

ION CHROMATOGRAPHY  
IC1820  
INSTRUCTION MANUAL



# Catalogue

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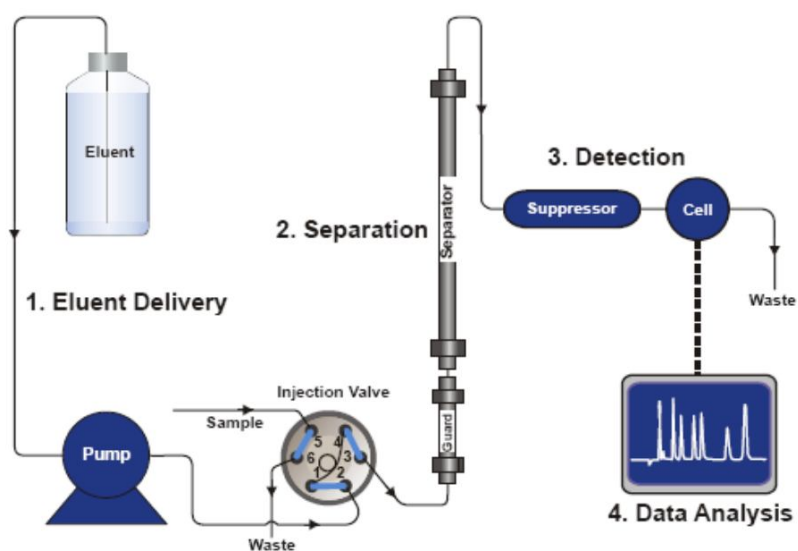
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# Part I Ion Chromatography IC1820 Instruction Manual

## 1. Basic information

IC1820 Ion Chromatography is a kind of Ion analysis device that adopt isocratic elution system and conductivity detection methods, which regularly conclude of eluent system, high-pressure transfusion pump, injection valve, analytical column, suppressor, conductivity detector and data operation system.



Ion chromatography (or ion-exchange chromatography) is a chromatographic process that separates ions and polar molecules based on their affinity to the ion-exchanger, different ions will come to detector after elution/ separation. Its signal intensity will be detected respectively according to their separation sequence. Quantitative measurement/ Qualitative measurement will be available based on their retention time and peak value, then software workstation will calculate concentration automatically and demonstrate as spectrogram.

### 1.1 Eluent transfusion

IC1820 makes isocratic elution available, which means eluent's components and concentration will not change during operation.

## 1.2 Separation

Based on ion's affinity to ion-exchange and kinematic velocity differences with their property like ions radius and charge number within exchange columns.

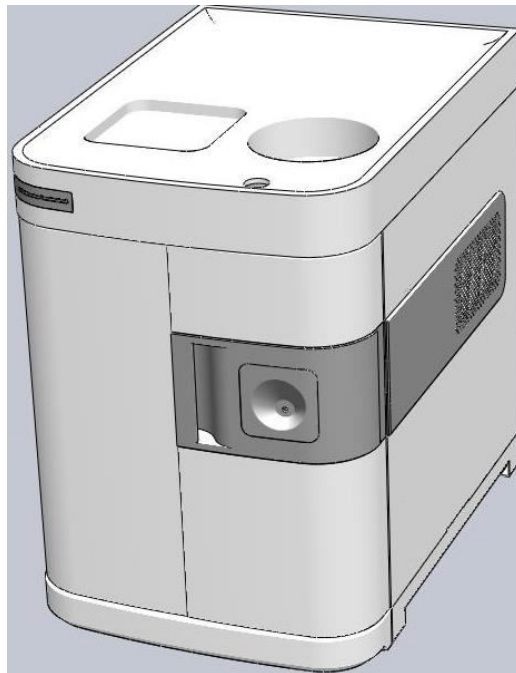
## 1.3 Detection

Eluent and sample comes to suppressor after separation, by reducing background noise to increase detection sensitivity, then comes to conductivity detector to measure its response signal value.

## 1.4 Data analysis

IC1820 will transfer conductance cell's signal to data collection system, perform quantitative measurement/ qualitative measurement according to ion's retention time and peak value, etc.

## 1.5 Standard configuration and optional accessories



Standard configuration of IC1820, equip with anion system, consists with transfusion pump, injection valve, column thermostat and conductivity detector. And choose different analytical columns, separation columns and suppressors. Cation system is optional.

Through Clarity workstation, users could control IC and execute different tasks, e.g. parameter setting, data collection, data supervision, data process and data saving, etc.

Also, IC1820 standard accessories include solvent tray, eluent bottle, micro-injector and anion columns. However, columns, bottles and micro-injector are consumable items.

## **2. Installation and Precautions**



IC1820 Ion Chromatography as one of the laboratory precision instrument, it has rigid requirements for its application conditions and operation. Please read this instruction manual carefully and take precautions accordingly if any danger might happen.

### **2.1 IC Application Conditions**

- Laboratory should keep clean, quiet, and make sure that there are no flammable, explosive and corrosive gases, which might reduce the instruments serving time.
- Environment temperature should keep between 15-30°C, and make sure there are no obvious fluctuation. Relative humidity(RH) should also keep between 5%-85%
- Keep the stand stable and avoid mechanical vibration, and electromagnetic/ electrostatic interference.
- Save 25cm space around the instrument, and at least 8cm space behind, in order to easily ventilation and cable connection.
- Power voltage range is 110-240V, frequency 50/60HZ.



- Sample solvent normally is aqueous solution, after suppressor electrolysis, will produce Hydrogen and Oxygen. So the instruments should keep away from fire or any devices that might cause fires. Fire extinguisher must be available.
- This instrument is kind of precision instrument, which is not suitable to use outside.

## 2.2 precautions for installation

- Avoid direct blowing from air condition and explosion from sunlight, as well as vibration.
- Start-on sequences: click software workstation after opening instrument's power switch.
- Switch-off sequences: stop the pump firstly, and then close workstation after the pressure's decreased. Power off instrument at last.
- The instrument should keep application records, and keep maintenance timely according to the using frequency.

## 2.3 Precautions for Application

- Avoid any liquid comes into the instrument, which may cause instrument short circuit and rustiness.
- Avoid using ethanol and other organic solvents to clean the instrument, it may cause color-fading. Using absorbent paper and soft cloth if any solvents splashed on the cover.
- Processing Cleaning and emptying operation at the first time when using the instrument.



- After the operation, should clean the whole transfusion pipe, to avoid eluent crystal and sediment during the analysis and make preparation for the upcoming operation.
- Always keep in mind that the solvent should be filled within the whole transfusion pipe system. Stop using the pump once using up, or in any similar situations. Transfusion pump should be used without solvent.



- Transfusion pump should be used without solvent.
- Do not open the cover when the instrument is during operation, in case of any danger.
- Instrument should be placed on the stable and horizontal stand.
- Before connecting the power, check the voltage first. If the voltage exceeds the allowed range, should equip with more than 1000W UPS. System issues or damages caused by voltage will beyond warranty coverage.
- Must power off during instrument inspection and maintenance. As well as when change the fuse.

### 2.3.1 eluent application

Configure eluent solvent according to the columns requirements, and use 0.45um filter membrane to degas like O<sub>2</sub> caused by chemical reaction before application.

Regular degassing methods:

1. Helium degassing
2. Heating and refluxing method
3. Vacuum degassing
4. Ultrasonic degassing

Piping system of IC1820 is PEEK material, so do not use eluent as follows,

Concentrated sulfuric acid, concentrated nitric acid, dichloroacetic acid, acetone, Tetrahydrofuran, dichloromethane, chloroform and dimethyl sulfoxide

#### ATTENTION

Must use water to clean the pipe more than 30 min if use eluent which contends buffer salt solution.

### 2.3.2 Eluent Adjustments

During application, sometimes need to change eluent. In this case, must stop the pump first, or the air will come within. Especially during anion and cation exchange, must clean the transfusion system with pure water, normally need 30-40 min until the system is stable.

Mis-operate without comply attention above, piping system will be blocked easily, and in some cases, flow cell would also be contaminated and blocked. The changing the flow cell would be necessary, users will bear unnecessary loses.

### 2.3.3 Reservoir

Keep the eluent reservoir clean is the key point in the application. Must use 0.45um filter membrane firstly to degas and other impurities.

### 2.3.4 Pipe Connection

- Power off and pull out the plug when connect the piping system
- Entirely insert the pipe to the end, or will cause dead volume and peak widening.
- Use smaller diameter piping system to reduce extra column effect and achieve ideal analytical results.
- Do not screw the piping joint too tight, which may damage the thread.

## 2.4 Precautions for Basic Operation

- Open emptying valve before running the pump, extract eluent solvent with syringe, after like 10s, the solvent should be coming out continuously.
- Close emptying valve if it is not in use, or the air pressure will make eluent solvent flow out from the emptying valve.
- Notice if the eluent solvent is enough or not during the application, must stop the pump and add/ change solvent if it is not enough.
- Switch injection valve quickly during sample injection, or it may cause pressure bounce and effect instruments' serving life.
- If the eluent contains buffer salt solution, must clean the piping for 30 min after finishing sample analysis.
- After running the pump, with solvent coming through the suppressor, then could open suppressor switch.
- When running pure water, do not increase electric current, unless for special purpose.
- Suppressor's input/output interface should be seal-preserved with water filled inside, preserved temperature should be 4-35 °C. And water circulation period should be 1-2 weeks.
- Before IC application, samples should be pre-treated, extract heavy metal ion and organics.

## 2.5 Electro-static prevention

IC1820 Ion Chromatography adopt electrochemical suppressor, which may produce Hydrogen and Oxygen. Users should pay more attention on potential fire accidents or explosions, and avoid electro-static accumulation. Precautions are as follows:

- Do not touch instruments with electrified material.

- If available, equip with anti-static cloth and material
- Spray anti-static material on the floor
- And some other effective ways

### **3. Installation of IC1820 Ion Chromatography**

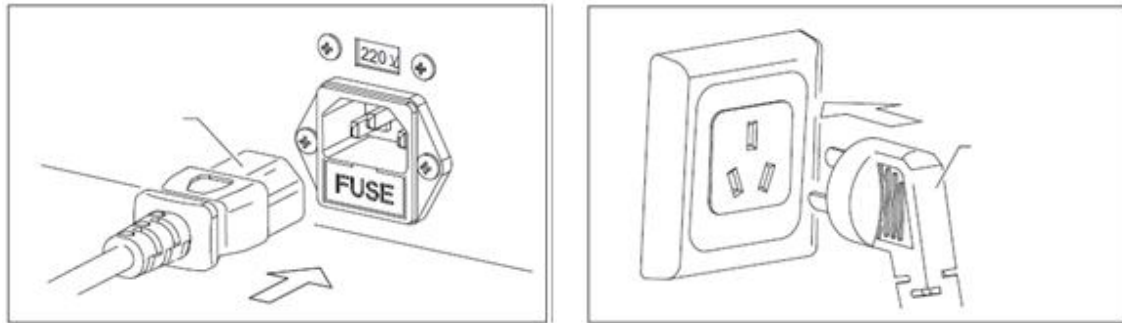
In order to make it easier for users to install the instrument, in this part, there are some introductions users could refer to

#### **3.1 Preparation**

Out package of IC1820 is wooden box, after unpacking, users should check packing lists carefully and confirm each accessories are attached. Places of instrument should comply with following conditions.

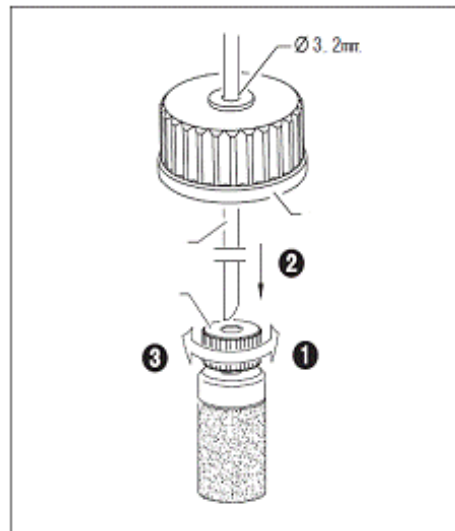
- Favorable atmospheric conditions
- Stay away from fire
- Equip with fire extinguisher and with water nearby
- Avoid dust and corrosive gases
- Stay away from high field and high-intensity magnetic field devices
- Room temperature range 15-30°C, with less temp. fluctuation
- Air condition do not blow directly to the instrument
- Avoid direct sunlight exposure
- Stable stand and without vibration
- Related humidity range should be 5%-85%

### 3.2 Power Connection



### 3.3 Installation of Transfusion Section

#### 3.3.1 Installation of Suction Filter



### 3.4 Suppressor Connection

Connect suppressor as follows, piping system and joints should be PEEK or PTFE material, internal diameter is 0.01 inch, definitely cannot use metal pipes and joints. Pay attention to the pressure change during connection, stop installation if the pressure fluctuation is over 1Mpa, and then check out the reasons.



E-IN: Eluent input

E-OUT: Eluent output

R-IN: Regenerated solvent input

R-OUT: Regenerated solvent output

### 3.5 Detector connection

Detection cell input connects with suppressor eluent output, and detection cell output connects with regenerated solvent input.

### 3.6 Telecommunication Connection

IC1820 Ion Chromatography equip with Clarity workstation, which makes it controlled after connecting PC with USB interface.

## 4. IC1820 Pump

### 4.1 IC1820 Pump Introduction

#### 4.1.1 Pump Features

Features: Pulse control, flow volume calibration, upper and lower pressure limiter, constant pressure flow, set volume dispensing

#### 4.1.2 Technical parameters

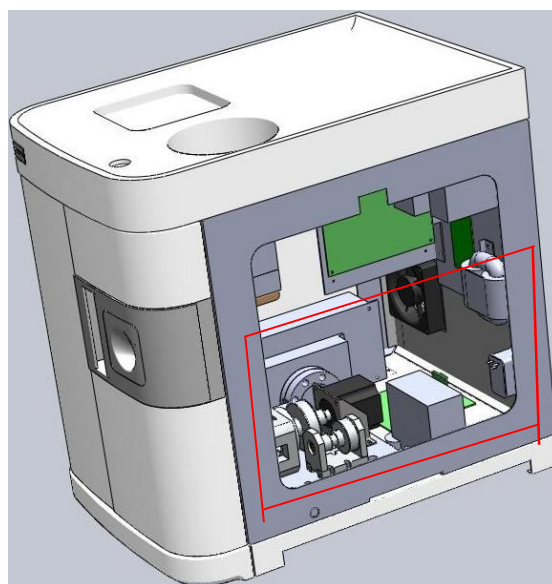
The pump of IC1820 is imported from Japanese FLOM Corporation, parameters is as follows:

FLOM Dual Pump	
Pump head material	PEEK
Max. pressure	20Mpa
Flow rate range	0.01-10.00mL/min
Flow per stroke	32uL
Flow accuracy	±0.3%
Pressure accuracy	±5%
Wetted materials	PEEK type: PEEK, Sapphire, Ruby, PTFE, PCTFE
Remote control	Input: pump on/ off Output: error signal

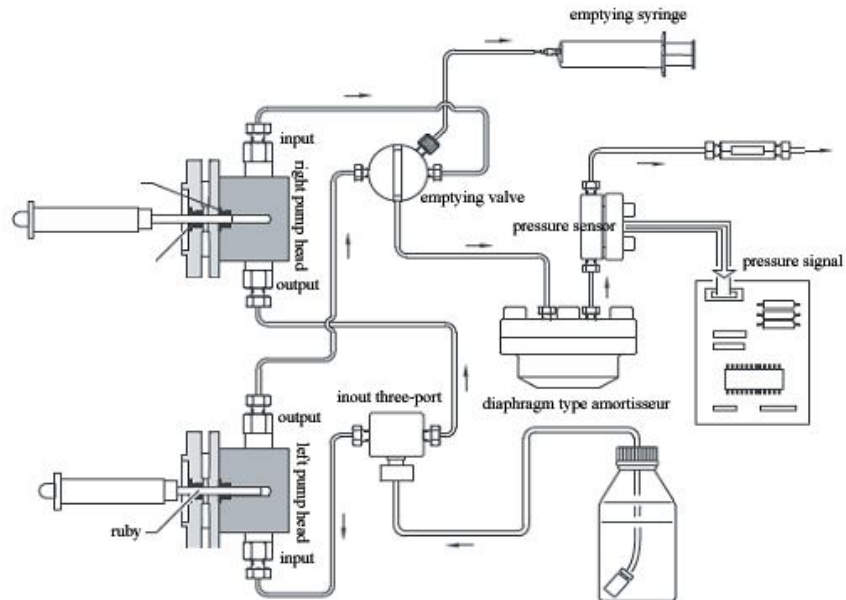
## 4.2 Pump's Structure and Working Theory

### 4.2.1 Transfusion Pump's structure and Liquid Flow Theory

Pump's internal structure of IC1820, like the pictures as follows, includes pump head, one-way valve, plunger driving structure (worm and gear, motor and driving board), diaphragm type amortisseur, pressure censor, etc.



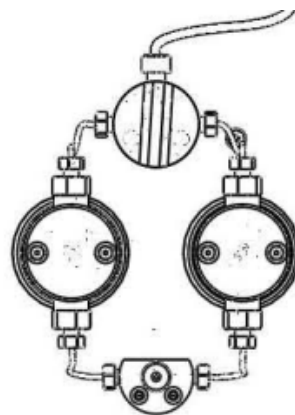
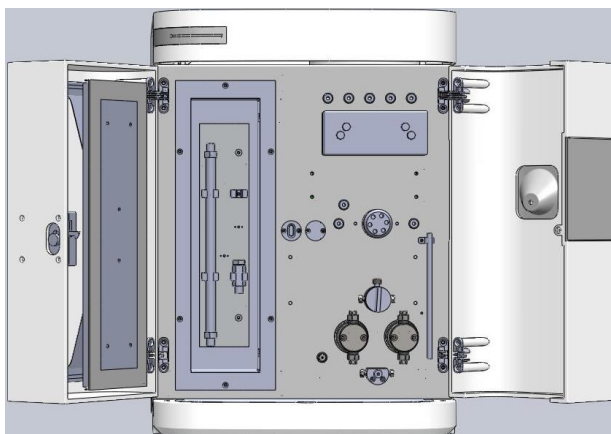
Eluent flow path, as picture follows, shows specific structure how it will be worked in the process.



▲ if the eluent contains salt solution, users must clean the ruby plunger, and sealing ring, etc.

#### 4.2.2 Transfusion Part

Transfusion part includes left pump head, right pump head, two-set input one-way valve, two-set output one-way valve, three-port valve and emptying valve.





## 4.3 Troubleshooting

### 4.3.1 Unstable pressure

During installation or daily application, unstable pressure may be caused by several reasons as follows,

- There are bubbles in the pipe, suggest cleaning the piping system after detach column, or switch on emptying valve to extract with syringe.
- Input one-way valve is not working, which is also commonly encountered during the application.

How to judge whether it is working or not, here are a few steps:

- A. Use pure water as eluent solvent
- B. Switch on emptying valve, and connect liquid that's coming out with measurement cylinder
- C. Press "setup" button until "cleaning" is coming out, select yes and press "confirm". Flow rate 5ml/min, time 5min (make sure that the emptying valve is switched on, or it may cause damage to the column)
- D. After cleaning, check measurement cylinder to see if it is 25ml (5\*5). If yes, then it means the pump is working normally under low pressure. If not, then it means one of the one-way valve is not working (generally it is input one-way valve)

Reasons caused failure of one-way valve is as follows,

- Columns, if the columns are not used during a certain time, then the internal solvent residue will stick with ruby. Column maintenance will be necessary, suggest that users fill with pure water once a week.
- Impurities or other reasons that contaminated one-way valve. IC1820 is one kind of microanalysis instruments, some of the users suppose that the

eluent solvent have been filtered, however the fact is not. So daily maintenance is very essential.

Solutions to solve failure one-way valve:

- A. Screw off one-way valve (totally two pieces)
- B. Put these two valves into the ultrasonic cleaner, which filled with alcohol, for like 10 min, then clean them with water.
- C. Use standard needle to flush. During flush, make sure not to wipe out the inner spacer.
- D. Then install the one-way valve again, and screw tight.

If the pump flow is working normally under low pressure, then suggest to test under high pressure. Process is as follows

- A. Open IC workstation after connecting pump analysis system.
- B. Set 1ml/min flow rate
- C. Start up pump
- D. Check pump's pressure status to see if it is stable, if not, check piping joints and make sure there's no leakage and screw them tightly. If there's leakage, then it is still one-way valve issues, should clean valve once again.
- E. After doing process above, and pressure still is not stable, then it might be seal ring problems.

#### 4.3.2 Liquid Leakage

Amount of reasons may cause liquid leakage, here name some of them

- Joint leakage

- Liquid pipe fracture
- Screwer on the injection valve is loose
- One-way valve block is loose
- Piston seal is broken
- Piston is damaged
- Spacer within pressure sensor is leaking

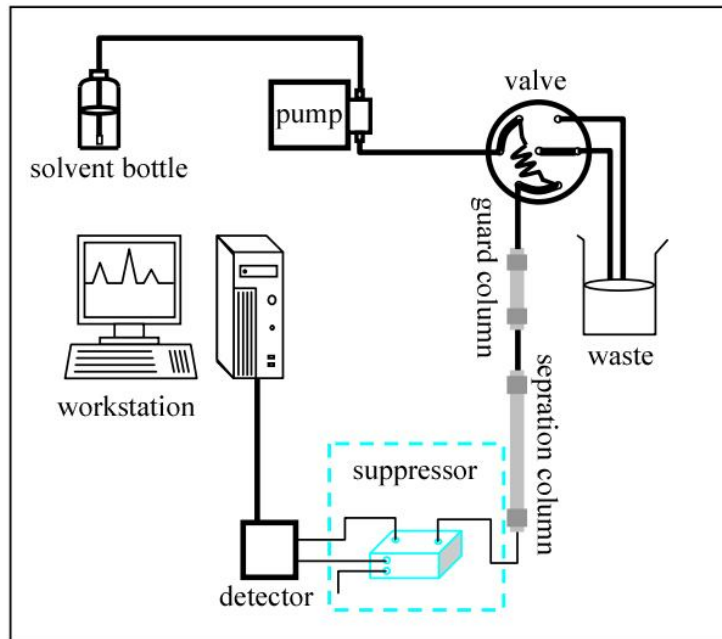
#### 4.3.3 Pump transfusion issues

- Do not connect with eluent solvent
- Empty eluent solvent
- Solvent leakage

#### 4.3.4 System Pressure Over-high

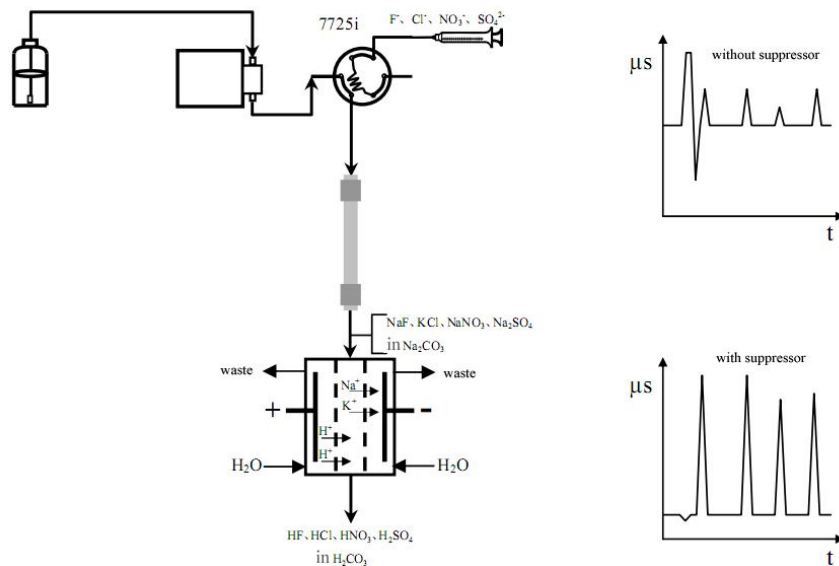
- Blocked flow path
- Flow rate is too high
- Column's filter board is blocked
- Column contamination
- Suppressor is contaminated or blocked

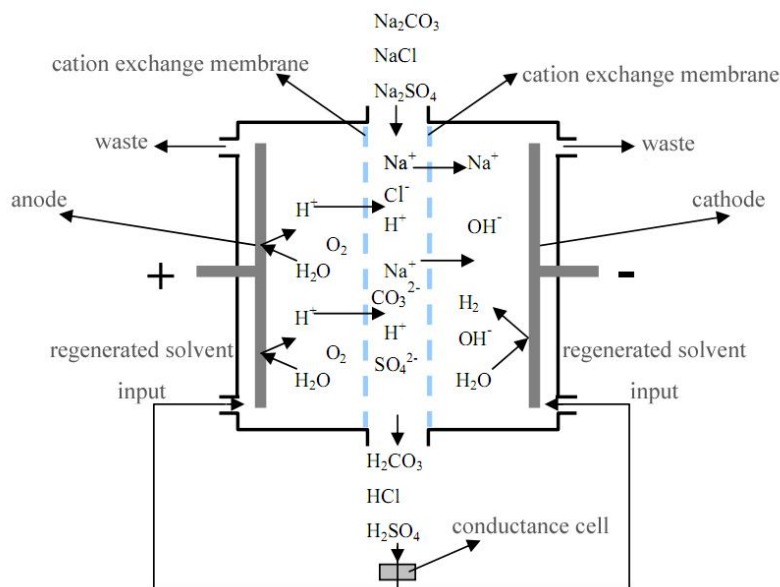
## 5. Suppressor Introduction and Operation



### 5.1 Functions of suppressor

Effectively reduce post-column background conductivity, improve anion's detection sensitivity. The following picture shows the results, compared with suppressor and without suppressor.





## 5.2 Operations of Suppressor

### 5.2.1 Suppressor's connection and activation

### 5.3 Suppressor's Maintenance

- After running pump and there's solvent coming through, then could we running suppressor and add electric current, or it will shorten suppressor's serving life. Suppressor will be damaged if there's long time running without solvent coming through.
- Do not add electric current when there's water coming through. Because there's no solvent to suppress, it will waste electrode and shorten suppressor's serving life.
- Suppressor's input/output interface should be seal-preserved with water filled inside, preserved temperature should be 4-35°C. And water circulation period should be 1-2 weeks.
- Before IC application, samples should be pre-treated, extract heavy metal ion and organics. Samples without pre-treatment will shorten suppressor's serving life and when seriously, it will damage suppressor.

## 5.4 Regular Troubleshooting

➤ Cannot add electric current

A. Suppressor power interface or constant current power is broken

B. Suppressor's broken

➤ High conductivity

A. low electric current

B. contamination

## 6. IC1820 Column Thermostat

### 6.1 Column thermostat technical specifications

➤ Temperature range:  $RT+2^{\circ}\text{C}$ — $100^{\circ}\text{C}$

➤ Temp. setting resolution:  $0.1^{\circ}\text{C}$

➤ Temp. display: actual temp. and setting temp. will be displayed in the monitoring panel

➤ Heating power: 150W

➤ Power:  $220\pm 22\text{ V} / 50\pm 0.5\text{HZ}$

### 6.2 Precautions and maintenance of Column thermostat

➤ Close column thermostat tightly to make the temp. constant

➤ Keep inner space clean

➤ Do not leak solvent in column thermostat

➤ Do not change inner structure randomly

## 6.3 Troubleshooting

- Cannot heat up: check the connection of heating power plug and temp. sensor
- Display abnormally: manufacturer have certain settings during production, users should not change irrelevant settings. Please contact supplier if the temp. displayed abnormally.

## 7. Bi-polar-pulse Conductivity Detector

### 7.1 Introduction

Working temperature of IC1820 detector's electrode measurement have three options, which is 40°C, 50°C and 60°C.

Do not suitable for corrosive organic solvent measurement like ketone and aldehydes.

Two measurement range options: 0-1000  $\mu$ S and 0-5 mS

### 7.2 Technical Performance

#### 7.2.1 Using Conditions

- Power: 220 $\pm$ 22 V /50 $\pm$ 0.5HZ
- Ambient temp.: 15°C—30°C
- Related humidity (RH): 5%-85%RH
- Without obvious vibration and magnetic field interference

#### 7.2.2 Technical Parameters

- Measurement range: 0-1000  $\mu$ S and 0-5 mS

- Accuracy:  $\pm 1\%$  FS
- Stability: 0.5%
- Power: 3W

## 7.3 Application and Maintenance

### 7.3.1 Cleaning of Conductance Cell

Separate conductance cell and suppressor, withdraw 10ml 3mol/L HNO<sub>3</sub> solvent, inject 5ml HNO<sub>3</sub> through conductance cell and inject again the rest HNO<sub>3</sub> solvent after 2 min. Then after 2 min, use 10ml deionized water to flush

### 7.3.2 Conductivity Calibration

Calibration have already been processed during production, specific method is as follows: connect pre-pump liquid with 1 mmol/L KCL solvent, emptying bubbles in the pipe, set flow rate 8.0ml/min, inject this liquid directly through conductance cell. Change flow rate 2.0ml/L after two min, reading after stable should be  $147\pm 2 \mu\text{S}$ , if the reading is out of this range, please adjust with special screwdriver or contact after-sale service engineer.

### 7.3.3 Operation and application

Choose different conductance cell temp. and measurement range through the monitor panel, IC1820 do not equip with temp. compensation function.

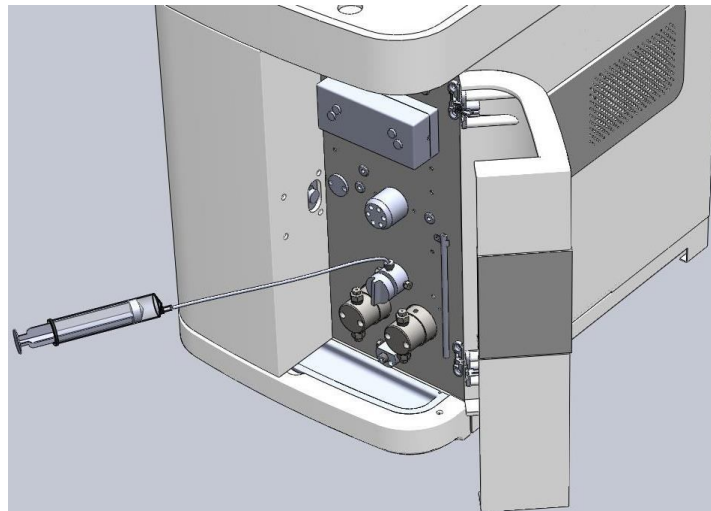


### 7.3.4 Precautions and maintenance

- Place and preserved under clean and dry conditions
- Electrode factor is changeable during application and preservation. Once it changes, please refer 7.3.2 to adjust.

## 8. IC1820 Ion Chromatography Operation

### 8.1 Pipe Empty Operation



- Use emptying pipe/ tube to connect emptying valve's output.
- Check eluent input pipe and make sure the suction filter is immersed in the solvent.
- Solvent bottle should be placed above eluent's input pipe, usually be placed in the solvent tray.
- Switch on emptying valve.
- Pull syringe and withdraw like 10-20ml eluent solvent.
- Take down syringe and perform cleaning operation
- Switch off emptying valve



- The first time using instrument or do not use the instrument for a long time, perform cleaning operation is essential after emptying piping system, in order to extract the bubbles in the pipe.
- Do not run the transfusion pump if there's no liquid within or there's air within.
- When performing emptying operation, should block high pressure transfusion output. Or the eluent will come out from this output, also called siphonic effect.
- Must perform degassing operation if there are no degasser components, to reduce bubble's effect to pump and conductance cell.

## 8.2 Working Mode

All the operations could be process through Clarity workstation, like real time display monitoring, data process and data saving, etc.

Please refer Part II 1820 Clarity workstation for detail operations

## **9. Routine Maintenance of Every Assembly Units**

### 9.1 Maintenance of Columns

In order to protect columns and pro-long its serving life, precautions should be took.

Use same padding material guard column.

Pump's pressure restrictions should be 8-15Mpa in case of high pressure impact.

Column should be preserved with eluent solvent (generally eluent solvent) filled-in and block column's each side.

## 9.2 Maintenance of Manual Valve

Injection volume is decided by quantitative loop's volume, IC1820's volume is 20uL. This valve has two operations: Loading and Injection. When during loading, eluent solvent comes into separation column through pump, instead of quantitative loop. Sample will come into quantitative loop and preserve inside until injection, excess sample will be expelled out from waste liquid pipe.

When during injection, eluent will come into quantitative loop, sample will flush to separation column.

After each application, especially when there are big concentration differences, should use special tools to flush the injection valve's ends several times. In case of inorganic salt sedimentation and inner deterioration and block caused by sample particle, as well as cross contamination.

When install injection valve, output 5 and 6 and syringe should be placed in the same horizontal, in case of siphonage effect which may cause quantitative loop's repetitive variation.

## 9.3 Maintenance of Transfusion Pump

### 9.3.1 Precautions of Transfusion Pump Maintenance

Pump's sealing ring is the most easily damaged components, and it will cause many malfunctions. Sealing ring's serving life is related with its material, pressure value and buffer solution.

Do not run the pump without eluent solvent or before eluent solvent comes into pump head, it will cause plunger's dry grinding.

Clean the piping system each time after daily application, to prevent salt sedimentation. Periodically clean pump's piping system is also essential if the instrument will be not used for a long time, in case of mold and fungus coming out.

Use analytically pure reagent, better be top grade pure reagent.

Use filter element, in case of damaging plunger or motor by over pressure caused by pump obstruct.

Pressure min. limitation should be set between 0.5—1Mpa, in case of plunger's dry grinding caused by empty solvent or sever leakage.

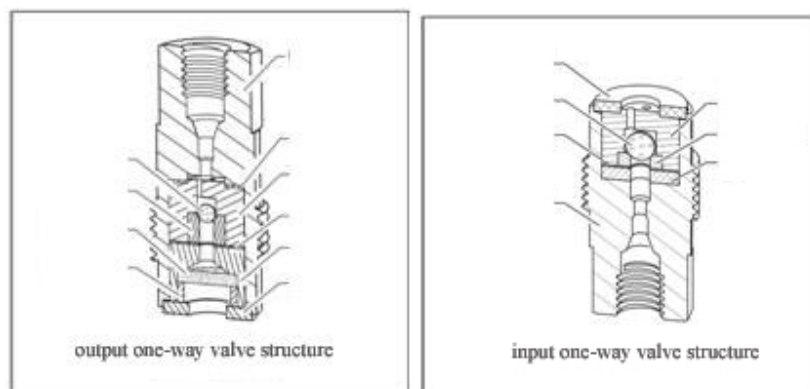
### 9.3.2 Periodical Inspection and Maintenance

Plunger rod, sealing ring, one-way valve, suction filter, emptying valve and pump mechanical components.

All above accessories should be inspected and keep routine maintenance periodical, in order to pro-long instrument's serving life

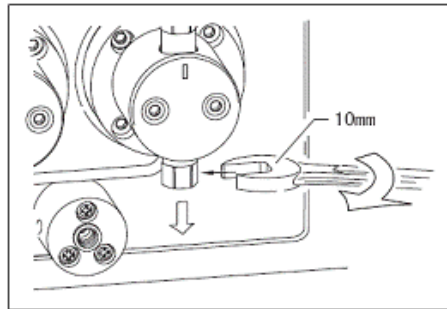
### 9.3.3 Maintenance of One-way Valve

#### 9.3.3.1 Structure of one-way valve



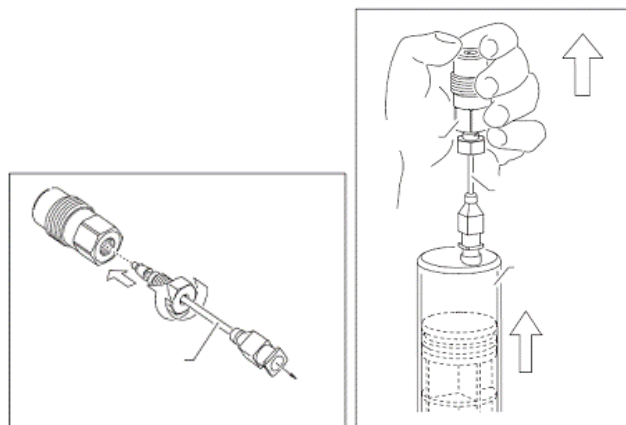
Inner components of each one-way valve is unique, input valve and output valve's components are not exchangeable, so in case of mis-installation, users should operate one of them at one time, and seriously, it may cause valve scrapped.

### 9.3.3.2 Disassembly of one-way valve



- During the disassembly, keep all the tools clean
- Place eluent bottle below the pump's input, in case of eluent come out from disassembly end
- All the component after disassembly should be placed in clean container, in case of contaminating the pipe

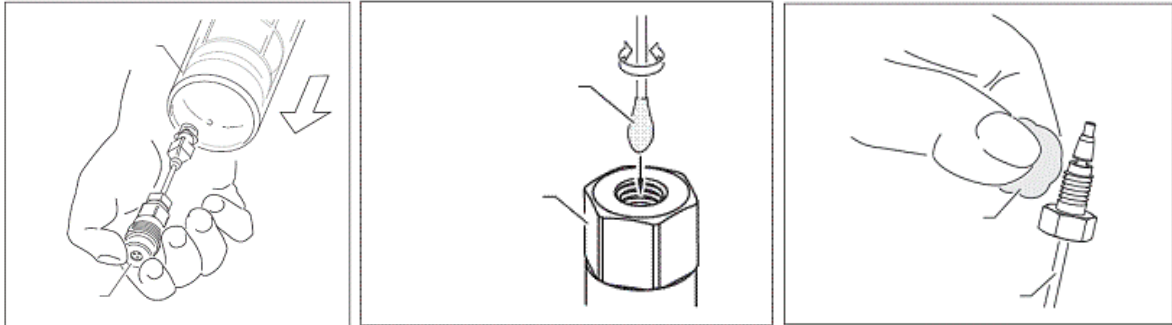
### 9.3.3.3 One-way valve's fault diagnosis



### 9.3.3.4 One-way valve's cleaning

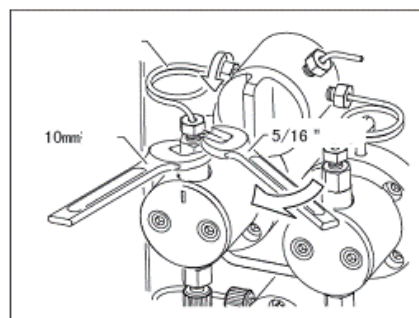
Normally, when one-way valve has dysfunction, users could make it recovery through cleaning

- Use provided syringe and connect it with one-way valve, should pack certain volume of distilled water or isopropanol inside the syringe
- After cleaning, could put one-way valve into the isopropanol or ethanol solution if there still are contaminated components. Ultrasonic cleaning for like 15 min, and then clean with pure water.



- During the cleaning, high pressure will separate inner valve components, so Users must block the white filter plate
- Before installing one-way valve, should also clean screw thread and seal components

#### 9.3.3.5 Installation of one-way valve



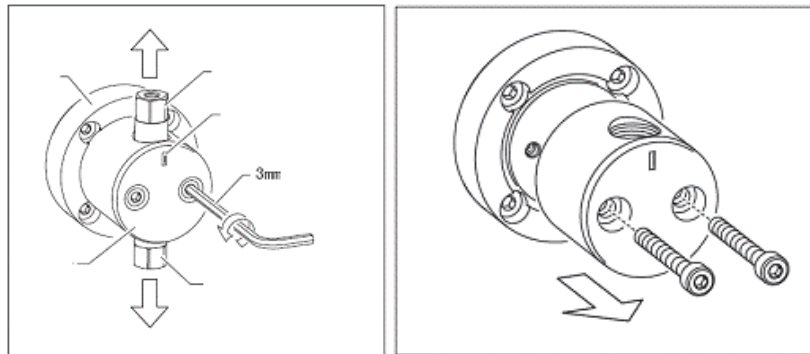
- Put cleaned one-way valve into the pump head, and screw tight with 10mm wrench
- Connect one-way valve output with emptying valve, and screw tight
- Extract air from pump firstly, and running the pump to see if there are leakage, and check pump pressure as well

### 9.3.4 Maintenance of plunger rod and sealing ring

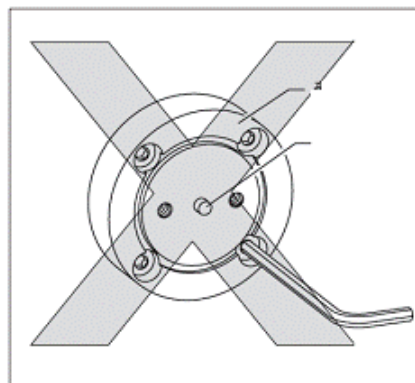
Plunger and sealing ring are easily damageable components, when these situation as follows come out, users should change them timely

- flow rate is lower than set valve
- big pressure fluctuation
- cannot reach high pressure
- leakage sensor alarming
- sealing ring have been used more than 500,000 times

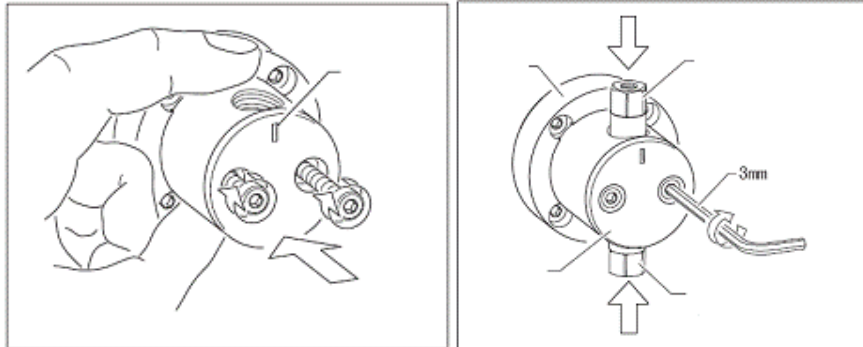
#### 9.3.4.1 pump's disassembly



- When screw pump's fixed screw, should pay more attention because it is very easy to break the plunger rod

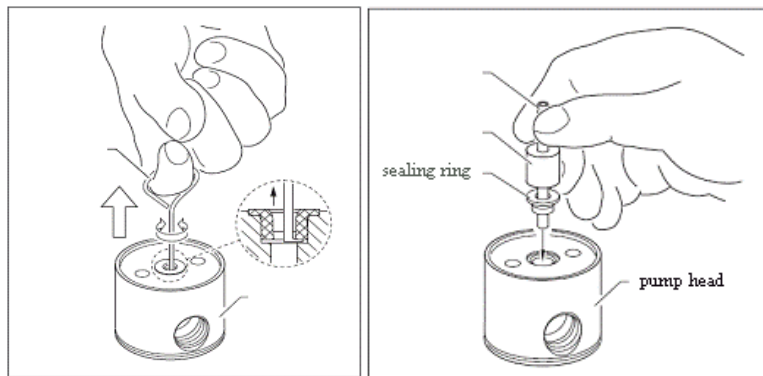


### 9.3.4.2 Pump head installation

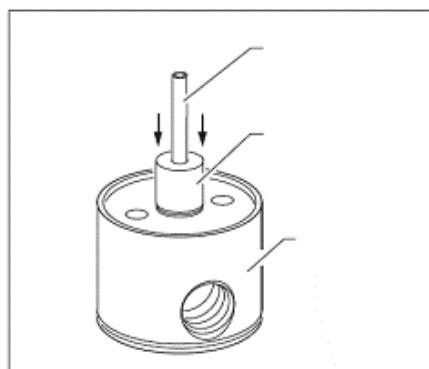


### 9.3.4.3 sealing ring's disassembly and replacement

#### ➤ Sealing ring's disassembly

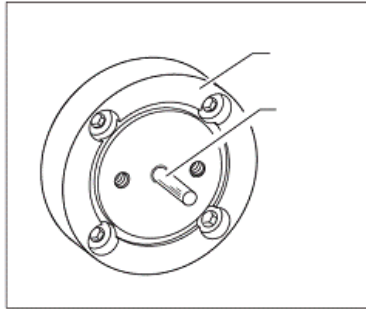


#### ➤ Sealing ring's replacement





### 9.3.4.3 plunger rod's cleaning



- ▲ in order to clean plunger rod completely, need to pull it out, so in this situation, it is easily broken. Users should wipe or clean the rod gently, and push it back to its original position

### 9.3.5 Maintenance of suction filter

Particles will block filter's micro-pore and affect eluent's transfusion, so should better clean the filter once three months

Solutions to check if the filter's blocked

- Switch on three-way port eluent joint, and place it above output for like 30cm, then because of syphon effect, eluent will come out the output. If the filter's blocked, eluent will come out discontinuously or even do not come out.
- Users could also take out the filter, to check pre-column pressure if it is normal.

Steps to clean the suction filter

- Screw filter's joint, and unplug eluent's input pipe
- Clean or flush filter's residue liquid

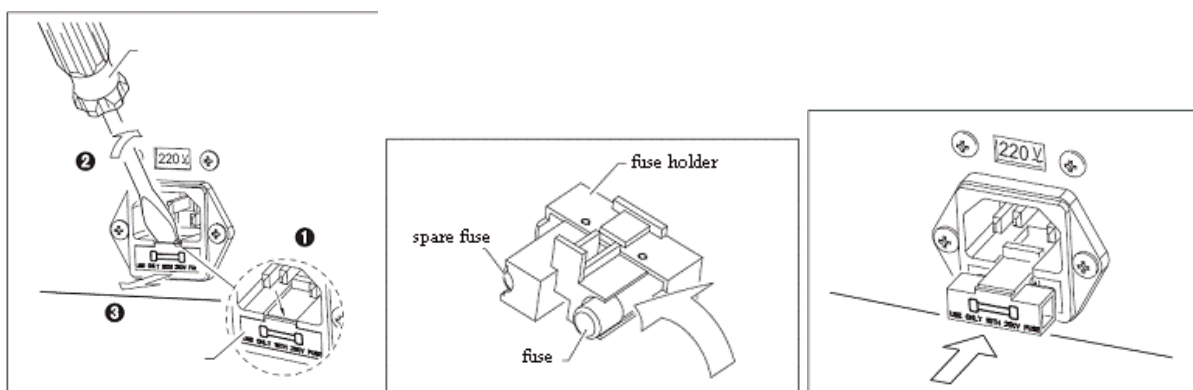
- Put the filter into the isopropanol or ethanol solution, and ultrasonic cleaning for 20-30 min
- Then flush filters surface isopropanol or ethanol after ultrasonic process
- Install the filter properly
- Transfusion pipe's emptying process
- Set eluent flow rate as 1.000ml/min for 10 min
- Check if there are bubbles within the pipe, if yes, extract these bubbles firstly

#### 9.4 Maintenance of Conductivity Detector

Keep conductance cell clean and flush whole piping system through pure water, routinely back flush conductance cell with strong solvent (disconnect column) to clean flow cell

#### 9.5 Other Operations

##### 9.5.1 fuse replacement



- Before replace the fuse, should check power voltage and cable connection to see if there's short circuit. Solve these issues first before replace the fuse
- The instrument should be power off and unplug, or it may cause short circus and other damages
- Use appropriate model and rated fuse

### 9.5.2 External cleaning

Liquid or solvent splashed on the instrument surface, do not use acid, alkali, alcohol and some other organic solvent like acetonitrile, acetone and n-hexane, etc. to clean, just in case of surface color fading. Should use absorbent paper or dry/ soft cloth to wipe and clean.