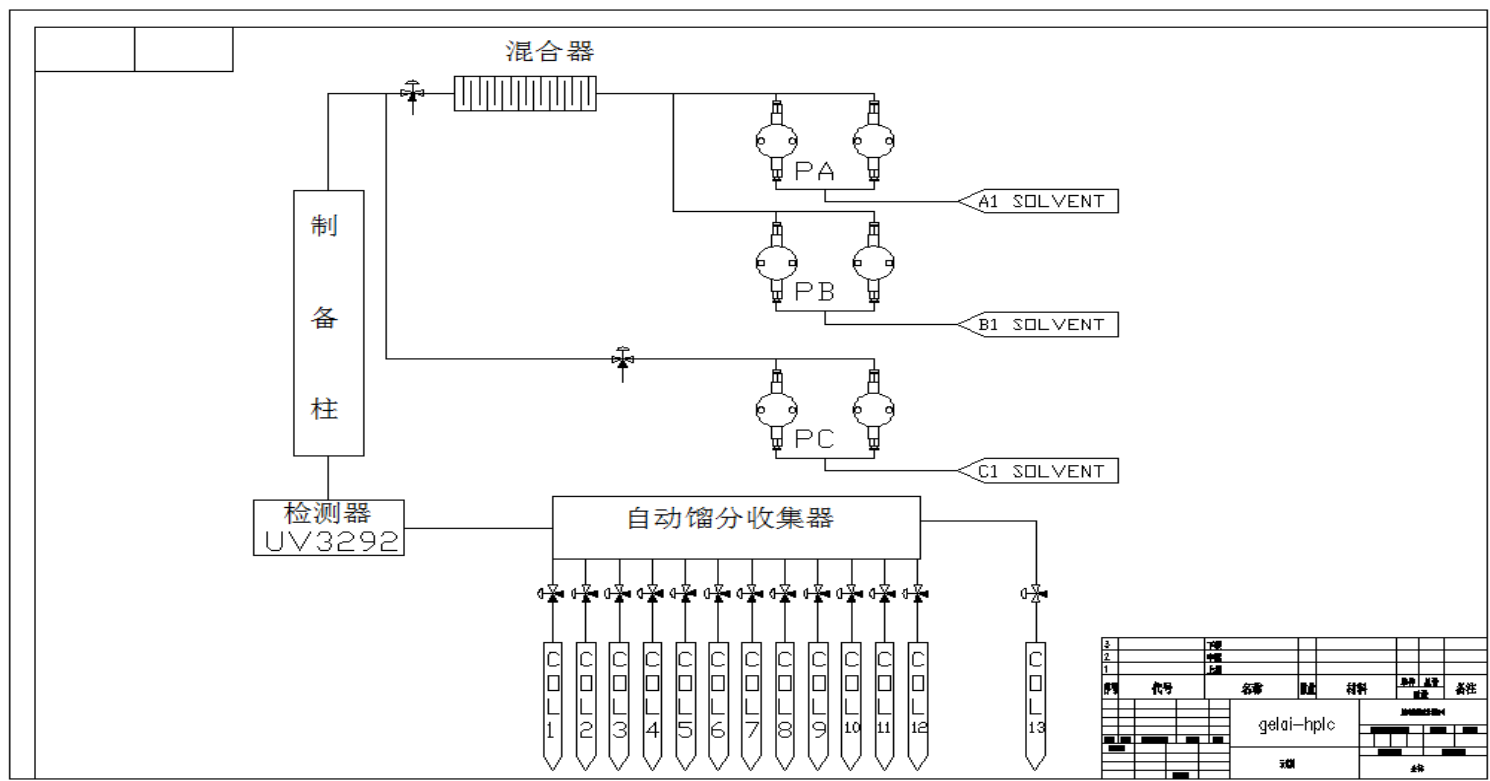
The component absorption value, when passing the UV detector that is set to the maximum UV absorption wavelength for the component, is converted into a digital signal continuously, and became workstation recorded chromatogram.

The Fraction collector will collect the desired sample component into specified container channel, according to the time position or peak signal voltage setting.

系統設計圖如下： System design diagram is as follows:



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## 2.2 检测器 : Detector

190-740nm 波段紫外检测器(波长可设定), 配备氙灯和钨灯.

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流通池規格為：2.5\*2.5, 體積為 0.049ml, 材質為石英玻璃.

設計波長準確度為±1nm, 微電腦單片機控制, 每次開啟後均進行自我檢測.

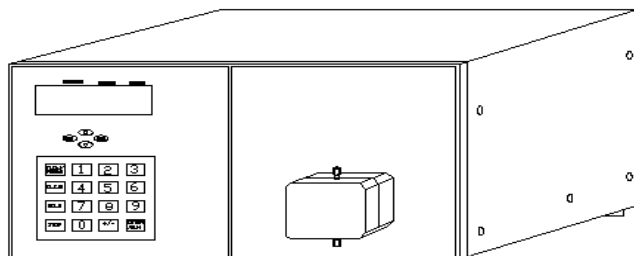
190-740nm wavelength range UV detector (wavelength can be set) with Deuterium and Tungsten lamps.

Flow cell specifications: 2.5 \* 2.5, volume 0.049ml, made of quartz glass.

Design wavelength accuracy: ± 1nm, microprocessor control, self-test(self diagnosis) performed for each turning on.

系統圖紙如下：System drawings as follows:

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12-100	UV	304L	制备型	1台	15kg		
序号	名称	材料	规格	数量	重量	备注	
设计	陈开明	UV-3000紫外检测器				日期	2012. 1. 5
C A D						比例	1:100
审核						共页	第页
工艺						图号	12-UV
批准						档案号	gelai-003

2.3 製備分離管柱：300mm 直徑 DAC 軸向壓縮系統。

Preparative chromatography column: a 300mm diameter DAC axial compression system.

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由油壓缸，啟動馬達，分離管柱頭活塞，分離管柱筒，篩板，分配器，支撐體構成。

分離管柱筒材質為 316L 不銹鋼，分配器材質為 316L 不銹鋼。

篩板材質為 316L 不銹鋼燒結片，孔徑大小為 2um，其它零配件材質為 304 不銹鋼。

It is composed of a hydraulic cylinder, start-up motor, the column inlet piston, column cylinder, sieve plate, distributor and body support.

The column, distributor and sieve plate are made of 316L stainless steel.

The sieve has a pore size of 2um · other parts are made of 304 stainless steel.

製備分離管柱系統安裝

壓力設計與計算：

壓縮空氣壓力：P 氣；表示裝分離管柱時所需要的壓力。

分離管柱內壓：P 分離管柱；表示預計得到的製備分離管柱壓力。指定分離管柱內壓為 90bar

油幫浦放大倍數：N；為分離管充填模組的一項性能常數，本設備該項常數為 60。

分離管充填模組的油壓缸內徑：D 油壓缸；為 150mm。

製備分離管柱內徑：D 分離管柱；300mm。

計算公式：

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$$P_{\text{氣}} = \frac{P_{\text{柱}}}{N * \left( \frac{D_{\text{油缸}}}{D_{\text{柱}}} \right)^2}$$

該設備裝柱時應調節壓力為：

$$P_{\text{氣}} = \frac{90}{60 * \left( \frac{150}{300} \right)^2}$$

=6 ( bar )

Installation:

Design and Calculation of Pressure:

P-Air: Compressed air pressure, the pressure required for packing column.

P-column: Column internal pressure · the column pressure expected to packing, 90 bar is specified.

N: Hydraulic pump gain, a performance constant of the column packing module, is 60 here.

D-Hydraulic cylinder: Hydraulic cylinder inner diameter of the column packing module, is 150mm here.

D-Column: Preparative chromatography column inner diameter, 300mm here.

The formula is :

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$$P\text{-Air} = \frac{N}{*} \left( \frac{D\text{-Hydraulic cylinder}}{D\text{-Column}} \right)^2$$

The P-Air for column packing is :

$$P\text{-Air} = \frac{90}{60} \left( \frac{150}{300} \right)^2 = 6 \text{ ( bar )}$$

將勻漿罐閥門對準層析分離管柱筒後開啟閥門，填料勻漿液經由閥門自動流入分離管柱體。  
調節氣壓閥至所需值，控制方向閥向下。分離管充填模組的聯動桿帶動分離管柱頭向下運動。  
溶液透過燒結片從分離管柱頭管路和分離管柱尾管路快速噴出。

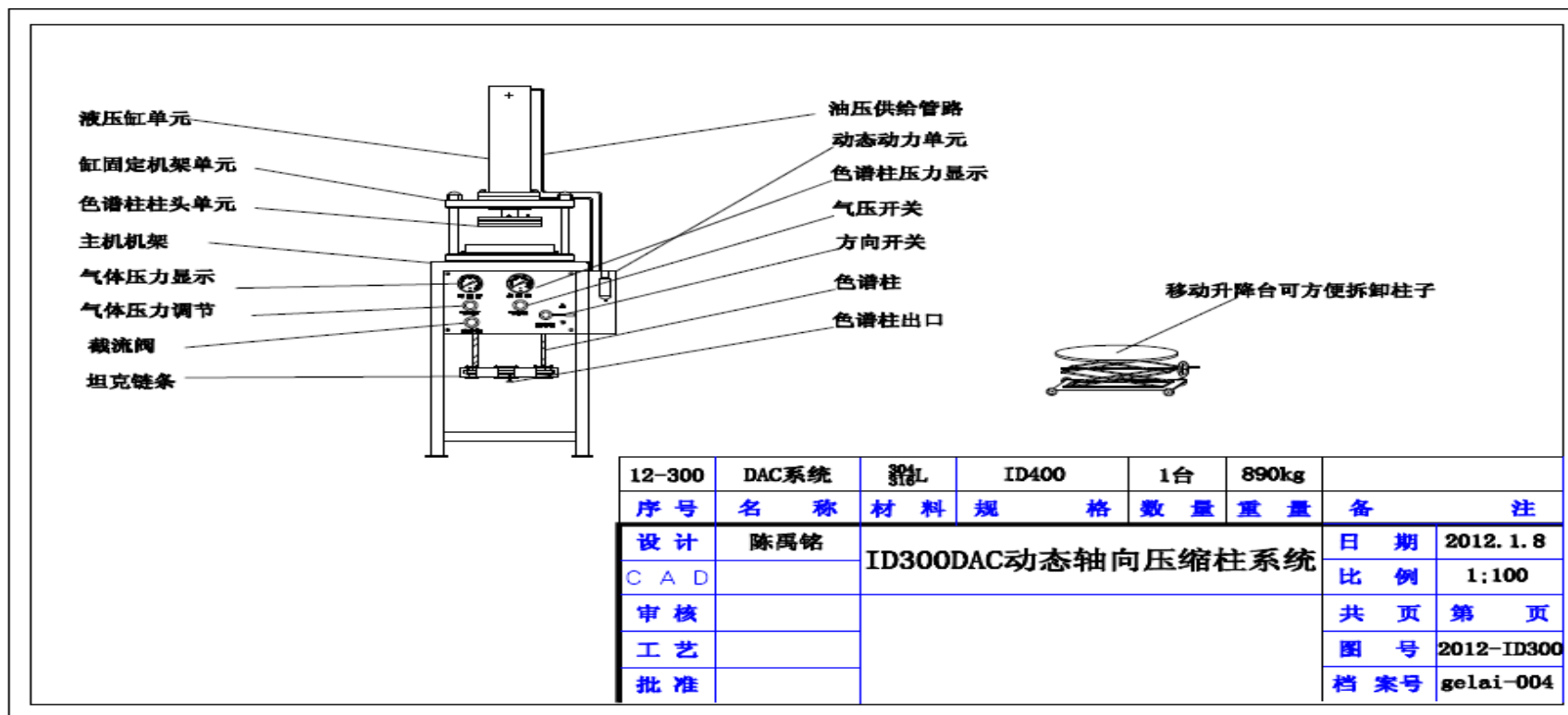
Align the homogenizer tank valve to the column cylinder · the open the valve to let the packing material to flow into the column cylinder automatically.

Adjust the pressure regulating valve to a desired value °

Position the control valve in downward direction that will drive the chromatography column head downward by the linkage rod of the column packing module °

The solvent rapidly passes through the sintered sheets at both the inlet and outlet portions of the column °

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## 2.4 自动馏分收集器：Automatic fraction collector

自动馏分收集器采用全数位设计，信号由单板机完成资料处理，

处理后结果由 RS232 介面传到 PC(或上位机)，进行成份峰的记录，达到智慧化收集。

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設備設計 12 個流出口，其中一個常開，

其他的收集口可自由切換到不同的收集瓶。

與樣品接觸的閥門材質為 316L 不銹鋼，支撐體和外殼材質為 304 不銹鋼。

設備淨重：7.5kg，外觀尺寸：420mm\*330mm\*175mm

The Automatic fraction collector is all-digital design. The signal data processing is completed by the microprocessor, with the processed data transmitted by RS232 interface to PC (or a Master module) that records component peaks and to realize sophisticated collections.

The equipment is implemented with 12 flow outlet channels, one normally open, and other freely switchable for different collection bottles.

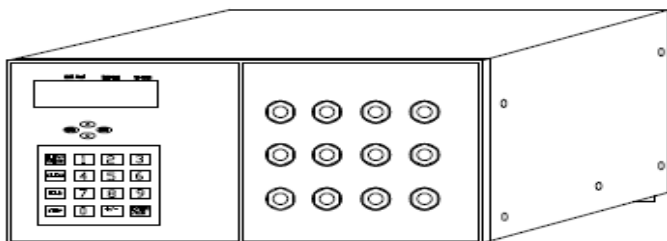
The material of the valve that may contact with the sample is of 316L stainless steel, and the support and the shell is made of 304# stainless steel.

Net weight: 7.5kg, Dimensions: 420mm \* 330mm \* 175mm

系統設計圖如下：System design diagram is as follows:



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12-100	流分系统	φ8L	十二口φ8通径	1台	15kg		
序号	名称	材料	规格	数量	重量	备注	
设计	陈禹铭	全自动流分收集系统				日期	2012. 1. 5
C A D						比例	1:100
审核						共页	第 页
工艺						图号	12-φ8L
批准						档案号	gelai-003