



SepaBean™ machine T

Flash Chromatography System

Hardware Manual - May 2019



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Preface

Thank you for purchasing the SepaBean™ machine T, the flash chromatography system by Santai Technologies, Inc. In this manual, the operation and maintenance of the SepaBean™ machine T is described in detail.

For the proper use of the system and maximizing output, the user is recommended to carefully read the instructions and safety measures as good laboratory practice.

The SepaBean™ machine is a unique flash chromatography system which provides learning and sharing tools to users. This instrument provides users with a convenient and effective mobile operation interface, secured data sharing, environmental-friendly column management system, and purification solution. The data-sharing feature helps users to obtain information from the global knowledge database and share with each other as well. The above-mentioned features facilitate the improved efficiency of research and development, secured data sharing, gathering of global intelligence, and enhanced authority over the separation and purification for complex samples.

Notices

The copyright and the right of interpretation of this manual and the related software belong to Santai. Besides the copyright, all trademarks and product names mentioned in this manual are owned by this legally registered company, Santai Technologies, Inc. No part of this manual can be reproduced or transmitted in any form or by any means without the written permission of Santai. This system is covered by a standard limited warranty. The terms of warranty are listed in this manual in detail. All information in this manual including software, operating conditions, system updates, and control techniques are subject to change without prior notice and does not represent a commitment of Santai. The SepaBean™ machine T and its components are subjected to various patents filed in the People's Republic of China and all over the world as well. Changes or modifications not solely approved by Santai could void the user's authority to operate the equipment. The use of replacement, consumable components and accessories from other suppliers instead of Santai is not recommended. Using such parts in SepaBean™ machine T will be the sole responsibility of the user or related company.

Safety Guidelines



Caution

As this machine deals with solvents, silica gel, and different chemical compounds, it's always recommended to use safety goggles while working on this system. Never open the pump tubing or joints when the pump is under high back pressure. Tubing can rupture due to high back pressure or a valve may open erroneously causing a spray of solvents. It's recommended that the pump should be de-pressurized before opening any of its joints. Also, it's recommended to use the appropriate safety gloves for different type of solvents.



Warning

Instrument with high voltages. Power from the mainframe panel should be shut down before opening the instrument. Only an authorized Santai service personnel or trained people by Santai can open the inside or back panels of this machine. Always use the provided power cord with the system. If it's needed to use any other standard power cord, please check if the power cord meets the instrument voltage specifications and requirements.



Warning

Electrical Grounding. The instrument must be properly grounded to prevent damages from a lightning strike or electric leakage voltages. Proper grounding can protect the operators from an injury. Grounding resistance should be less than 0.1Ω . Also, the leakage voltage should not be more than 3V.



Warning
High
temperature

Warning

High Temperature Surface. This symbol indicates that the surface is too hot to touch with bare hands. It may cause burns if not handled properly.



Warning

Unknown risks. User must be vigilant when using the system.

The production standards of this instrument are in line with the highest safety regulation and quality standards of the country of origin. However, it does not rule out the possibility of human error or if the instrument is not operated in accordance with the Standard Operating Procedure (SOP). SepaBean™ machine T should be installed and stored in a GLP environment and operated in the best suitable conditions. Any instrument issue or safety issue must be informed to the dealer, or Santai directly, as soon as possible. The instrument should be operated within the limits of pressure, flow, solvent type, and temperature as stated in the manual. The instrument is equipped with multiple security systems and sensors. If the instrument is operated in a non-compliant way, the system and sensors will fail to alarm the user about any possible risk. If unknown hazardous solvent or sample was handled with, the personal protection gears should be included according to the safe practices of the lab. Laboratory reagents, which are corrosive, flammable, toxic, or any other harmful characteristics, should be handled under the corresponding lab's guidelines. Users should pay attention to safety and protection issues.

1. Overview

1.1 Product Description

SepaBean™ machine T is an unconventional flash chromatography system. The utility of this machine is not only limited to flash chromatography separation and purifications, but also is a learning and sharing tool of global knowledge. The SepaBean™ machine T is comprised of a machine body, iPad, SepaBean™ software, and components related to wireless communication. The instrument has various modules integrated, including an HPLC pump module, UV detector module, fraction collector module, control module, alarm module, cartridge arm and a test module with some minor components. The default communication device is an iPad and the default operating system is iOS (update to the latest version available). The input of chromatography parameters, method setup, actual run, and data analysis with interpretation is realized through the iPad.

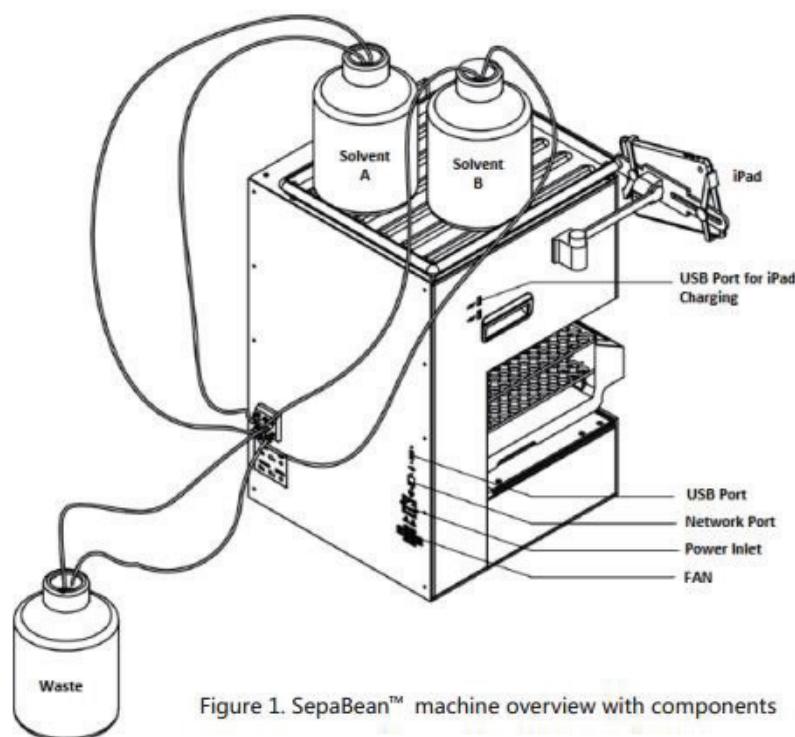
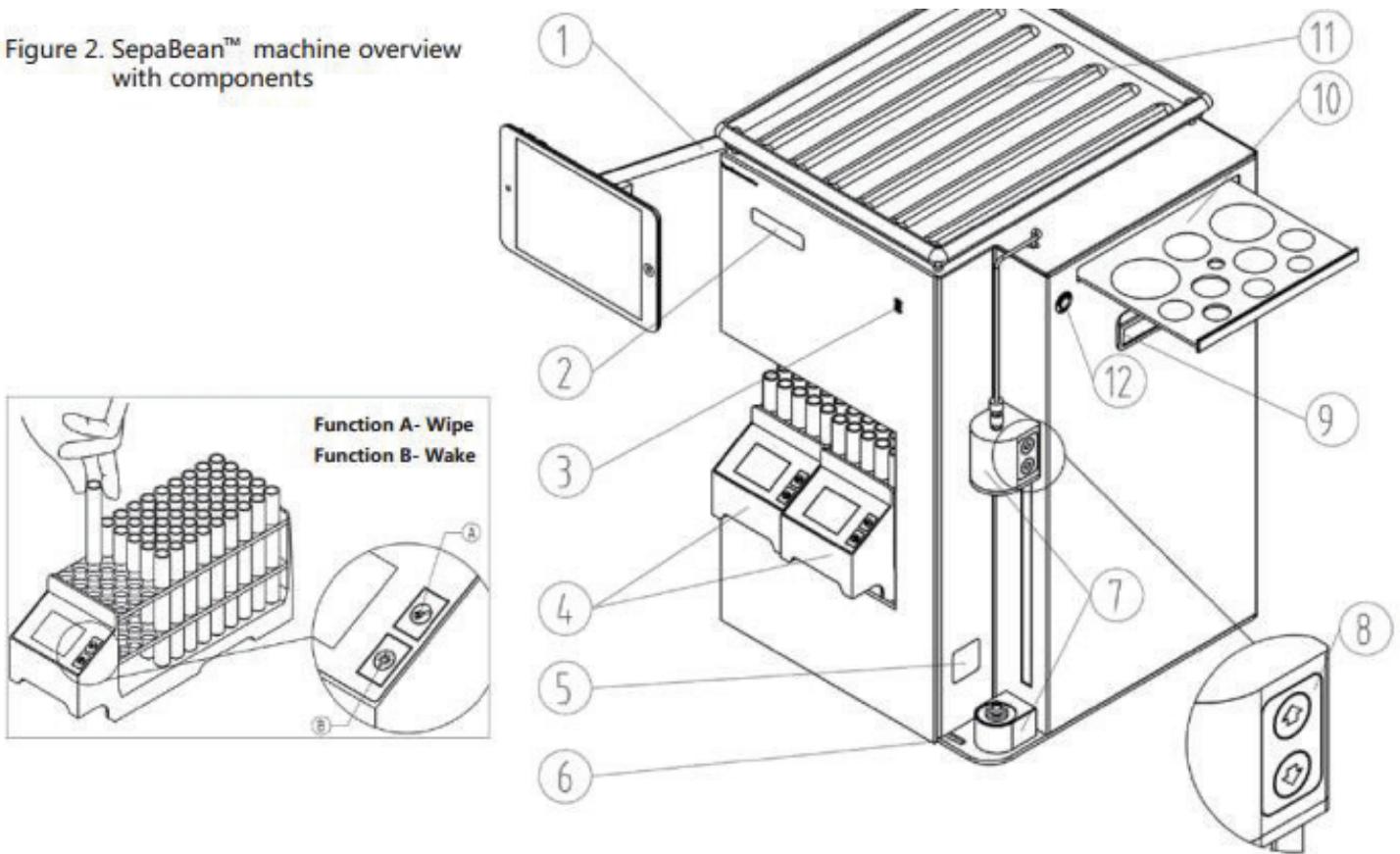


Figure 1. SepaBean™ machine overview with components

Figure 2. SepaBean™ machine overview with components



System Components Description

1. **iPad and iPad Holder** – An iPad is used to control the Sepabean™ machine T and it's installed on the holder, which can be adjusted to operate the iPad at eye level.
2. **Machine Main Screen** – Displays the system status, schedules, and other information.
3. **RFID Scanner** – Scan the RFID tag of the cartridge and it displays the related information on the main screen (not available for SepaBean™ machine T).
4. **Test Tube Rack** – Two racks can accommodate up to 60 test tubes each, collect the liquid fractions, and display the status on the built-in screen.
5. **Cartridge RFID Scanner** – Identify the type and size of cartridge with RFID scanning and transfer the data to the software for method development (not available for SepaBean™ machine T).
6. **Leakage Drain** – Drain the leaking solvent while installing the solid loading cartridge. Install cartridges properly; loosely installed cartridge will cause leakage.
7. **Main Column Holder** – For cartridge installation and fixation.
8. **Column Arm Touch Keys** – Moves the arm up or down when the respective buttons are pressed.
9. **Handles** – Two handles on both sides allow an easy lift of the instrument.
10. **Auxiliary Column Holder** – Pops up to hold various sizes of flash cartridges, and easily put back with a simple touch while not in use.
11. **Solvent Bottle Tray** – Holds various sizes of solvent bottles
12. **Emergency Stop Button** – When pressed, the instrument will be stopped immediately.

1.2 Product Features

1.2.1 Built-in Database and ChemBeanGo™ (hereinafter referred to as CBG) Global Knowledge Database

Knowledge Database

This database provides users with sample information, purification methods, information about the related compounds, submitted purification methods for the target compounds, and multiple ways of achieving a successful chromatographic separation for the target compound. This enables users to achieve optimization for separation and purification methods. By accessing CBG global knowledge database, SepaBean™ machine T will become more efficient in the development of purification method and data processing. If SepaBean™ machine T is not connected to the Internet, it can still work in offline mode and provide methods imported from CBG database to the user.

1.2.2 Control via Smart phone/tablet

SepaBean™ machine T can be controlled using a smart phone or tablet computer. Also, users can access the sample information, compound structure, separation methods, and other data through the smart phone or tablet computer.

1.2.3 Data Sharing

Users can access the data from multiple SepaBean™ machines within a network group. This enables users to get help for critical compounds or difficult separations methods from other groups. Also, the same machine can access the CBG global knowledge database for better understanding. The data is encrypted by using 128/256-bit AES data encryption and the same encryption is used while storing or transferring data. Under the confidential policy, the encrypted data cannot be obtained by any unauthorized person.

1.3 Technical Specifications

| | |
|---------------------------------|---|
| Sample Weight | 10 mg - 330 g |
| Column Size | 4 g - 330 g (up to 3 kg with adapters) |
| System Pump | Valveless metering pump, maintenance-free, high accuracy, long lifetime |
| Flow Rate | 1 - 200 mL/min |
| Flow Rate Accuracy | 1% |
| Pressure Limit | 200 psi (13.8 bar) |
| Detector | <p>Diode array Detector:</p> <ul style="list-style-type: none"> • Measures at two wavelengths simultaneously, supports realtime wavelength modifying • Scanning at full wavelength range helps to determine the optimal absorbance wavelength for unknown sample • Lower noise level, higher detection sensitivity, wider linear range • Equipped with Optical Path Length adjustable flow cells • Wavelength range: 200-400 nm (standard) or 200-800 nm (optional) • Absorbance range: 0-5.0 AU • Flow cell: initial setting 0.3 mm, adjustable range: 0.3~2.4 mm (support external ELSD detector or other detectors) |
| Wavelength Accuracy | 1 nm |
| Gradients | Four solvents, binary |
| Gradient Types | Linear, step, isocratic |
| Sample Loading Method | Dry load, liquid load, or load sample directly in column |
| Main Column Holder | Smart column installation |
| Auxiliary Column Holder | Provides flexible installation mode and use of the column in series |
| Controlling Software | SepaBean™ machine T employs an iOS App, called SepaBean App, to control the system. There are several features built into the app, including smart gradient generation from TLC or HPLC information and built-in separation method database that automatically recommends the most appropriate method based on the key information inputted by the user. The SepaBean App is guaranteed free with updates through it's whole lifetime. |
| Fraction Collection Mode | Collect all, threshold, slope, time, and manual collection mode |
| Fraction Collector | <p>Test tubes: 18*180 mm, 18*150 mm, 16*150 mm</p> <p>Bottles: 125 mL, 250 mL, 500 mL bottles with cap: 28*60 mm (25 mL), 28*95 mm (40 mL)</p> <p>With colored fraction display, convenient for TLC analysis</p> |
| Data Security | Multi-level auditing protects sensitive and private data, 128/256 bit AES encrypted data storage and communication to ensure data is safely protected. |
| Power Supply | Volts: 100-240; Amps: 4; MAX Hz: 50/60 |
| Dimensions & Weight | Dimensions (HxWxD): 62x40x40cm ; Weight: 50kg |

Chinese Patent Number: ZL2012 1032 0096.0

Chinese Patent Application Number: 2015 1031 2780.8; 2015 1001 2855.0; 2015 1033 5132.4

1.4 Working Principle

1.4.1 SepaBean™ machine T modules

1.4.1.1 Pump Module

The pump module consists of one valveless metering pump with high accuracy. This module works by drawing the solvent from bottles, mixing the solvent according to the gradient or isocratic elution profile entered by the user, and passing it through the column for sample separation.

1.4.1.2 Detector Module

This module consists of a dual wavelength UV/Vis detector, which detects the compounds eluting out of the column. Also, this module sends the detection signal to the software where the signal was shown as a UV curve on the chromatogram.

1.4.1.3 Column Module

This module enables users to install the column in the flash system and fix it automatically.

1.4.1.4 Fraction Collection Module

This module allows users to collect the fractions of the peak or to pass the entire flow to waste. There are various sizes of fraction collector trays available.

1.4.1.5 Solvent Level Monitoring Module

This module monitors the real-time solvent and waste levels. It will pause the running when the solvent level is too low, or waste level is too high. It also monitors the solvent leakage alarms and high solvent pressure alarms.

1.4.1.6 Control Module

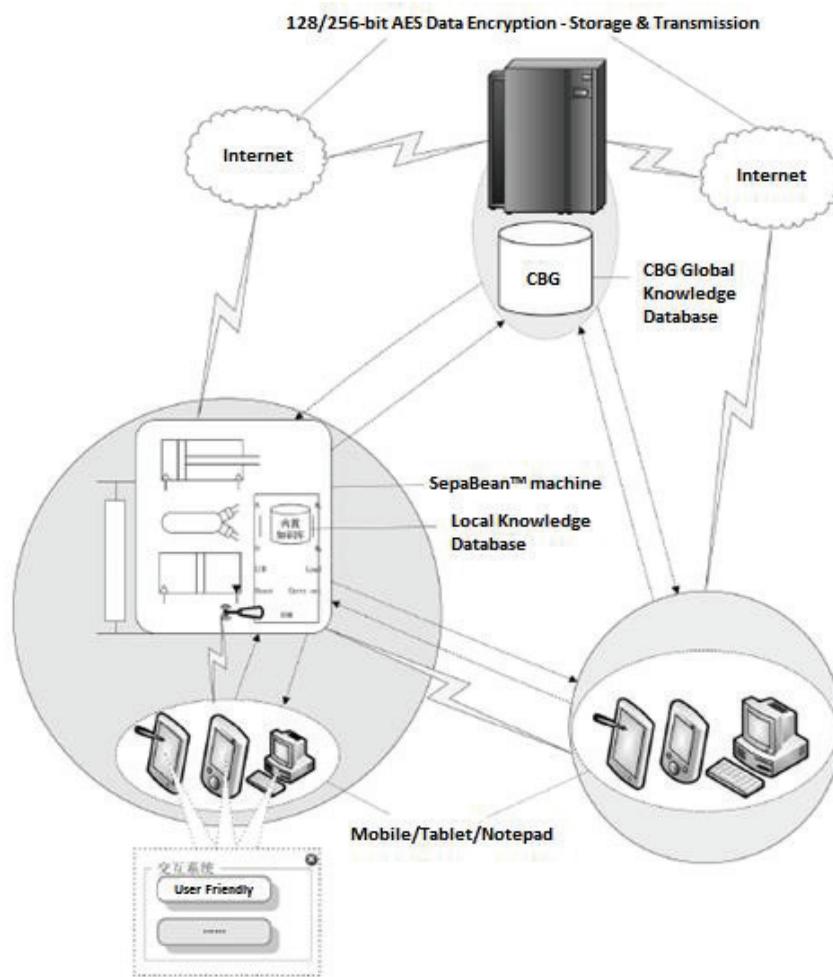
The control module monitors all above mentioned modules through the APP initiated control instructions.

1.4.2 SepaBean™ machine OS

With SepaBean™ machine T, the OS creates an independent research and development tool for flash chromatography. It can be flexibly installed on most smart phones, laptops or tablet computers for user-friendly, remote monitoring and controlling of the system. The SepaBean™ machine OS is based on an embedded Linux platform. Please refer to the SepaBean™ machine Software Manual.

1.4.3 Network Database of Separation and Purification Method

Whenever a method is running on the SepaBean™ machine T for chromatography separation or purification, the record of the method and data is saved on the built-in knowledge database. With the user's permission, the data from the local database can be uploaded on the CBG global knowledge database. Please note that the local data on SepaBean™ machine T is 100% secure and confidential. The data cannot be shared without multiple and multi-level permissions. Only with authorization can users access the CBG global knowledge database and update the existing purification methods.



2. Installation

2.1 Unpacking

2.1.1

The SepaBean™ machine T and its accessories are shipped and packed in one box. When the box is opened, please check for any signs of damage during shipment to the system or its accessories. If any part of the shipment is found to be broken, please contact Santai Technologies or the dealer.

2.1.2

If possible, please retain all the original packing material if the system needs to be transported to another location.

2.1.3

Please find a packing list inside the system and verify all the parts mentioned on the price list. If any part is missing, please feel free to contact Santai customer services.

2.1.3

Please check if the packing list meets the PO description.

2.2 Tubings Installation

Please connect all the solvent and waste tubing as per the diagram sticker on the back of the instrument.

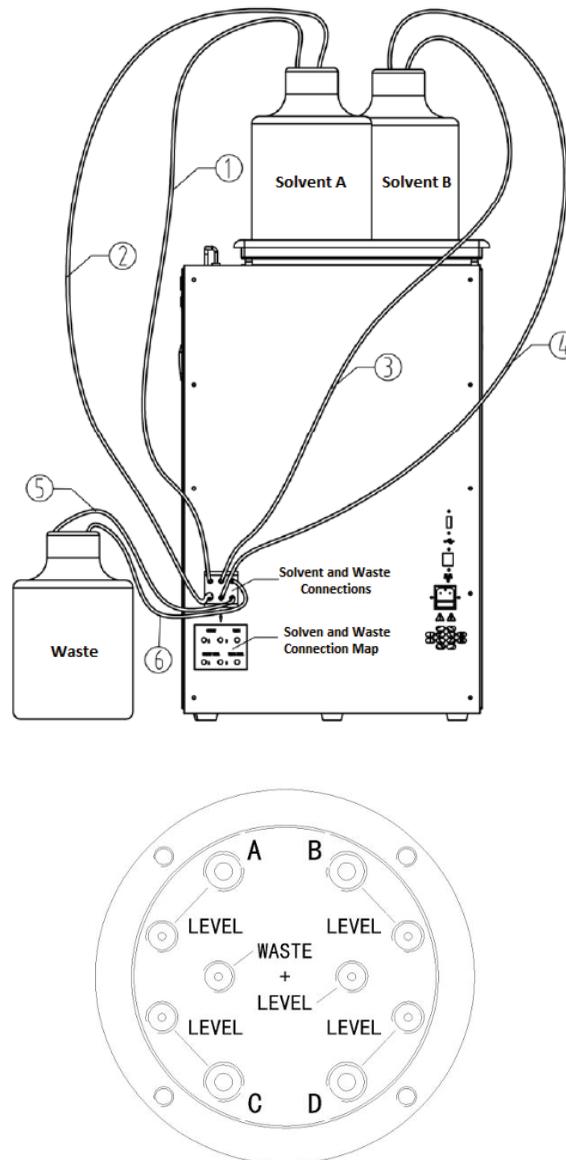


Figure 3. Diagram of solvent and waste line connections.

2.3 Installation Site Requirement

The normal working conditions of the instrument are described as follows:

- Ambient temperature: 5 to 35°C; preferably 20°C
- Relative humidity: 20% to 80%
- Power supply: voltage 100 to 250V
- Frequency: 50/60Hz
- Properly grounded
- Well ventilated

Things to avoid:

- Flammable gases
- Corrosive and explosive gases
- Strong vibrations
- Electromagnetic interference

In order to ensure the safety of users as well as the instrument, please refer to the following instructions.

1. Keep the room ventilated
2. Use GB general power cord
3. Personal Protective Equipment (PPE) must always be worn: gloves, glasses, aprons and shoes
4. Remove spilled solvent or material immediately
5. Ensure the safety of solvent bottles
6. Obey no-smoking rules

3. Networking

3.1 Router Settings

Wireless router is provided with the system. It's pre-configured to the settings below.

| | |
|-------------------------------------|-------------------|
| Name of the Wireless Network | SPB-xxxxxx |
| Wireless Password | 12345678 |

Note: If the wireless router parameters are to be changed or if the router is connected to the internet, please refer to the installation manual of the wireless router included in the original box.

Wired Connections

Connect the network cable port of the SepaBean™ machine T to the wireless router via network cable.

Wireless Connections

If the user intends not to use a network cable for communication, SepaBean™ machine T will automatically connect with the Wi-Fi router via Wi-Fi network.

3.2 iPad Control Terminal

3.2.1

Open the iPad box which is inside the tray box.

3.2.2

Using the iPad, connect to the Wi-Fi network of the related router of SepaBean™ machine T.

3.2.3

Click on the SepaBean™ app from the home screen of the iPad to start the controlling software.

4. Debugging

4.1 Boot

Plug in the power cord to SepaBean™ machine T. The instrument boots with various self-tests running in the background. The main screen on the system displays the results of self-tests, including the pumping system self-test, detector system self-test, fraction collector self-test, column arm self-test, and other internal processes.

4.2 Method Adjustment

After the successful boot, the instrument runs on its own automatically. Users can either select a method to run from the history section of the software or do a manual adjustment of the parameters. Please refer to the SepaBean™ software manual.

5. Operation

5.1 Method Setup

Users need to input different parameters to the software in order to generate the best suitable gradient profile for the sample. Users can input the data of HPLC to run the reversed phase column. Based on the input, the software decides the best suitable gradient. Users can create a gradient of their own choice.

5.2 Run Setup

Users can refer to the software manual for deeper understanding of the run setup. This section mainly consists of the following steps.

5.2.1 System Cleaning and Pipeline Washing

Users can use a strong solvent through Channel B to flush the system free of other strong solvents or residual impurities. Once the cleaning is completed, the system can be equilibrated with the starting non-polar solvent of the gradient.

5.2.2 Installing Column

Users need to select an appropriate column as per the sample quantity. Once the column is selected and the **Install Column** button is clicked, the column arm automatically elevates to a height more than the selected column. Users can install the column and click the **Finish** button. The arm moves down to fix the column automatically.

5.2.3 Column Equilibration

Based on the column selected, the software automatically decides the flow rate and duration time for equilibration of the cartridge. Ideally, 3-5 column volumes (CV) should be passed through the cartridge to achieve enough equilibration. Users can modify it anytime.

5.2.4 Purification of the Target Compound

With the combination of various controllable parameters, the target compound can be separated and purified successfully.

5.2.5 Air Purge

In this option, an integrated air pump blows the air through the column to dry it out. The residual solvent goes to waste.

5.2.6 Washing Solvent Pipelines

The instrument prompts users if they want to clean the solvent lines by purging. Users can always choose to do so or not.

5.2.7 Storing the Used Flash Column

This step is applicable for storage of a bonded phase column such as C18 series. A mixture of Methanol/ACN and water in 80:20 ratio should be pumped through the column for a considerable duration of time. The caps should be put on the inlet and outlet before storing it in a cool place.

6. Instrument Maintenance

6.1 Change of Mobile Phase

6.1.1 Normal Phase to Reversed Phase (Channel A/B of mobile phase, for example)

Put Channel A and Channel B in Isopropyl Alcohol (IPA), set the flow rate to 30 mL/min and rinse for 10 minutes. Then, put both channels in Methanol, set the flow rate to 30mL/min, and rinse for 10 minutes. To make the system ready for reversed phase operations, put both channels in water, set flow rate as 30mL/min, and rinse for 10 minutes. This will ensure all the pipelines are cleaned and free from normal phase solvents. The collection needle should also be cleaned manually.

6.1.2 Reverse Phase to Normal Phase (Channel A/B of mobile phase, for example)

Put Channel A and Channel B in methanol, set the flow rate to 30 mL/min, and rinse for 10 minutes. Then put the channels in IPA, set the flow rate to 30 mL/min, and rinse for 10 minutes. Then, put Line A in Petroleum Ether/DCM and Line B in Ethyl Acetate/Methanol respectively, set the flow rate to 30 mL/min, and rinse for 10 minutes. This will ensure that the pipelines are cleaned and free from reversed phase solvents. The collection needle needs to be cleaned manually.

6.2 Fuse Replacement

Fuse replacement procedure is described as follows:

- Shut down the instrument and switch the power OFF.
- Remove the power cord from the power entry module.
- With the help of flathead screwdriver, open the fuse compartment.
- Replace the old fuse with a new one of the correct rating and push the fuse box back in place.

6.3 Hardware Maintenance

6.3.1 Cleaning Solvent Filter

If the solvent filters are found to be clogged, uninstall the solvent filters from solvent bottle caps and sonicate it in IPA. Wash with water thoroughly at the end.

6.3.2 Pump

The pump used in this instrument are metering pumps and these valveless pumps are maintenance-free. It's not recommended for users to uninstall the parts of the pump. Only authorized service personnel are allowed to open the pump components. Under no circumstances should the pump run without its components in place.

6.3.3 Changing the UV lamp and Tungsten lamp

- Shut down the instrument, switch off the power, and uninstall the power cord from the power entry module. Wait for 15-30 minutes to allow the lamp to cool down.
- Remove the two Allen screws to open the side panel of the instrument. The entire detection assembly with all the components is clearly visible.
- Unlock the tray by opening the hand-tightened screw and pull the trayout to the right position.
- Disconnect the UV and tungsten lamp cables delicately.
- Using a Phillip screwdriver, open the screws securing both the lamps.
- Use the proper gloves to handle the uninstalled lamps.
- Install the new lamp (either UV or tungsten). Pay close attention to the lamp's fixed position and aperture position while installing the lamp. Tighten the two screws to fix both the lamps.
- Push the tray back, connect the lamp cables, fix the hand-tightened screw and put the side panel back in its place with two Allen screws.
- Power up the instrument to start working.

6.3.4 Pump

The flow cell gets dirty with various samples used on the system and proper cleaning is not carried out routinely. A strong solvent such as Methanol or DMF should be pumped through the flow cell to dissolve away any crystallized sample inside the flow cell. If the problem is not resolved, the strong solvent can be pumped manually with a syringe gently through the flow cell. This step should only be practiced by trained personnel.

6.3.5 Maintenance Plan

| Things to Check | Frequency |
|-------------------------------------|---|
| Solvent Bottle cleaning | Daily |
| Tubing pinched, broken, or cut | Weekly, or when there is a leakage or air bubbles in the flow |
| Cleaning flow cell | Quarterly, or whenever UV sensitivity is reduced or decreasing |
| UV lamp | Quarterly, or as the lamp energy falls below the limit or in case of increasing noise |
| Replacing the tubings and connector | Yearly |

6.4 General Instrument Issues and Troubleshooting

6.4.1 Detector Issues and Resolution

| Symptoms | Possible Cause | Resolution |
|----------------|---|--|
| Baseline Noise | Dirty flow cell | Clean the flow cell by passing a strong polar solvent Disconnect and clean the flow cell externally Replace the flow cell |
| | Air bubble inside the flow cell | Increase the flow suddenly to push the bubble out Connect a BPR at the outlet of the cell to increase back pressure dislodging the bubble |
| | UV lamp | UV lamp misaligned UV lamp reached its hours limit UV lamp faulty. Replace the lamp |
| | Solvent leakages | Tighten the connectors |
| | Bubbles in the solvent line | De-gas the mobile phase Increase the back pressure of BPR System leak |
| | Silica inside the flow cell | Check the column for frit breakage Call Santai service |
| Baseline Drift | Dirty flow cell | Clean the flow cell by passing a strong polar solvent Disconnect and clean the flow cell externally Replace the flow cell |
| | Detector temperature change | Check the ventilation |
| | Immiscible mobile phase cross-contamination | Flush the system thoroughly with the solvents of the current run to clean |
| | Dirty solvent bottles | Clean the solvent bottles or replace with new |
| | Contaminants from the previous run | Clean the column and system with a strong solvent to remove any contaminant |
| False Peak | Air bubble inside the flow cell | Solvent degassing System leak |
| Negative Peak | Injection fault | Check the injection valve for leakage |
| | Impure mobile phase | Use HPLC grade mobile phase |

6.4.2 Pump System Issues and Resolution

| Symptoms | Possible Cause | Resolution |
|-----------------------------------|---------------------------------------|--|
| No flow | Solvent bottle empty | Refill the solvent bottle |
| | Pumps not purged | Purge the pumps |
| | Pump not running | Check the power to the pump |
| | Solvent positioned below the pump | Keep the solvent bottle at the same level or above the pump |
| Actual flow is less than set flow | Tubings pinched | Check the tubing and replace if necessary |
| | Solvent filter clogged | Check and sonicate the solvent filter |
| | Gradient valve clogged | Check and clean/replace the gradient valve |
| High Back Pressure | Blocked tubing | Trace and clean the blocked tubing or part Replace if necessary |
| | Blocked column | Replace the column or flush with strong solvent |
| | Blocked flow cell | Clean by passing strong solvent through it |
| | Small diameter tubing connected | Connect the correct diameter tubing |
| | Faulty pressure sensor | Check and replace the pressure sensor |
| Pump stops during run | Solvent pressure exceeds max pressure | Refer to “High Back pressure” section |
| | Pumps overheated | Check the external ventilation and instrument fan at the back |
| | Vapour sensor error | Check and arrest any leakage |
| | Solvent level error | Check and refill the solvent bottles |
| | Waste level error | Check and drain the waste container |

| Symptoms | Possible Cause | Resolution |
|-------------------------------------|-----------------------------------|--|
| Humming sound from pump | Motor failure | Call Santai Service |
| | Line voltage lower than specified | Check and increase the line voltage |
| | High back pressure | Check and remove any blockage |
| Column pressure present but no flow | Serious system leak | Check and arrest any leakage |
| | Blocked flow | Clear the injector valve, injector, or any tubing after the column |
| | Column inlet blocked | Clean the frit by sonication. Make sure not to have sediments in the dissolved sample. |

6.4.3 Fraction Collector Issues and Resolutions

| Symptoms | Possible Cause | Resolution |
|-------------------------------------|--------------------------------------|---------------------------------------|
| No collection | No flow | Check the pumps and purge if required |
| | Faulty fraction collector valve | Check and replace if necessary |
| Fraction collection not centered | Fraction collector needs calibration | Contact Santai Service |
| Fraction collector arm doesn't move | Arm is getting obstructed | Check and remove any obstruction |
| | Motor is faulty | Check and replace if necessary |

Sorbent Technologies

Address: 5955 Peachtree Corners E | Norcross, GA 30071

Website: www.sorbtech.com Email: info@sorbtech.com

For more information, please call us at 770-936-0326

