

Operation Manual

For P1100 High-Pressure Constant Flow Pump

V1.0.6

ELITEHPLC

Statement

The manual describes various contents of P1100 pump. It is intended to help users to understand, use and maintain the instrument of P1100; Elite Analytical Instruments Co., Ltd. does not assume the responsibility caused by the manual.

This manual is subject to change without notice.

This manual has been published, after careful review, it is believed to be accurate and complete. Elite Analytical Instruments Co., Ltd is not responsible of any error that may appear in the manual and the resulting incidental or renewal of harm.

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Precautions

Thank you for your continue patronage. Observe the following precautions in order to make safe and stable use of the pump.

Precautions are divided into three groups in this operation manual depending on the degrees of danger. The three groups are



[Warning] Failure to properly follow the instructions and precautions indicated by this sign can result in serious injury or damage to health and property. The property damage include the environment around and the instruments.



[Caution] Failure to properly follow the instructions and precautions indicated by this sign can result in slight injury or damage to health and property. Slight injury means no hospitalization is needed to the wounded. Slight property damage means the instruments can be recovery through simple maintenance.



[Note] The sign is used wherever information is given to ensure optimal performance of the instrument.

1. Precaution for usage



[Warning] P1100 pump should only be used as a part of liquid chromatography. Do not use it any other purpose. Except for special instructions, the instrument does not have explosion-proof function.

2. Ambient Conditions



[Warning] When we use organic solvent. It is recommended that interior must be well ventilated, the firework should be prohibited. Also, a sink or equipment for washing eyes should be installed nearby in case of the organic solvent coming into contact with the eyes or skin.



[Note] In order to ensure good efficiency, keep the instrument away from caustic gas and dusty environment. The width of worktable should be more than 600mm. Ambient is between 10°C to 30°C with a small fluctuation, and RH is between 45% to 85%. Avoid it from cold or hot source as well as direct sunshine. The system should not close to strong magnetic field.

3. Precaution for installation



[Warning] The instrument should be installed following the instructions strictly by professionals, make sure that the voltage of the power socket is the same as the power supply voltage indicated on the instrument. Using the wrong power voltage could result in danger and fire.

The accessory power cable should be used to connect the pump to the power socket. Other cable should not be used.

The equipment should be connected with protective earth to prevent static and leakage.



[Caution] The instrument is so heavy, you should move it carefully and watch your hands in the same time.



[Note] The instrument should be connected following the instructions strictly. Wrong connection could cause communication error.

4. Precaution for use



[Warning] Do not use the instrument in places where heat resource, fire seat, magnetic resource, strong vibration exist or may exist. It is prohibited to play flammable nearby.

The bottle for storing the mobile phase should have pore in cap to prevent danger caused by negative pressure in the bottle.

A gap between waste tube and the cork of waste bottle is necessary to prevent the waste bottle bursting when it is overfilled. The gap should be smaller to insure less evaporate of hazardous solvents. Even though, the waste need to be clean up promptly.



[Caution] When using organic solvents, please wear safety goggles, special lab coats, gloves mask etc. .If your body contact with toxic solvent accidentally, wash it immediately, and then go to hospital for specialized treatment.



[Note] When preparing mobile phase, please use HPLC-grade or equivalent at this level solvents. Solvents must be prefiltered by the manufacturer with a 0.45- μm (or smaller).Degas all mobile phase before using it. Degassing can help to ensure a stable baseline and consistent analytical results.

Before first use, rinse the entire piping system according to the requirements of the manual, direct use is likely to block pipeline.

Before sample test, ensure that the pipeline in the system is filled with mobile phase without any bubbles, otherwise it will affect the reliability of test results.

If an eluent is replaced with another eluent which is insoluble, such as positive mobile phase (hexane) and reverse phase (methanol), be sure to operate according to the specified method in the manual, otherwise it will cause serious pipeline jam, and even system paralysis.

Do not use the following solvent: concentrated sulfuric acid, nitric acid, dichloroacetic acid, methylene chloride, chloroform, chloroform, dimethyl sulfoxide, acetone, tetrahydrofuran, etc. Such solvents always reduce the strength of the PEEK material, make it become fragile and broken, but short-term use of aqueous solution of acetone(lower than 0.5%) in gradient performance, the impact is receptive.

When using PEEK pipes, the press of system should be lower than the tolerance pressure of peek material, otherwise it may burst.

The bending radius of peek pipe should be more than 10mm,make the peek pipe natural relaxation during installation.

The PEEK pipe should be intercepted with professional tube cutter in order to make the pipe more smooth. Pay attention to that there is no cutting debris left in the pipe.

5. Repair, maintenance and parts replacement



[Warning] Before repair, maintenance and parts replacement, please turn off the power in case of leakage and electric shock.

There is no need to open the host cover while daily maintenance and repair. If the repair need to open the host cover please entrust agents or communicate with us.

Use dry close to wipe the instrument. Do not use water or alcohol. The use of these liquids may erase characters or color on the panel.

Do not replace components (e.g., fuses, deuterium lamp, etc.) from other company or other type, all accessories are required to be specified to prevent danger.

6. Precaution for static electricity



[Warning] As this pump may use a lot of flammable, explosive organic reagents which can contaminate laboratory air. When the reagent concentration is too high, any spark or flame could cause fire or explosion accidents. Do not use the pump near any fire resource, hot resource, and static electricity resource. To reduce static electricity, please take the following measures:

- 1) Make the instrument grounded. It is very important, please pay attention to it.
- 2) Maintain proper indoor humidity (humidity is greater than 65% can prevent static electricity effectively) keep the environment clean.
- 3) Metal waste bottles (external conductive) should be grounded (no ground insulation). When using other materials container, you can insert one end of the wire into liquid in the bottle and make the other end earthing.
- 4) Replace thicker pipe when the mobile phase's flow is large.
- 5) Wipe the instrument regularly.
- 6) Staff wear anti-static clothing, anti-static bag is needed on the floor.
- 7) People and objects with static electricity is prohibited to touch the instruments.

7. Warning label instructions

To ensure the safety of staff, we attach warning labels on the equipment where is danger. If the label is missing, please request new ones from the company, and attach to the correct position.

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1. Chapter One: Introduction

1.1 Overview

P1100 high-pressure constant flow pump is based on years of experience in the research and production of high-pressure pump. It is a high performance pump for HPLC system.

As an infusion unit of HPLC system, P1100 can be easily used with a variety of liquid chromatography detectors, autosampler, column oven etc., and it also can be used independently as a delivery tool.

1100 Series products include P1100 constant flow pump, D1100 UV-visible detector, ST1100 solvent tray, W1100 workstations, GM1100 gradient mixer, VB1100 valve stents etc.. For more information, please contact Elite Analytical Instruments Co., Ltd.

P1100 high pressure constant flow pump is driven by a small CAM. There are two tandem plungers whose stroke is short, the infusion pulse of P1100 is low. Subdivision stepping motor control technology allows motor running smoothly at low speed. Floating guide plunger installation, high quality piston rod and other key components ensure the pump running stability and durability in long period. Coefficient of the mobile phase correction and dual correction results in high accuracy. You can easily control the instruments by workstation. P1100 high pressure constant flow pump is very suitable for pharmaceutical, biochemical, environmental protection, quality control and other areas of HPLC applications, also, in some special areas such as high-precision feed pump, it also has a unique advantage.

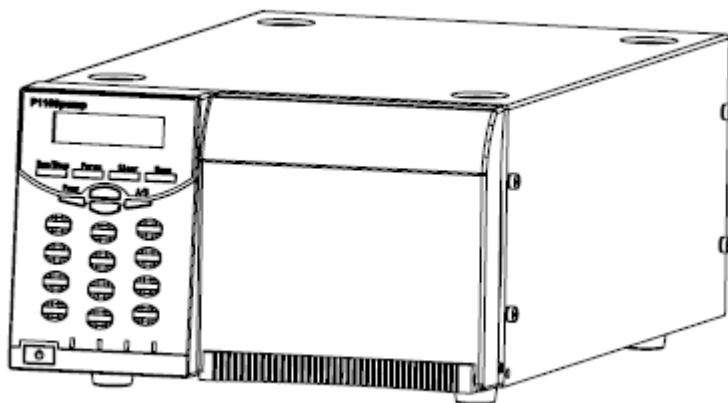


Figure 1-1: P1100 pump

1.2 Features and Functions

Draw lessons from the current domestic and foreign advanced technology, Elite companies independently developed the P1100 high pressure constant flow pump with independent intellectual property, its main characteristics are as following:

Driven by a small CAM, the infusion pulse of P1100 is low. The traditional liquid chromatograph buffer is canceled, which reduces the system volume.

Subdivision stepping motor control technology ensures that P1100 pump is accurate and precise, even at low flow rate or binary gradient system. This greatly increases the repeatability of the results.

Floating guide plunger installation, high quality piston rod and other key components ensure running stability and durability of the pump in long period.

The advance operation menu allows user to amend the flow compressibility and flow correction values. User can adjust the flow rate within $\pm 15\%$ using these two functions. Hence accurate and precise flow rate is obtained for different solvent system.

P1100 pump has RS-485 connector which can be used to control the instrument from a computer, by using the appropriate software. Furthermore, through RS-485 connector, two P1100 pumps can communicate with each other to achieve accurate and consistent binary gradient flow.

Real-time pressure display, maximum and minimum pressure warning ensure the security of instrument operation.

VFD can display pressure in 3 different units: MPa, psi and Bar.

The pump has purge function to instantly increase the flow rate of mobile phase for flushing purpose (P1100 8mL/min).

Using the integrated circuit controller AT89C55 and SPI bus technology, P1100 is compact and reliable.

The VFD-LCD display and keypad are user-friendly and easy to operate.

1.3 Performance Specification

Table 1-3: Performance Specification of P1100 pump

Item	Specification
Flow Rate	0.001-10.000mL/min(Step:0.001mL/min)
Accuracy	$\leq \pm 0.3\%$ (1.0mL/min, 8 ± 2 MPa, water, ambient temperature)
Precision	$\leq 0.1\%$ (1.0mL/min, 8 ± 2 MPa, water, ambient temperature)
Max Pressure	42MPa(0.001-5.000mL/min) 20MPa(5.001-10.000mL/min)
Pressure accuracy	$\pm 3\%$ or $< \pm 0.5$ MPa
Pressure pulsation	$\leq 1.0\%$
Leakproofness	Pressure drop ≤ 1.5 MPa(40MPa, 10min)
Communication mode	RS-485
Dimension/Weight	420mm×260mm×160mm/14kg
Power Supply	AC 220V,50Hz
Power	80W

2. Chapter Two: Installation and transport

2.1 Unpacking inspection and standard accessories

P1100 high pressure constant flow pump is packaged with corrugated boxes and foam lined structure, as you receive the instrument, check the packaging first, if you found packaging is damaged, please contact with Elite Analytical Instruments CO., Ltd. or local dealer.



[Warning] If there is any damage to the instruments when you receive it, please don't try to install it. You can ask Elite Analytical Instruments CO., Ltd to inspect and assess it.

2.1.1 Demolition of the packing

Put the pump on level ground with the face of the packing box up. Cut the tape on the top, take out the pump and accessories package, place it on the table. Then remove foam, open the instrument protective film.



[Warning] The pump is heavy, it is suggested that installation operation need at least two people to prevent instrument slide.

2.1.2 Deliver checklist

Before installing, please check the deliver list carefully, if one or several of them omissions, please communicate with Elite Analytical Instruments CO., Ltd. Or local distributors as soon as possible.

Table 2-1: Deliver list of P1100 pump

NO.	Item	Quantity
1	P1100 pump	1 pc.
2	Certificate	1 pc.
3	Service Card	1 pc.
4	Start Package	1 pc.



[Note] If there is discrepancies between the packing list in the box and in the specification, please refer to the packing list in the box,It is subject to change without prior notice.

2.2 Installation Requirements

2.2.1 Site Requirements

Environment

Pump P1100 need to work under ambient conditions in Table 2-2 below:

Table 2-2: Environment requirements

Item	Specification	Requirements
1	Work environment	Room should be free of dust, inflammable and explosive materials, also,good ventilation is important
2	electromagnetic field	No electromagnetic noise nearby
3	Operating temperature	4~40°C (39~104°F)
4	Humidity	20%~80% , non-condensing
5	Temperature fluctuation	< ± 2°C /hr



[Caution] Do not use the pump under conditions of temperature fluctuations. If the ambient temperature is too low, make the room temperature increase slowly to avoid condensation inside caused by rapid heating.

Bench space

The P1100 pump's dimensions allow placing the pump on almost any laboratory bench. If you want to display the complete 1100 system on the bench, make sure that the table can bear the weight of all components. It needs an additional 50mm on the left,150mm on the right,150mm on the back to facilitate the circulation of air, electrical connections.



[Warning] The instruments should be placed on a a horizontal position, otherwise there is a danger of falling!

2.2.2 Power and power line

To ensure the instrument can be normal and safe, please use a dedicated power line within the specified voltage range.

Grounding, ac power to 220 v + 10%, 50 Hz;

High pressure, please choose T1.25 A (250 v) fuse.



[Warning] The accessory power cable should be used to connect the pump with the power socket. Other cable should not be used in case of danger or damage to the instrument.

If the instrument is connected to a grid above the scope of application, it may cause electrical shock or damage to the equipment and staff.

Please unplug the power cord before replacing the fuse to avoid electric shock. The external fuse is installed in the back of instrument.

2.2.3 Computer requirements

Hardware requirements

- The lowest hardware requirement: Inter Core 2 CUP, 2G internal storage, more than 1G hard-dist space; (Refer to the use of W1100 workstation)
- The lowest resolution of displayer: 1024×800, 64K(16 bit image);
- Others: USB or RS232 interface for communication, CD-ROM driver for software installation。

Operation system requirements

- Windows XP Professional(SP3)、Windows 7 or higher version(Refer to the use of W1100 workstation).

Workstation requirements

- Use W1100 workstation to control the instruments.

2.2.4 Communication connection

Communication, management and control functions between 1100 components is completed by detector, the communication line is connected as follows:

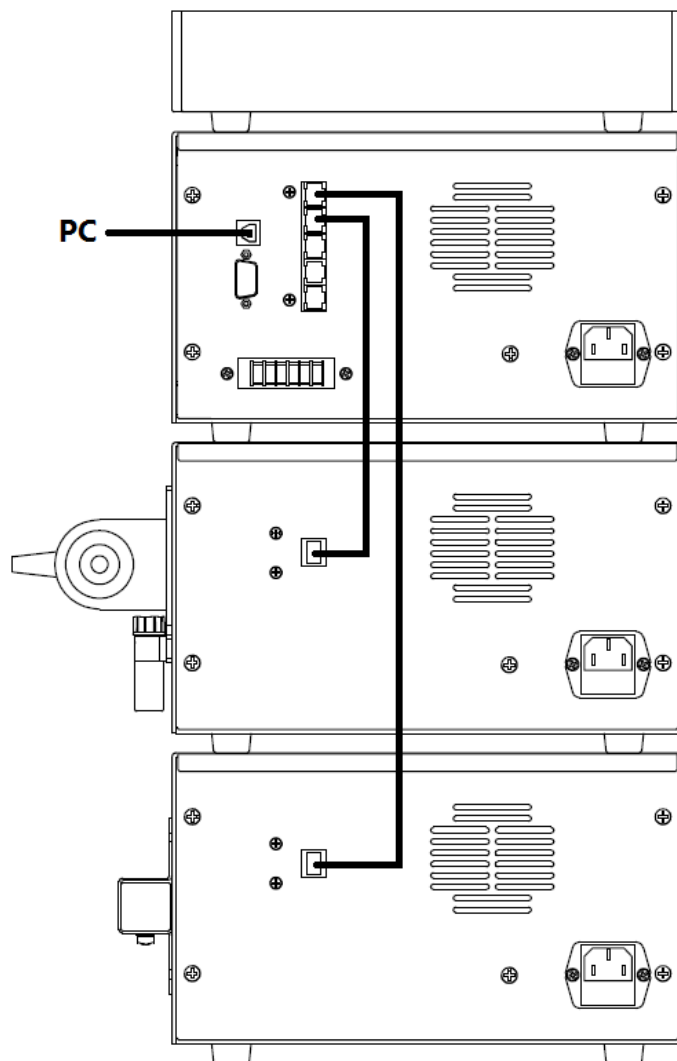


Figure 2-1: 1100 HPLC communication

2.3 Tube Connection

In addition to the column system, piping, fittings and injector, detector volume are likely to cause bands broadening. Inappropriate tube material also lead to band broadening, even lead to degeneration of the sample. Please connect the tubes with instruments correctly to improve efficiency. The tips are as follows:

2.3.1 Tube material

Different material of tube is required according to the working pressure, the kind of mobile phase and the nature of sample. The commonly used tube materials are as follows: stainless steel, polyetheretherketone (PEEK), polytetrafluoroethylene, polyethylene or polypropylene in which the most commonly used material is stainless steel. The outer diameter of LC connection tube is 1.59mm(1/16"), the inner diameter of LC tube are 0.175mm (0.007"), 0.25mm (0.01"), 0.5mm (0.02"), 0.75 (0.03") mm and 1.0mm (0.04") etc., user can choose from them. Stainless steel tube is generally used for high-pressure part.

Polymer tube can be used in low-pressure part of LC System, such as from reservoir bottle to pump, detector outlet, injector discharge port, etc.. The polymer tube is the most common connection tube in LC system.

PEEK tube can withstand about 30MPa pressure, it is more inert than stainless steel pipe which means it is a good choice for separation, analysis and preparation of biological samples. In bio-separation system, PEEK is alternative materials for stainless steel.

2.3.2 Cleaning the connect tube

Please wash new pipeline with solvent before use. Cleaning order: chloroform - methanol (ethanol) - Water - 1 mol/L nitric acid - water - methanol - dry with nitrogen stream. Also, silicone tube should be rinsed with methanol before use.

2.3.3 1100 System connection instance

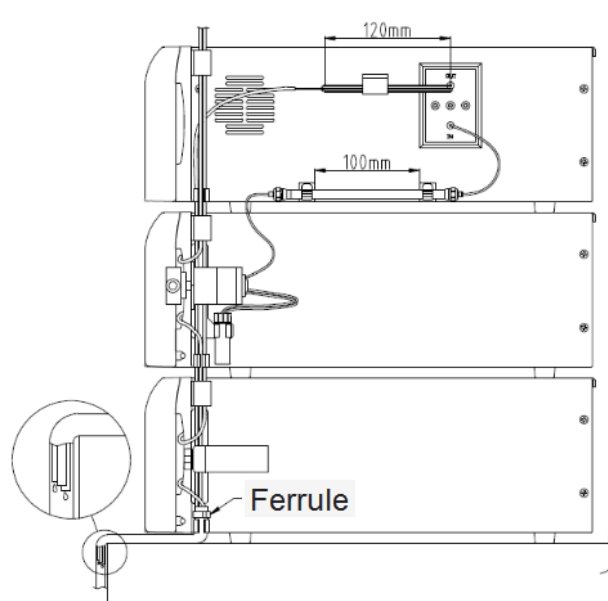


Figure 2-2: 1100 System connection diagram

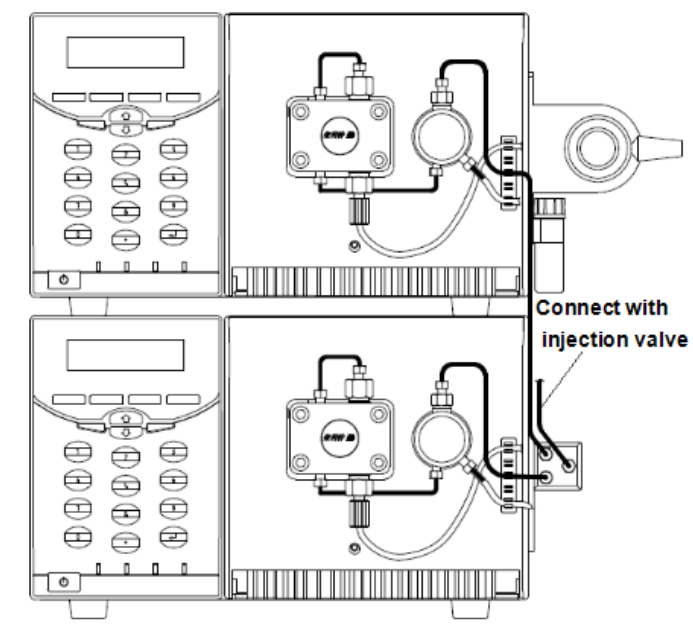


Figure 2-3: Stainless steel tube connection diagram

2.4 P1100 Front

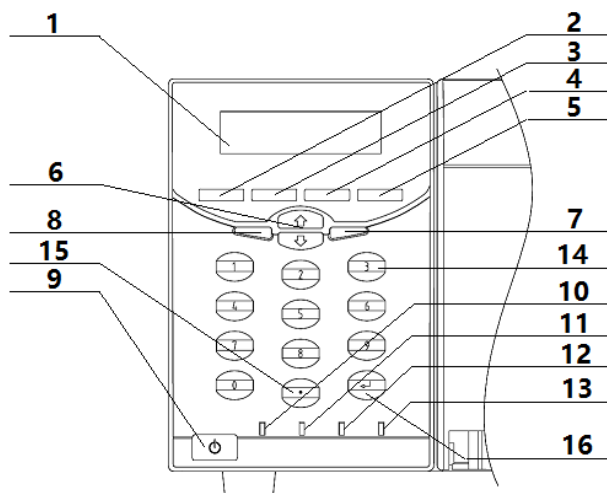


Figure 2-4: Front of P1100

Table 2-3: Keypad Function

No.	Key	Function
1	VFD – display	VFD displays operational status, menu and sub-menus, and parameters' values and units.
2	RUN/STOP	Local mode: to start and stop the pump. Press once, the pump indicator light will be on and the pump will operate according to a pre-set flow rate. Remote mode: Press RUN/STOP key to pause the pump operation.
3	PURGE	To flush the pump system at large flow for P1100. It can be used to purge out trapped air bubbles or during changing of mobile phase.
4	CLEAR	To delete wrong data input or to disarm an alarm.
5	MENU	To access to function menu. Press the MENU key once, to access to the respective MENU1. Press again, to MENU2.
6	↑↓	Press ↑ and ↓ key to move between different menu and sub-menu.
7	A/B	To switch A/B pump
8	PMax	For direct to the maximum pressure Settings interface.
9		Power switch
10	POWER	Power is on when the indicator is illuminated.
11	RUN	When the run indicator is illuminated, the pump is in run mode.
12	PURGE	When the purge indicator is illuminated, the pump is in purge mode.
13	Alarm	When the alarm indicator is illuminated, the pressure is more or less than alert value.
14	0 – 9	Numerical keys
15	.	Decimal point
16	ENTER	To confirm values and selections. Upon pressing ENTER key, the cursor will automatically move to the next parameter.

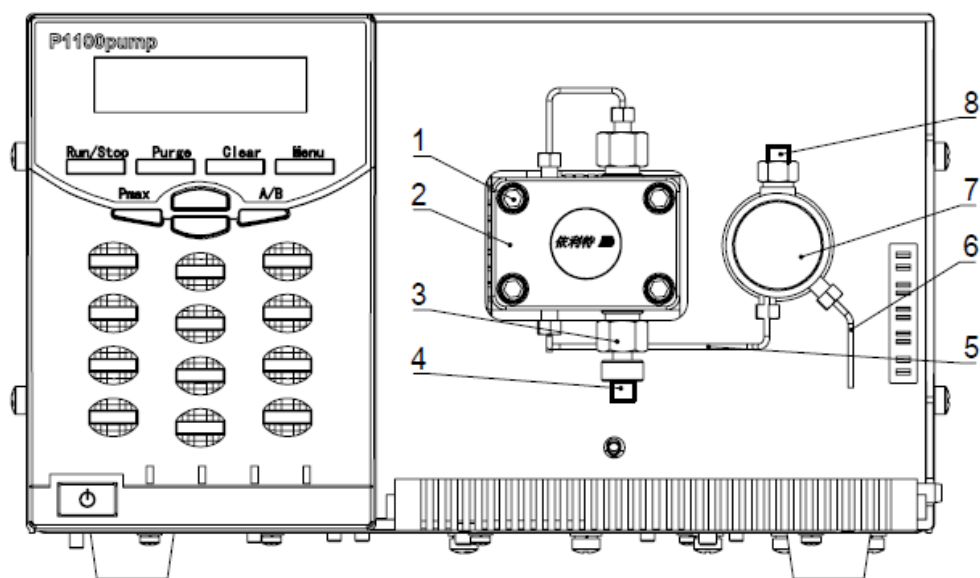


Figure 2-5: Fluid-contact components of pump head assembly

Table 2-4: Fluid-contact components

No.	Component	Function
1	Mounting screws	To fasten and lock the pump head
2	Pump head	To draw and deliver mobile phase
3	One-way ball valve	Prevent backflow and allow mobile phase to flow in one direction
4	Inlet capillary	To connect with Teflon solvent tubing to pump head
5	Connecting tube	To connect pump head with relief valve
6	Relief tube	release air and waste liquid from the pump head
7	Relief valve	Loosen the relief valve knob to release pressure from the pump head. It can be used for purging and priming purpose.
8	Outlet capillary	Mobile phase exits the pump from here. It can be connected to a mixer, manual injector device or auto-sampler.

2.5 P1100 Rear

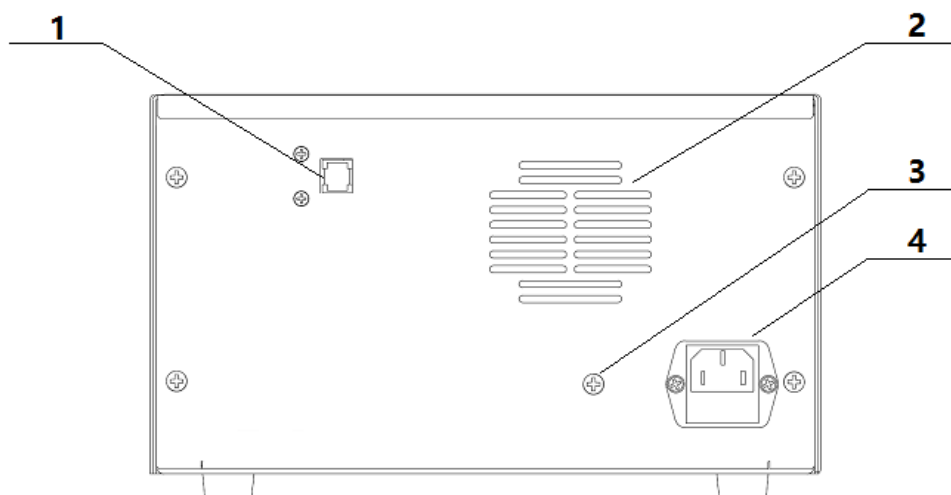


Figure 2-6: P1100 pump rear panel

Table 2-5: Rear panel

No.	Component	Function
1	RS485 interface	This socket is connected to pump controlling board of the computer for remote control.
2	Cooling fan vent	Cool the instrument.
3	Ground terminal	To ground the main body of the pump
4	Power connector	The power cable is connected into grounded power outlet.

2.6 Fluid Connection System

2.6.1 Solvent pipeline system diagram

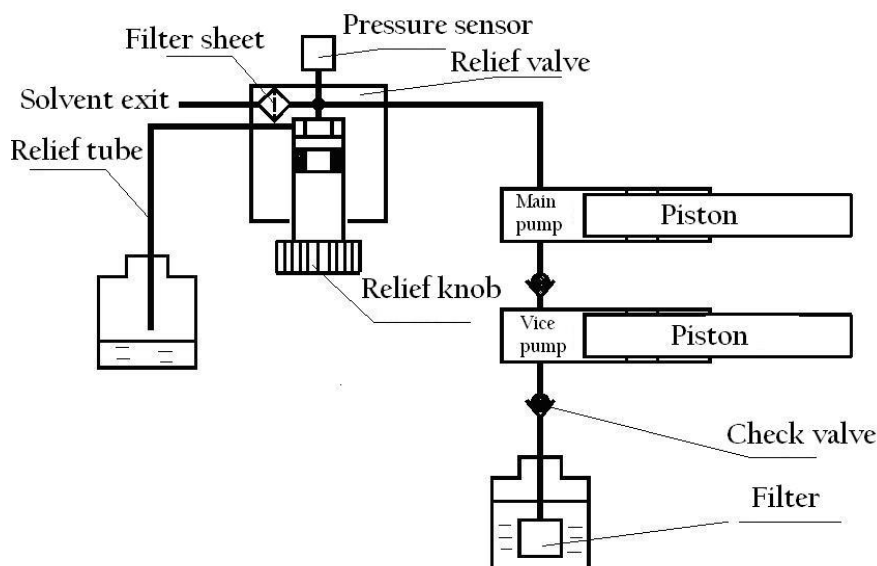


Figure 2-7: Fluid Connection Flow Diagram

2.6.2 Installation Preparations

A 500mL or bigger solvent reservoir is needed, there should be two 3-4mm holes on the cap. Remove the seal plug of the pump outlet that is above the vent valve. connect the stainless steel tube (OD1/16"× ID0.02") with pump port, the other end of the tube will be connected with injection valve.

2.6.3 Connecting solvent reservoir to the pump

Attach the solvent inlet filter to one end of the solvent tube, then, put it inside the solvent reservoir. The other end of tube should be connected with the inlet of the pump.

2.6.4 Connecting injection valve to the pump

Connect the outlet of the pump to the inlet of injection valve (No. 2 hole is usually the inlet for the mobile phase) with stainless steel tube(with screw connection and sealing edge ring).

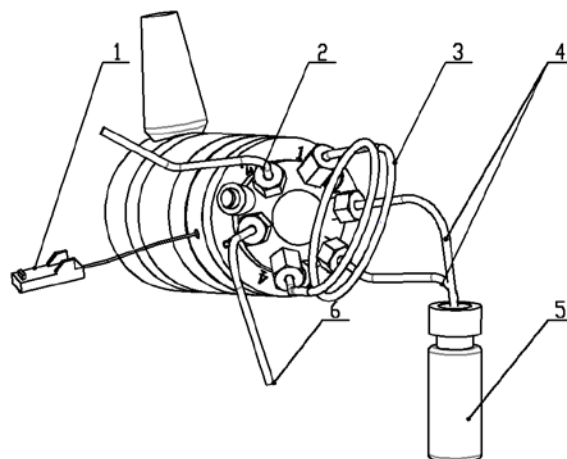


Figure 2-8: Fluid connection of Manual filling valve

1. Automatic trigger interface; 2. Mobile phase entrance; 3. quantitative loop;
4. waste tube; 5. Waste bottle; 6. Mobile phase export

Port #3 of injection valve should be connected to the entry of column.

Port #2 of injection valve should be connected to the outlet of pump.

Do not over tighten the connecting screw, as it may damage the ferrule.

If there is leakage, please replace Blade ring.

To reduce the column efficiency loss, the pipe length between the injection valve and the column, between the column outlet and the detector inlet should be as short as possible (ID:0.007" is recommended).

Make sure the end of all the stainless steel tube is smooth to reduce dead volume of the system (It is recommended that you'd better choose the universal column connector to connect column inlet and the outlet, which is available from Elite).

2.6.5 Connecting the pump to the mixer

A mixer is required when the pump system consists of more than one pump, e.g. gradient system. The mixer ensures the mobile phases come from different pumps mix well before entering HPLC systems.

The mixer is placed externally, besides the P1100 pump. Using a stainless steel tube, connect the pump outlet to the mixer's inlet. Connect the mixer's outlet to port #2 of the injection valve.

You can choose different mixer according to the analysis. GM1100 is recommended.

2.6.6 Solvent waste bottle

The solvent waste bottle should be placed at a lower position with respect to the equipment.

2.7 System Configuration

In normal instance, the instrument customers received have been tested and came with verification, the performance met our requirements in factory, users have no need to test and verify. If you have any doubt about the pump's performance, verify it refer to the following steps:

Check the sealing performance

- 1) Connect the chromatographic column properly, then, start the pump, observed whether the pressure displayed is stable, if not, please clean check valve or relief bubble in pump head.
- 2) Set the max alarm pressure to 40MPa, close the outlet of injection valve.
- 3) Start the pump, the pressure will rise slowly, when the pressure rise to 40 MPa the pump will stop automatically, observe the pressure drop on the screen.
- 4) Pressure drops less than 1.5MPa in 10min, sealing of the pump is qualified.
- 5) Pressure drops more than 1.5MPa in 10min, Many factors should be considered, such as seals lax of check valve, sampling valve or piping joint, or air bubbles in the pump head.

Isocratic system

- 1) Take a chromatographic column, the positive phase system selected SiO₂ column, inverse system using C18 column.
- 2) Prepare mobile phase and samples according to evaluation report provided by the column manufacturer.
- 3) Empty air bubbles in the pump system, when the system is stable, detect it according to the testing requirement.
- 4) If the result and column efficiency is conform to the information provide by column manufacturer within the error range, that means the HPLC is qualified.

Gradient system

- 1) Connect gradient system to the detector through a two-way, set detector wavelength to 254nm.
- 2) Link the work station to gradient system and detector, set gradient parameters according to figure 2-12, mobile phase A is pure water, mobile phase B is 0.2% (V/V) acetone water, the total flow is 1.0 mL/min.
- 3) Start to collect data until the instrument is stable. Gradient error was calculated by the formula (2-1), take the largest for gradient accuracy.

4) If each steps is smooth without obvious concave and convex, and mixed gradient accuracy within $\pm 2.0\%$, the gradient conform to the requirements, the pumps match well.

$$T_{Ci} = L_{ti} - \frac{V_i - V_A}{V_A - V_B} \times 100\% \quad (2-1)$$

T_{Ci} ——The i segment gradient error

L_{ti} ——Set gradient error of the ith segment

V_i ——The signal value of the ith segment

V_A ——The signal value when the mobile phase A is 100%

V_B ——The signal value when the mobile phase B is 100%

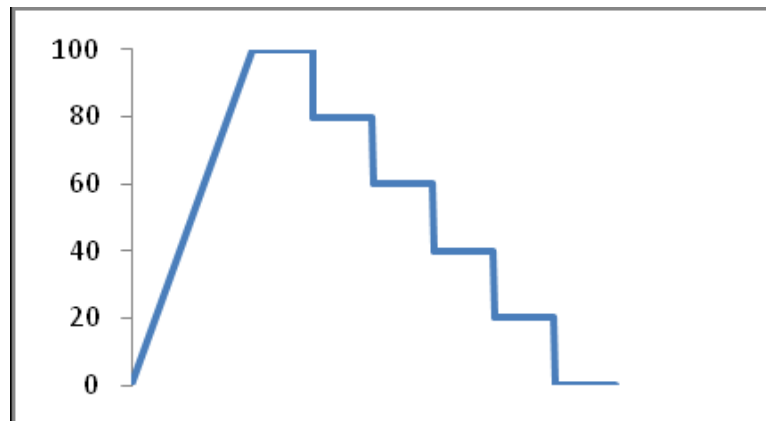


Figure2-9: Gradient diagram

2.8 Transportation

High pressure constant flow pump is a precision instrument, please gently while long-distance transportation, severe vibration, drops are likely to cause damage to the internal parts of the instrument. The random original packaging can effectively protect the instrument. When the instrument is required to move or returned for service, please follow these steps for packaging.

Turn off the power.

Unplug the power cord and 485 line.

Removing the connecting pipe and other elements between components.

Remove the pump from chromatography system, put it into special sealed bag on a large platform.

Put the pump into the original packaging foam, fix it.

Placed the fixed pump and other accessories into original packaging carefully.

Tape the box sealed to prevent liquid from entering. Cover the packaging box with plastic wrap is recommended.

Transport packaged instrument.



[Warning] Before packing, please check the box, if the original packaging has been damaged, do not use it, you should consult your local dealer or Elite Analytical Instruments Co., Ltd. customer service staff to solve!

3. Chapter Three: Basic Operation

3.1 Power On

- Plug the power cord into the power outlet.



[Caution] The power switch is turned off at this time.

- Turn on the power switch (lower left corner of the front panel).
- Power indicator light, LCD screen is bright, P1100 pump begins to self-test. The LCD display sequence is as follows:

Agress P1100

Ver 1.00

Flow 1.000mL/min

P 40.0MPa Pump-A



[Caution] If this is the first time you use the P1100, the main interface parameters are default parameters, All parameters of the pump is maintain the previous shutdown parameters.

3.2 Menu 1: Basic Operation

In the main interface, you can modify the maximum alarm pressure and flow rate, if you want to modify a parameter, first press the "←" Enter key, and then press "↑, ↓" key to move the cursor to the parameter to be modified, after typing the new parameter value press "←" button to confirm. Press the "Run / Stop" button directly, the pump will running according to the set value, if you want to stop the pump press the "Run / Stop" button again.

If setting value flow rate is greater than limit range, the pump will sound an alarm after confirmation, then, restore the value before the modification. Press the "Menu" button once to enter "MENU-1 Basic" functional state, you can move into the flow rate, the maximum limit of the pump pressure, the minimum pressure interface by "↑, ↓" key, you can modify them in corresponding interface. You can type a new value directly when the cursor is flashing on the parameter you want to modify, then, press "←" button to confirm.

Flow 1.000mL/min



[Caution] Flow rate range: 0.001-10.000mL/min

Pmax 42.0MPa



[Caution] Pmax: ≤42MPa (flow rate: 0.001-5.000mL/min) Pmax: ≤20MPa
(flow rate: 5.001-10.000mL/min)

Pmin 0.0MPa

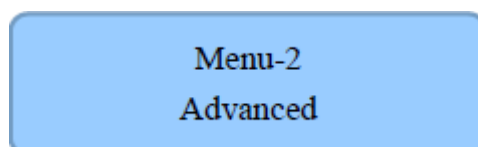


[Caution] The work pressure of pump is real-time detection, if the pressure reaches P_{\max} or less than P_{\min} in one minute from it started, the pump will send an alarm signal and stop the pump. For all parameters, If the setting parameters beyond the scope, P1100 pump will not accept it and continue to maintain the original ones.

After modifying the parameters in MENU-1, press "Menu" again to enter MENU-2. Press the "Menu" twice to return to the main screen.

3.3 Advance Operation

From the main interface, press MENU button to access to "MENU-2 ADVANCED". Use \uparrow and \downarrow to access various parameters in MENU2, including the coefficient of the mobile phase adjustment, the velocity correction factor, pressure unit setting. Then, key in the new value and press " \leftarrow " to alter the parameters.



3.3.1 Setting P1100 pump A / B in Gradient system

P1100 can be controlled from its front panel, also, you can control it by computer through our workstation software. Further gradient analysis, flow time program analysis and other functions can be found in the workstation to meet the requirements of users in the field of production and research. You can change the setting of A/B pump by press "A / B" button.

3.3.2 Flow compressibility

Different solvents exhibit different compressibility characteristics. The compressibility of the solvents in use will affect retention time. In order to minimize this effect, the P1100 provides a compressibility compensation feature which optimizes the flow stability according to the solvent type. The flow compressibility is set to a default value of 100% (using degassed distilled water as mobile phase) and can be changed through the user interface.

measure flow compressibility

Equipment: 10mL volumetric flask, Stopwatch, Degassed solvent.

Procedure:

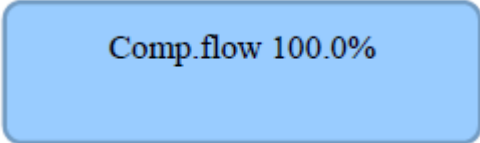
- (a) Disconnect the column, eliminate backpressure of the system.
- (b) Select a proper flow rate according to analysis method, press the “RUN/STOP” key to start the pump.
- (c) Start the stop watch and begin collecting the mobile phase from the pump outlet in a 10mL volumetric flask.
- (d) Record the time it takes to fill 10mL, t.
- (e) Repeat step (b) to (d) three times, t1.
- (f) Stop the pump and reconnect the column. Then repeat step (b) to (e). Calculate the mean time with column attached to system, t2.

Flow compressibility = $(t2 - t1) / t2 \times 100\%$

If the relative error is allowable, you have no need to change the compression coefficient, if the error is obvious, adjust the compression coefficient following steps blow.

Adjusting the compressibility parameter

Enter the “MENU-2 ADVANCED” to adjust the compressibility parameter, input a new compressibility parameter, and press “←” to conform.



Comp.flow 100.0%



[Caution] The range of flow compressibility is 85–115%. If the entered flow compressibility value exceeds the range, the cursor will blink and the value will return to 100%.

3.3.3 Flow correction

Several factors will affect the accuracy of flow: dirty block filter, clogged capillary tubing connection, dirty valve, leaking seal, etc. Do check these areas before correcting the flow calibration.

Enter the “MENU-2 ADVANCED” to adjust the compressibility parameter, input a new compressibility parameter, and press “←” to conform.

The method of flow accuracy correction is the same as flow compressibility measuring. If the flow accuracy is beyond the permitted standard, you should adjust the calibrate parameter as below:

Enter the “MENU-2 ADVANCED”, press “↑、↓” button to get into flow correction interface, then, input a calibrated parameter, and press “←” to conform.



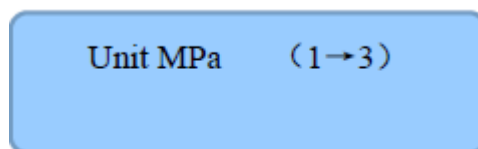
[Caution] The range of flow correction is 85 – 115%. If the entered flow correction value exceeds the range, the cursor will blink and the value will return to 100%.

3.3.4 Pressure unit

P1201 pump can display pressure in three different units: MPa, Bar and psi.

1 MPa = 106 Pa = 10 bar = 145.04 psi

Enter the “MENU-2 ADVANCED”, press “↑、↓” button to get into unit interface, then, chose the unit you need and press “←” to conform.



[Caution] Select “1” for MPa; “2” for Bar; “3” for psi.

3.4 Mobile phase replacement

There are various liquids used in HPLC as mobile phase, including organic solvents, water, buffers, etc.. Intermiscibility and buffer salting out are important parameters should be considered. Please take care when you need to replace mobile phase. If necessary, you can refer to the corresponding physical chemistry handbook.

3.4.1 Replacing with miscible liquid

E.g. replacing methanol with acetonitrile

- 1) Store acetonitrile in a clean solvent bottle.
- 2) Take the filter components out from methanol reservoir, wash it with acetonitrile, then, put it into acetonitrile.
- 3) Open the relieve valve. Flush the pump with approximately 20mL new mobile phase.
- 4) Close the relieve valve, disconnect the column from the system, then, put a bottle at the outlet of inject valve.
- 5) Turn on the pump, make the new mobile phase flow about 10 ml.
- 6) Reconnect the column. Turn on the pump at a suitable flow rate, e.g.1mL/min, the system need to equilibrate for at least 30 minutes.

3.4.2 Replacing with immiscible liquid

E.g. replacing methanol with n-hexane

Choose an intermediate washing liquid, which must be miscible with both the new and old mobile phase. In the above example, iso-propanol can be used as the intermediate washing liquid, because iso-propanol is miscible with both methanol and n-hexane.

Follow the procedures as described in section 3.4.1 using the intermediate washing liquid to replace old one.

Repeat the procedures as described in section 3.4.1 using the new mobile phase to replace intermediate washing liquid.

3.4.3 Replacing organic solvent with salt buffer

crystalline salt may appear when Buffer salts mix with organic solvent, crystalline salt is harmful to seals, the plunger rod, the injection valve and the internal rotor and stator, moreover, it may make the tube block. So, please transition the system with a certain proportion of water-containing organic solvent before analysis. After the experiment is finished, do transition the system again with the same method above, and save the column with organic solvent.

4. Chapter Four: Maintenance and Repair

4.1 Troubleshooting

Troubleshooting a pump can be frustrating and sometimes a mysterious process. This section outlines a common sense process for troubleshooting a pump. If troubles can not be solved refer to this section, please contact Elite post-sales service or local vendor.

4.1.1 Elimination of Air Bubbles

Air bubbles is likely to be trapped in P1100 pump under the following circumstances: the initial use of pump, the pump has been left idle for sometime, improperly degassed mobile phase etc. It is crucial to eliminate these trapped air bubbles otherwise, it affects system operation in a number of ways, such as: pressure fluctuation, unstable flow rate, and damage to the column.

How to eliminate trapped air bubble

Open the relief valve and press “PURGE” key, flush with high flow to remove air bubbles in pump head and inlet lines.

If the pump is unable to draw mobile phase after PURGE key was pressed, use a syringe to withdraw mobile phase from outlet of relief valve until the liquid flowing.

If the pump is still unable to withdraw mobile phase, it is probably caused by dirty check valve. Follow related content in maintenance manual to clean the check valve.

4.1.2 leakage of pump head

Pump head leakage is a common problem, seal damage in the pump head is the main cause of leakage. Therefore, when the pump discharge occurs, replace worn parts in time.

4.1.3 Overpressure

In the process of operation, real-time pressure monitoring system works, when pressure exceeds set maximum pressure, P1100 pump will automatically stop and alarm. Open the vent valve to release the system pressure is a good choice at this time, then reset the pressure cap, or check the entire flow, looking for surplus pressure.



[Caution] Setting maximum pressure should be lower than the maximum pressure the column can withstand, or the column may be damaged.

4.1.4 Pump not delivering solvent

Pump not delivering solvent is usually caused by air bubbles in pump head or blocking in solvent filter. In general, problem can be solved by eliminating air bubbles or cleaning solvent filtering cup. But dirty check valve can also cause the problem. So if pump does not suck liquid after filtering and cleaning solvent cup, please clean the check valve. Cleaning check valve refers to the related contents in the user manual. Common failures and solutions are shown in table 4-1.

Table 4-1: A summary of most common problems affecting system operation

Symptoms	cause	Solution
Infusion instability, and the pressure fluctuation	Bubbles in pump head	1. Eliminating air bubbles through relieve valve. 2. Spare bubbles with a syringe through the relieve valve.
	The old solvent remained in the pump cavity	Increase the flow rate to replace old solvent from relieve valve.
	bubbles in solvent filter and the inter line	1. Vibration solvent filter to eliminate air bubbles. 2. If solvent filters is dirty, clean them with ultrasonic cleaner or replace solvent filters. 3. Degas mobile phase.
	Something wrong with check valve	Clean or change the check valve.
	Piston rod or seal leakage	1. Replace piston rod and seal. 2. Change the faulted part.
	Pipeline leakage	1. Tighten the screw where leakage occurs 2. Replace the failure parts
	Pipeline jam	Clean or replace the tube.

Symptoms	cause	Solution
Pump is running , but no liquid out	Air bubbles in the pump cavity	2.Eliminating air bubbles through relieve valve. 2.Spare bubbles with a syringe through the relieve valve.
	Air in pump head entering from infusion entrance	Tighten the pressure cap of the pump head
	Air in pump head	Perfuse fluid in pump head, open the relieve valve and turn on the pump under the maximum flow rate until there is no air bubbles appear.
	Incorrect check valve installation	Install the check valve correctly
	Dirty check valve or worn check valve	Clean or exchange the check valve
	No solvent in reservoir	Fill up the reservoir
The actual flow rate is lower than the set value	Abnormal check valve	Clean or exchange the check valve
	Dirty filter	Clean or exchange the filter
No liquid delivered by pump (pump is not running)	Pump off	Turn on the pump
	The power supply is not connected	Connect power supply
Flow rate decreases when the pump is running	Air in pump is gathering	Open the relieve valve, let the pump run under high velocity to eliminate air bubbles.
	Solvent filter plugged	Open the pressure cap of the pump head, if there is no liquid out from infusion tube quickly, it means solvent filter is plugged, please clean or replace the filter.
	Immiscible solutions in the pump	Use transition solvent to dissolve Immiscible ones
	Plunger seal leakage	Inspect and replace piston rod and seal
	Compression compensation failure	Check or replace the pressure plate or pressure transmitter.
Flow rate is too high	The velocity compensation failure	Inspect or replace it(see instructions)
	P.C. board failure	Replace the P.C. board
	Compression compensation failure	Inspect or replace it
High pressure	Tubing blockage	Screening each section of pipe to find blocking part, replace or cut off the block tube.
	Improper pipe diameter	Replace it with proper tube
	Online filter blocking	clean or replace filter sieve .
	Chromatographic column plugged	Replace the chromatographic column.

Symptoms	cause	Solution
No/Low pressure	No solvent in reservoir	Fill up the reservoir
	Vent valve is not tight	Tighten the relieve valve
	Pump pressure sensor fault	Check or replace the pressure sensor.
	Pipe joint leakage	1.Tighten the screw or blade ring where is leaking. 2.Replace the worn parts
	Seal leakage	Clean or replace the sealing ring.
	Both the inlet and outlet of the pump have air bubbles	Open the relieve valve, let the pump run under high velocity to eliminate air bubbles.
The pump has a humming sound, and can not start properly	The motor failure	Stop the pump and check it.
	Phase voltage is too low	Phase voltage is too low
Flow rate is zero	Air bubbles in pump head	eliminate the air (refer to above item)
	The entrance check valve plugged	Check and replace it.
	The export check valve plugged	Check and replace it.
	The direction of check is reverse	Install the check valve in the right direction.
The pump stop in operation.	Pressure is higher than limit pressure	a) To reset the highest limit pressure. b)Replace the column. c) Replace tubes with proper ones
	Power cut	a) Check the power supply. b) Shut off the main power supply, check the fuse.
The pump is on, the pressure is common, but no liquid comes out.	Serious leakage in the system	Repair inject valve or pipeline and fasteners between pump and detector.
	Fluid passage blockage	Clean injection valve or the connection between the column and detector or particles in flow cell.
	The entrance of column is plugged with particles	Clean or replace the column inlet filter, or replace the column. Degas mobile phase and samples properly.
The column pressure increases, but the flow rate decreases.	Column or protect column is partially blocked	Clean or replace the column inlet filter, or replace the column.
	The entrance tube of detector is partly plugged	Remove and clean the flow cell and line

4.2 Maintenance and repair

In order to ensure the normal operation of the high pressure constant flow pump, maintenance and repair is important. Maintenance means simple repair, such repairs can be done from the front panel of the pump, there is no need to take out the pump from the stacked configuration. And repair is mainly referred to those who need to change the internal parts, remove the pump body from stacked configuration and disassemble.

4.2.1 Maintenance of solvent filters

Dirty reservoir and mobile phase contamination is likely to cause blockage to solvent filter, also, using buffer for a long time may lead to filter pollution and flow impassability. The blockage, pollution and impassability will affect pump operation. Recommended practices can extend the service life of filter and guarantee the normal work of the pump. Replacing colorless reservoir with brown reservoir is an effective way to prevent fungi biological from growing.

Filter all solvents through a 0.45 micron (or smaller) filter.

The aqueous mobile phase need to be replaced or filtering often.

Under the condition of test allowed, add 0.0001 to 0.001 mole of sodium azide may put an end to the growth of fungi

When the solvent filter is blocked seriously, air bubbles will appear in infusion tube even if the mobile phase was degassed, please clean the solvent filter at this time. Cleaning steps are as follows:

- 1) Remove the solvent filter from the bottle-head assembly and immerse it in a beaker with 30% nitric acid (v/v). Sonicate for 15 minutes.
- 2) Thoroughly rinse the solvent filter with distilled water. Sonicate the solvent filter in distilled water for 10 minutes.
- 3) Blow dries the filter.
- 4) Sonicate the solvent filter again in distilled water for 10 minutes.
- 5) Blow dries the filter again.
- 6) Reassemble the solvent filter, and put it into mobile phase bottle.

4.2.2 Cleaning the check valve

Pump outlet and inlet are equipped with check valve, the components are the same, so a check valve components can be used for any end of the pump, the appearance of check valve is shown in figure 4-1.



Figure 4-1: Appearance of check valve

Usually, check valve have no need to clean. If sediment occurs in valve or valve ball and seat is adhesive, cleaning should be carried out to check valve.

Overall cleaning:

When the check valve has been assembled completely, overall cleaning can make the adhesion condition improve.

- 1) Take out the check valve at pump entrance: remove infusion tube from entrance pressure cap, to unload entrance pressure cap using a wrench, take the check valve components out.
- 2) Take out the check valve at pump exit: remove infusion tube above pump head with a wrench, then, unload the pressure cap, take the component out.
- 3) Put them into ethanol and clean with ultrasonic twice in 15 min, blowing off the solvent inside.
- 4) Assemble the cleaned check valve properly, pay attention to the direction of check valve.



[Caution] The entrance of the check valve has ring mark near by. If overall cleaning can not solve the problem, deep cleaning becomes necessary, cleaning steps are as follows:

Deep cleaning:

- 1) Unload the pressure cap with a wrench, take the check valve out.
- 2) Make wallpaper knife into the gap between coat of valve and gasket. Take the valve ball, seat and seal limit set out carefully, put them into ethanol and clean with ultrasonic.
- 3) Observe the valve ball and seat with magnifying glass, if the valve ball or seat is damaged, please change a new one.
- 4) Assemble the cleaned check valve refer to figure 4-2 . Roughness of different side of valve seat is not the same, identify them carefully before installation.(gem ball seat smooth side).

5) Blowing is a good method to check the correction of the installation. Using a aurlave to blow the check valve from the inlet where have a ring mark near by, you can feel airflow at the the other side, otherwise, air can not through.



[Caution] It is suggested using a small container during cleaning to avoid the loss of the valve components.

Each group of valve ball and seat is ground in pairs, therefore, the components cannot mix between different valve.

The system should be washed with methanol and deionized water successively, if no one uses the pump for more than one month, or troubles may occur while the pump is running.

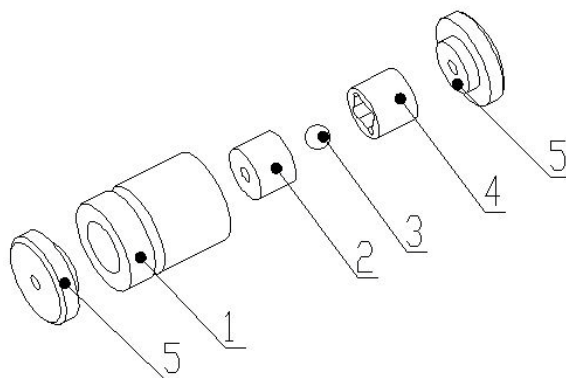


Figure 4-2: Assembly of check valve

1.The marked valve jacket, 2.valve seat, 3.valve ball, 4.Seal with limit set, 5.sealing gasket

4.2.3 Cleaning pump head

Crystalline salt may appear when using buffer salts for a long time, crystalline salt is harmful to seals and plunger rod. In order to avoid this situation, cleaning should be carried out frequently on the flow and sealing ring. Customers can make a suitable cleaning fluid (such as distilled water and 10% methanol, 20% ethanol aqueous solution, etc.). Plunger rod cleaning device has been allocated as standard in the high pressure constant flow pump. Select a suitable cleaning method refer to "3.2 normal operation" according to the need.



[Caution] Add and replace the cleaning fluid in time.

4.2.4 Pump Head Assembly

There is no need to open the case cover when removing the pump head, methods for pump head disassembly and installation are as follows:

- 1) Turn off the pump power.
- 2) Removing the infusion line connected with the pump.
- 3) Using 3# hexagonal key (Allen key) , unscrew the 4 pump head screws and remove the pump head body.
- 4) When installing the pump head, pay attention to evenly tighten four fixed screw, refer to figure 4-3.
- 5) Connect the infusion line removed in step 2 above.

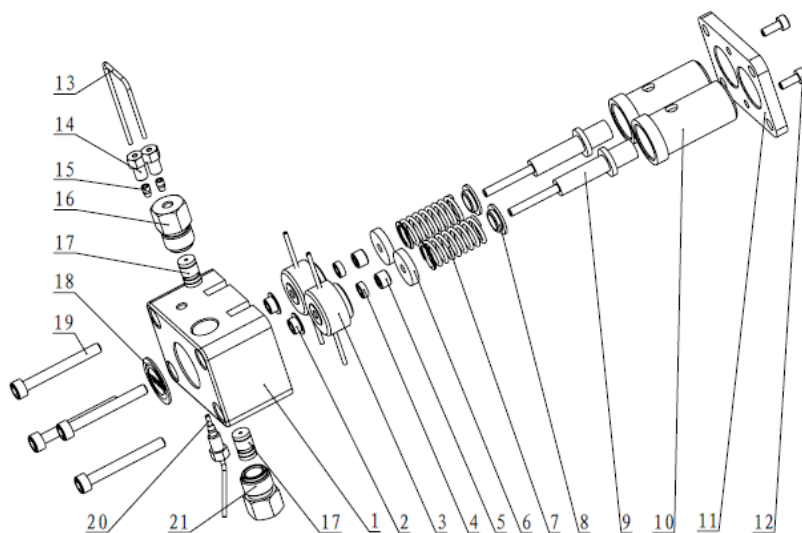


Figure 4-3: pump head assembly

1. Pump head body, 2. Plunger seal, 3. Support ring with plunger rinsing, 4. The secondary seal, 5. The secondary seal pressure ring 6. Spring outside locating sleeve, 7. Plunger spring, 8. Spring inside locating sleeve, 9. Plunger rod components, 10. Sleeve, 11. Mounting plate, 12. Mounting plate screw, 13. Stainless steel tube, 14. Tube screw, 1/16" I.D., 15. Stainless steel ferrule, 1/16" I.D., 16. Export pressure cap, 17. Check valve, 18. Badge of pump head, 19. Pump head screw, 20. Outlet pipe, 21. Entrance pressure cap

Pump head disassembly and installation methods are as follows(Refer to figure 4-3,figure 4-4):

- 1) Place the pump head body on a flat surface. Using 2.5# hexagonal key, unscrew the 2 mounting plate screws, #12 on Figure 4-3, remove the clamp(10#)
- 2) Unload the sleeve(figure 4-3,#10), plunger rod components(figure 4-3 #9), plunger spring(figure4-3#7), locating sleeve(figure4-3 #3) etc..
- 3) Observe the plunger rod surface with a magnifying glass to find whether axial wear occurs on it. If there is no axial wear, clean the plunger rod, or a new plunger rod is needed.
- 4) Take out the primary seal carefully(figure4-3 #2)(user should not remove it unless replace a new one is needed).
- 5) Put the new primary seal(the openings with spring should be in the direction of the pump head) into the pump head body(figure 4-4 #1).

Place all parts in order according to figure 4-4, install the pressure plate.

- 7) Put pump head on worktable, push the pressure plate slowly, press the two pressure plunger rod into the primary sealing ring, tighten two fixed screw evenly.

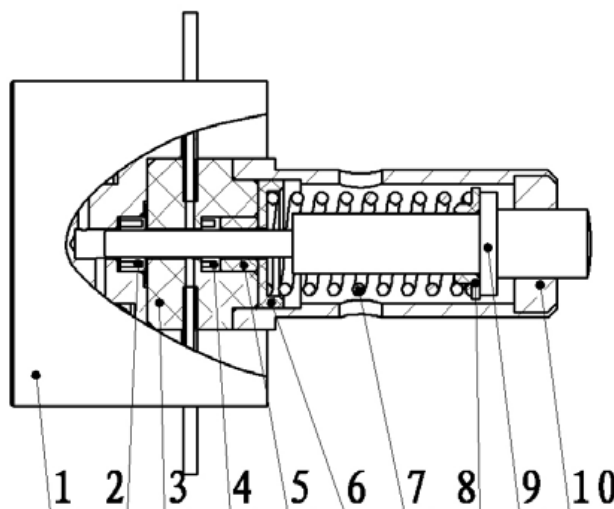


Figure 4-4: Cross-section of sapphire plunger

1. Pump head body 2. Plunger seal 3. Supporting ring with plunger rinsing 4. Primary seal 5.The secondary seal pressure ring 6.Spring outside locating sleeve 7. Plunger rod spring 8.Spring inside locating sleeve 9. Plunger components 10. sleeve



[Caution] Plunger rod is easy to broken, be careful while unloading and a ssembly.

4.2.5 Plunger seal replacement

Plunger and plunger seal will wear during long-term use, it is mainly connected with the flow rate, operating pressure and the kind of mobile phase. The impact of these factors is uncertain, so, Estimating the degree of wear for parts is difficult. It is necessary to check the surface of plunger rod when replacing piston ring. If there is even small scratches on the surface of plunger rod, please replace it. The method for plunger disassembly and installation can refer to “4.2.4 pump head assembly” above.

4.2.6 Fuse replacement

The fuse replacement process is as follows:

- 1) Turn off the power switch.
- 2) Remove the power cable from the power outlet.
- 3) Open the fuse box with a screwdriver refer to figure 2-6.

After replacing a new fuse, lifted the fuse lid.



[Caution] Please use the same model fuse. Fuse model: T 1.25A/250V.

5. Chapter Five: Components and Material list

5.1 Consumption parts

NO.	Describe	PN
1	Mobile phase bottle, colorless,500mL	33110001
2	Mobile phase bottle, colorless,1000mL	33110002
3	Mobile phase bottle, colorless,brown,500mL	33130008
4	Mobile phase bottle, colorless,brown,1000mL	33130009
5	Ptfe tube OD1/16"~ID0.03"	13010031
6	Solvent filter	18040009
7	3/16 " Y shape straight tee	33120232
8	VM-1002 parts clamp	14992427
9	Flat wire clip	14992562
10	Green Flangeless-Nuts	3215P-305X
11	Yellow Flangeless-Ferrules	3215P-300X
12	3/16"-32 Stainless steel connection screws	14510027
13	1/16"Stainless steel blade ring	14990070
15	OD1/16 " ~ID0.02 " stainless steel tube	12010007
16	Type A number tube	19000072
17	Type B number tube	19000073
18	Power line	17000001
19	485 line	18990075
20	T1.25A/250V fuse	15080015

5.2 Replacement Parts

NO.	Describe	PN
1	O-rings $\Phi 3.5 \times 1.8$	14992280
2	plunger rod	14010215
3	check valve group	14010012
4	The primary seal	14993349
5	The secondary seal	14993350

Appendix

Introduction to the connecting tube materials

In HPLC systems, column system, piping, fittings, and outside the injector and Extra-column of detector are likely to cause peak broadening. Improper tube material will also lead to peak broadening, even cause the sample degeneration, which affects the reliability of analysis results directly.

Good connection can fully exert the function of the instrument, improve the work efficiency. Different pipeline material is needed according to system pressure, properties of mobile phase and samples. Commonly used pipe materials including stainless steel, polyether ether ketone (PEEK), teflon, poly (vinylidene fluoride, polyethylene or polypropylene, the stainless steel pipe is most commonly used.

Outer diameter of HPLC system is 1/16"(1.59mm). Inside diameter can be chosen according to your need, Commonly used inside diameter including 0.007"(0.175mm), 0.01"(0.25mm), 0.02"(0.5mm), 0.03"(0.75mm) and 0.04"(1.0mm) etc..

Stainless steel tube is generally used in high pressure part. In HPLC systems, from the pump discharge to column inlet part is high pressure section, stainless steel tube is recommended.

Stainless steel tube have good corrosion resistance and coaxiality, bore pipe and joint should be match well while using it.

Also, polymer tube can be used in many sections of HPLC system, such as low pressure parts: from liquid bottle to export pump, detector and sampler drainage mouth, emptying valve outlet and others. Teflon is inertial to HPLC solvent and is the most commonly used plastic pipe.

When the pressure is lower than 20MPa, peek tube is more lazy than stainless steel tube and is suitable for biological sample analysis.


Safety information

General safety information

At the different stages of the instrument operation, maintenance and repair, everyone should abide the following general safety rules, breaking these rules may cause damage to instruments or staffs, Elite Analytical Instruments Co., Ltd. does not responsible for the impact caused by non-standard operation.

Standard of security

For marked with this symbol of the equipment, the user should refer to the instruction manual, so as not to cause harm to the operator and equipment damage.

Symbol	Description
	Please do not operate beyond the scope of caution, unless you have been fully understand and meet the required conditions.
[Warning]	Casualties may appear. Please do not operate beyond the scope of warning, unless you have been fully understand and meet the required conditions.
[Caution]	Data loss or equipment damage may appear. Please do not operate beyond the scope of caution, unless you have been fully understand and meet the required conditions.
[Note]	Unsatisfactory experimental data and instrument failure may appear. Please do not operate beyond the scope of note, unless you have been fully understand and meet the required conditions.

ELITEHPLC

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