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Vanquish

Integral Fraction Collector FT

VF-F20-A

Operating Manual

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ThermoFisher SCIENTIFIC

Original Operation Manual

The hardware descriptions in this manual revision refer to the device VF-F20-A

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1 Using this Manual

This chapter provides information about this manual, the conventions used throughout the manual, and the reference documentation that is available in addition to this manual.

1.1 About This Manual

This manual describes the functional features and operating principle of your Vanquish™ device and provides instructions for installation, set up, start up, shut down, operation, maintenance and troubleshooting.

The layout of this manual is designed to provide quick reference to the sections of interest to the user. To obtain a full understanding of your device, read this manual thoroughly.

This manual also contains safety messages, precautionary statements, and special notices that can prevent personal injury, damage to the device, or loss of data when followed properly.

Note the following:

- The device configuration may vary; therefore, not all descriptions necessarily apply to your particular device.
- If some detail applies to only one model or variant, the model or variant is identified by name.
- The descriptions in this manual refer to a Vanquish system configuration with optical detector. Not all descriptions necessarily apply to your particular system.
- Illustrations in this manual are provided for basic understanding. They can vary from the actual model of the device or component. However, this does not influence the descriptions. No claims can be derived from the illustrations in this manual.

The descriptions in this manual assume that the device is installed in the Vanquish system stack. If this is not the case, additional hardware is required and must be ordered separately. The information in this manual applies correspondingly.

1.2 Conventions

This section describes the conventions that are used throughout this manual.

1.2.1 Safety Messages

The safety messages and precautionary statements in this manual appear as follows:

- Safety messages or precautionary statements that apply to the entire manual and all procedures in this manual are grouped in the Safety chapter.
- Safety messages or precautionary statements that apply to an entire section or to multiple procedures in a section appear at the beginning of the section to which they apply.
- Safety messages that apply to only a particular section or procedure appear in the section or procedure to which they apply. They appear different from the main flow of text.

Safety messages are often preceded by an alert symbol and/or alert word. The alert word appears in uppercase letters and in bold type.

Make sure that you understand and follow all safety messages presented in this manual.

1.2.2 Special Notices and Informational Notes

Special notices and informational notes in this manual appear different from the main flow of text. They appear in boxes and a note label identifies them. The label text appears in uppercase letters and in bold type.

NOTICE
Highlights information necessary to prevent damage to the device or invalid test results.

TIP
Highlights information of general interest or helpful information that can make a task easier or optimize the performance of the device.

1.2.3 Typographical Conventions

These typographical conventions apply to the descriptions in this manual:

Data Input and Output

The following appears in **bold** type:

- Input that you enter by the keyboard or that you select with the mouse
- Buttons that you click on the screen
- Commands that you enter by the keyboard
- Names of, for example, dialog boxes, properties, and parameters

For brevity, long expressions and paths appear in the condensed form, for example: Click **Start > All Programs > Thermo Chromeleon 7 > Services Manager > Start Instrument Controller**.

References and Messages

References to additional documentation appear *italicized*.

- Messages that appear on the screen are identified by quotation marks.

Viewpoint

If not otherwise stated, the expressions *left* and *right* in this manual always refer to the viewpoint of a person that is facing the device from the front.

Particularly Important Words

Particularly important words in the main flow of text appear *italicized*.

Electronic Manual Version (PDF)

The electronic version (PDF) of the manual contains numerous links that you can click to go to other locations within the manual. These include:

- Table of contents entries
- Index entries
- Cross-references (in blue text), for example, to sections and figures

1.3 Reference Documentation

In addition to this operating manual, other documentation is available for reference.

Hardware Documentation

Additional hardware documentation includes the following:

- *Operating manuals* for the other modules of the Vanquish system
- *Vanquish System Operating Manual*
- *Instrument Installation Qualification Operating Instructions*

TIP Thermo Fisher Scientific provides up-to-date operating manuals as PDF (Portable Document Format) files that you can access from our customer manuals web site. To open and read the PDF files, Adobe™ Reader™ or Adobe™ Acrobat™ is required. Go to the following web site: www.thermofisher.com/HPLCmanuals.

Software Documentation

Additional software documentation includes the following:

- *Chromeleon™ Help and documents*
  The *Chromeleon Help* provides extensive information and comprehensive reference material for all aspects of the software.

In addition, the following documentation is available (availability depends on the software version):

- *Instrument Configuration Manager Help*
  For basic information about device installation and configuration, refer to the *Installation Guide*; for specific information about a certain device, refer to the *Instrument Configuration Manager Help.* In Chromeleon 7, devices are called modules.
- *Quick Start Guide*
  For information about the main elements of the user interface and step-by-step guidance through the most important workflows, refer to the *Quick Start Guide*.

TIP The *Chromeleon* Help and documents are included in the software shipment.

Third-Party Documentation

Refer also to the user documentation provided by the manufacturers of third-party components and materials, for example, Safety Data Sheets (SDSs).

2 Safety

This chapter provides general and specific safety information and informs about the intended use of the device.

2.1 Safety Symbols and Signal Words

2.1.1 Safety Symbols and Signal Words in this Manual

This manual contains safety messages to prevent injury of the persons using the device.

The safety symbols and signal words in this manual include the following:

Always be aware of the safety information. Do not proceed until you have fully understood the information and consider the consequences of what you are doing.

CAUTION

Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

WARNING

Indicates a hazardous situation that, if not avoided, could result in serious injury.

2.1.2 Observing this Manual

Observe the following:

- Before installing or operating the device, read this manual carefully to be familiar with the device and this manual. The manual contains important information with regard to user safety as well as use and care of the device.
- Always keep the manual near the device for quick reference.
- Save this manual and pass it on to any subsequent user.

Read, understand, and comply with all safety messages and precautionary statements presented in this manual.

2.1.3 Safety Symbols on the Device

The table lists the safety symbols that appear on the device or on labels affixed to the device. Follow the safety notices in this manual to prevent the risk of operator injury or damage to the device.

Symbol	Description
	Indicates a potential hazard. Refer to this manual to avoid the risk of personal injury and/or to prevent damage to the device.
I O	Power supply is on Power supply is off
~	Indicates alternating current.
	Indicates a potential pinch point hazard. Keep your hands clear to avoid harming your hands.

2.1.4 Applicable Symbols on the Device

Symbol	Description
	Need to remove the shipment lock before powering on the device.
	Consult instructions for use.

2.1.5 Rating Plate

The rating plate is present on the device near the electrical connections. The rating plate indicates the serial number, part number, module name, revision number, line and fuse rating, and the manufacturer's address.

TIP An additional type label on the leak tray of the device indicates the serial number, part number, module name, and revision number. To facilitate device identification, have the information from this label available when communicating with Thermo Fisher Scientific.

2.2 Intended Use

The device is intended to be part of the Vanquish system.

The intended use of the Vanquish system with fraction collector is to purify the compounds of a sample solution and collect the separated, purified compounds in sample containers for further analyses.

The device is for use by qualified personnel and in laboratory environment only.

The device and Vanquish system are intended to be used as General Laboratory Equipment (GLE).

They are not intended for use in diagnostic procedures.

Laboratory Practice

Thermo Fisher Scientific recommends that the laboratory in which the Vanquish system is used follow best practices for LC analyses. This includes among others:

- Using appropriate standards
- Regularly running calibration
- Establishing shelf-life limits and following them for all consumables used with the system
- Running the system according to the laboratory's verified and validated 'lab developed test' protocol

2.3 Safety Precautions

2.3.1 General Safety Information

All users must observe the general safety information presented in this section and all specific safety messages and precautionary statements elsewhere in this manual during all phases of installation, operation, troubleshooting, maintenance, shutdown, and transport of the device.

If the device is used in a manner not specified by Thermo Fisher Scientific, the protection provided by the device could be impaired. Observe the following:

- Operate the device only within its technical specifications.
- Use only the replacement parts and additional components, options, and peripherals specifically authorized and qualified for the device by Thermo Fisher Scientific.
- Perform only the procedures that are described in this operating manual and in supporting documents for the device.
  Follow all instructions step by step and use the tools recommended for the procedure.
- Open the enclosure of the device and other components only if specifically instructed to do so in this manual.
- Thermo Fisher Scientific cannot be held liable for any damage, material or otherwise, resulting from inappropriate or improper use of the device. If there is any question regarding appropriate usage, contact Thermo Fisher Scientific before proceeding.

Safety Standard

This device is a Safety Class I instrument (provided with terminal for protective grounding). The device has been manufactured and tested according to international safety standards.

2.3.2 Qualification of the Personnel

Observe the information below on the proper qualification of the personnel installing and/or operating the device.

Installation

Only skilled personnel are permitted to install the device and to establish the electrical connections according to the appropriate regulations.

- Thermo Fisher Scientific recommends always having service personnel certified by Thermo Fisher Scientific perform the installation (for brevity, referred to as Thermo Fisher Scientific service engineer).
- If a person other than a Thermo Fisher Scientific service engineer installs and sets up the module, the installer is responsible for ensuring the safety of the module and system.

General Operation

The device is designed to be operated only by trained and qualified personnel in a laboratory environment.

All users must know the hazards presented by the device and the substances they are using. All users should observe the related Safety Data Sheets (SDSs).

2.3.3 Personal Protective Equipment

Wear personal protective equipment and follow good laboratory practice to protect you from hazardous substances. The appropriate equipment depends on the hazard. For advice on the hazards and the equipment required for the substances you are using, refer to the material handling and safety data sheet provided by the vendor.

An eyewash facility and a sink should be available nearby. If any substance contacts your skin or eyes, wash the affected area and seek medical attention.

Protective Clothing

To protect you from chemical splashes, harmful liquids, or other contamination, put on appropriate protective clothing, such as a lab coat.

Protective Eyewear

To prevent liquids from striking your eyes, put on appropriate protective eyewear, such as safety glasses with side shields. If there is a risk of splashing liquids, put on goggles.

Gloves

To protect you from harmful liquids and avoid personal injury during maintenance or service, put on appropriate protective gloves.

2.3.4 Electrical Safety Precautions

WARNING— Electric Shock or Damage to the device

High voltages are present inside the device that could cause an electric shock or damage to the device.

- Do not make any changes to the electrical or grounding connections.
- Do not remove the grounding connections and always keep the grounding connections in good contact.
- If you suspect any kind of electrical damage, disconnect the power cord and contact Thermo Fisher Scientific Technical Support for assistance.
- Do not open the housing or remove protective panels unless specifically instructed to do so in this manual.
- Do not place liquid reservoirs directly upon the device. Liquid might leak into the device and get into contact with electronic components causing a short circuit. Instead, place liquid reservoirs in the solvent rack that is available for the Vanquish system.

2.3.5 General Residual Hazards

Pay attention to the following general residual hazards when working with the device:

WARNING—Hazardous Substances

Solvents, mobile phases, samples, and reagents might contain toxic, carcinogenic, mutagenic, infectious, or otherwise harmful substances. The handling of these substances can pose health and safety risks.

- Be sure that you know the properties of all substances that you are using. Avoid exposure to harmful substances. If you have any doubt about a substance, handle the substance as if it is potentially harmful.
- Wear personal protective equipment as required by the hazard and follow good laboratory practice.
- Reduce the volume of substances to the minimum volume required for sample analysis.
- Do not operate the device in a potentially flammable environment.
- Avoid accumulation of harmful substances. Make sure that the installation site is well ventilated.
- Dispose of hazardous waste in an environmentally safe manner that is consistent with local regulations. Follow a regulated, approved waste disposal program.

WARNING—Biohazard

Biohazardous material, for example microorganisms, cell cultures, tissues, body fluids, and other biological agents can transmit infectious diseases. To avoid infections with these agents:

- Assume that all biological substances are at least potentially infectious.
- Wear personal protective equipment as required by the hazard and follow good laboratory practice.
- Dispose of biohazardous waste in an environmentally safe manner that is consistent with local regulations. Follow a regulated, approved waste disposal program.

WARNING—Self-Ignition of Solvents

Solvents with a self-ignition temperature below 150 °C might ignite when in contact with a hot surface (for example, due to leakage in the chromatography system).

Avoid the use of these solvents.

WARNING—Hazardous Vapors

Mobile phases and samples might contain volatile or flammable solvents. The handling of these substances can pose health and safety risks.

- Avoid accumulation of these substances. Make sure that the installation site is well ventilated.
- Avoid open flames and sparks.
- Do not operate the device in the presence of flammable gases or fumes.

WARNING—Flammable and Hazardous Vapors

Flammable or hazardous vapors can escape from improperly sealed sample containers with flammable or volatile samples and can accumulate inside the device. This can pose health and safety risks and lead to wrong results.

- Observe the following safety guidelines with flammable and volatile samples.
- Use only vials or well plates that are made gas-tight by means of caps, sealing mats, or sealing tapes. Refer to the latest list of closures approved by Thermo Fisher Scientific.
- Inspect vials for cracks or defects before use. Do not use cracked or damaged vials.

CAUTION—Escape of Hazardous Substances from PEEK™ Capillaries

In the Vanquish system, capillaries made of PEEK may be used. Swelling or attack by acids can cause PEEK capillaries to start leaking or to burst.

- Certain chemicals, for example, trichlormethane ($CHCl_3$), dimethyl sulfoxide (DMSO), or tetrahydrofuran (THF) can cause PEEK to swell.
- Concentrated acids, such as sulfuric acid and nitric acid, or a mixture of hexane, ethyl acetate, and methanol, can attack PEEK.
- Swelling or attack is not a problem with brief flushing procedures.
- For more information, refer to the technical literature on the chemical resistance of PEEK.

CAUTION—Allergic Reaction

Some capillaries in the Vanquish system are made of MP35N®, a nickel-cobalt based alloy. Individuals with sensitivity to nickel/cobalt may show an allergic reaction from skin contact.

CAUTION—Sparking due to Electrostatic Discharge

Liquid flowing through capillaries can generate static electricity. This effect is particularly present with insulating capillaries and non-conductive solvents (for example, pure acetonitrile). Discharge of electrostatic energy might lead to sparking, which could constitute a fire hazard.

Prevent the generation of static electricity near the chromatography system.

2.3.6 In Case of Emergency

WARNING—Safety Hazard

In case of emergency, disconnect the device from the power line.

2.4 Solvent and Additive Information

2.4.1 General Compatibility

To protect optimal functionality of the Vanquish system, observe these recommendations on the use of solvents and additives:

- The system must be used with reversed-phase (RP) compatible solvents and additives only.
- Use only solvents and additives that are compatible with all parts in the flow path.

TIP Normal-phase (NP) compatible solvents and additives may be used with the fraction collector installed in a Vanquish Core system if the fraction collector and all other system modules have been modified for NP applications.

2.4.2 Allowed pH Ranges

Allowed pH ranges (standard system configuration):

System (Standard Configuration)	Allowed pH ranges	Remarks
Vanquish Core	Limited to 2-12 by Integral Fraction Collector	• *pH* values *of 2 or less*: The application time should be as short as possible. Flush the system thoroughly after these applications. • *pH values higher than 9.5 with optical detectors*: Avoid using mobile phases with a pH value higher than 9.5 together with optical detectors. This can impair the functionality and optical performance of the detector flow cell. • *pH values higher than 12*: May affect electrochemical detection. Before using highly alkaline solvents for flushing the system, disconnect the detector from the system. • *Mobile phases containing ammonium hydroxide*: In rare cases, a shortened lifetime of reversed-phase (UHMW-PE) piston seals has been observed with high pH, ammonium hydroxide containing mobile phases and prolonged exposure.
Vanquish Horizon Vanquish Flex	2-12	

2.4.3 Allowed Concentrations

Allowed concentrations (standard system configuration):

System (Standard Configuration)	Chloride	Buffer	Remarks
Vanquish Core	0.1 mol/L or less	1 mol/L or less	• *High chloride concentration*: The application time should be as short as possible. Flush the system thoroughly after these applications. • *Mobile phases containing ammonium hydroxide*: In rare cases, a shortened lifetime of reversed-phase (UHMW-PE) piston seals has been observed with high pH, ammonium hydroxide containing mobile phases and prolonged exposure.
Vanquish Horizon Vanquish Flex	1 mol/L or less	-	

2.4.4 Further Information

- For details about the materials that are used in the analytical flow path of the device, see the *Specifications* chapter in this manual. For information about the materials that are used in the flow path of the other modules in the Vanquish system, refer to the *Specifications* chapter in the *Operating Manual* for the modules.
- Follow any specific recommendations presented in other sections of this manual. Refer also to the *operating manuals* for all modules in the Vanquish system. They may provide additional guidelines and information.
- Observe the general guidelines and recommendations on the use of solvents and additives in the chromatography system. Refer to *Use of Solvents and Additives* in the *Vanquish System Operating Manual.*

2.5 Compliance Information

Thermo Fisher Scientific performs complete testing and evaluation of its products to ensure full compliance with applicable domestic and international regulations. When the device is delivered to you, it meets all pertinent electromagnetic compatibility (EMC) and safety standards as described in this manual.

Changes that you make to the device may void compliance with one or more of these EMC and safety standards. Changes to the device include replacing a part or adding components, options, or peripherals not specifically authorized and qualified for the product by Thermo Fisher Scientific. To ensure continued compliance with EMC and safety standards, replacement parts and additional components, options, and peripherals must be ordered from Thermo Fisher Scientific or one of its authorized representatives.

The device has been shipped from the manufacturing site in a safe condition.

See also

Compliance Information (Page 250)

3 Device Overview

This chapter introduces you to the device and the main components.

3.1 Integral Fraction Collector Features

The device comprises the following main features:

- Fraction collection for (U)HPLC separation at high precision and accuracy, with minimum carryover and variable fraction collection modes from 0.05 - 10 mL/min flow rate
- Support of reversed-phase (RP) and normal-phase (NP) solvents
- Support of racks and well plates with a footprint as specified by the Society for Biomolecular Screening (SBS footprint)
- Fraction collection can be triggered by both **peak-based** and **time-based**
- Support **AboveVial** and **InVial** collection including septum piercing
- Support of different collection path mode: **Vertical**, **SawVertical**, **Horizontal** and **SawHorizontal**
- Automated delay volume determination in Chromeleon CDS
- Washing of the outer needle surface and rinse of inner needle surface for minimum fraction collection carry-over
- The sample flow path is built with biocompatible components
- Temperature control is available in the fraction collector compartment
- A barcode reader inside the device identifies racks and well plates with barcodes for Vanquish rack type identification
- Flush function between fractions is available to improve recovery and minimize carry-over
- Predictive performance counters

3.2 Operating Principle

The operation principle of a purification LC system is based on a setup of an HPLC system combined with a fraction collector between the detector and the waste container. The capillary connecting the HPLC detector with the fraction collector is called delay capillary.

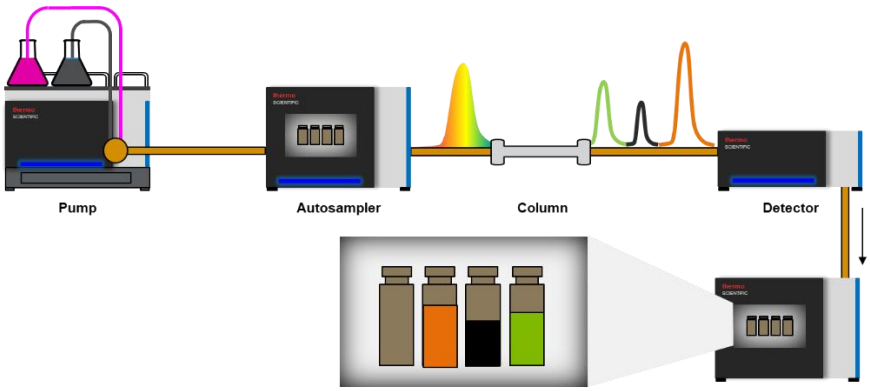

Figure 1: Operating principle of a purification LC system

Fractionation is the process of collecting the eluting liquid of interest into target sample containers with a fraction collection valve and a needle.

When a run is started, and the sample is injected by the autosampler the fraction collection valve is in waste position and the needle moves to the position of the defined sample container. When the Chromatography Data System (CDS) triggers the start of a fraction collection the fraction collection valve is switched to collect position, under consideration of the delay volume between the detector outlet and needle tip, to direct the flow into the collection sample container. The needle can be programmed to stay above the sample container or descend into the sample container during fraction collection. When the CDS triggers a *tube change* the needle moves to the next position on the sample rack. For that step the fraction collection valve can be programmed to switch to waste or stay in collect position. When the CDS triggers the end of the fraction collection the fraction collection valve is switched to waste and needle moves to the next position on the sample rack.

If the flush function is enabled and the CDS triggers the end of the fraction collection the fraction collection valve will be switched to flush position and the needle will stay at the current position on the sample rack. In flush position the flush buffer loop filled with flush solvent is switched into the flow path between detector and needle allowing to

dispense remaining fraction in the needle capillary and needle into the current *tube* to increase the recovery of the fraction and reduce carry over of the first fraction into the second fraction. When flush function is completed the fraction collection valve will be switched to waste position until a new fraction collection is triggered.

To remove residual sample from the needle external between runs, the needle moves to the wash port and descends into it. The needle wash pump supplies needle wash liquid to the wash port to wash the outer surface of the needle to the wash waste.

To remove residual fraction from needle internal between runs, the needle moves to the wash port and descends into it with fraction collection valve located at collection position. The HPLC pump flow supplies clean mobile phase to rinse the inner surface of the needle to the wash waste.

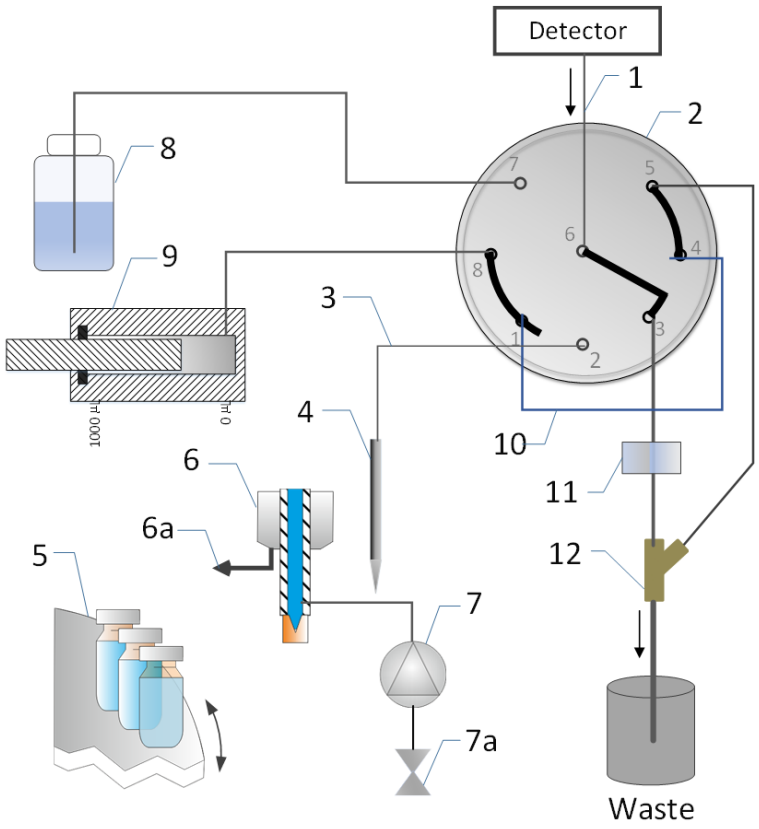

Figure 2: Fluidic configuration of the fraction collector in idle state (fraction collection valve in waste position)

No.	Description	No.	Description
1	Delay capillary	7	Needle wash pump
2	Fraction collection valve	7a	Needle wash liquid
3	Needle capillary	8	Flush solvent
4	Needle unit	9	Flush pump
5	Carousel with collection vials	10	Flush buffer loop
6	Needle wash port	11	Air bubble sensor
6a	Needle wash waste	12	Y-connector

Note: Waste drainage is routed to a waste container.

The following figures illustrate how the device operates for collecting fractions, flushing between fractions of one run, washing the needle externally between runs, rinsing the needle internally between runs and purging the flush pump. The fraction collection valve is switched between three different positions depending on the operation:

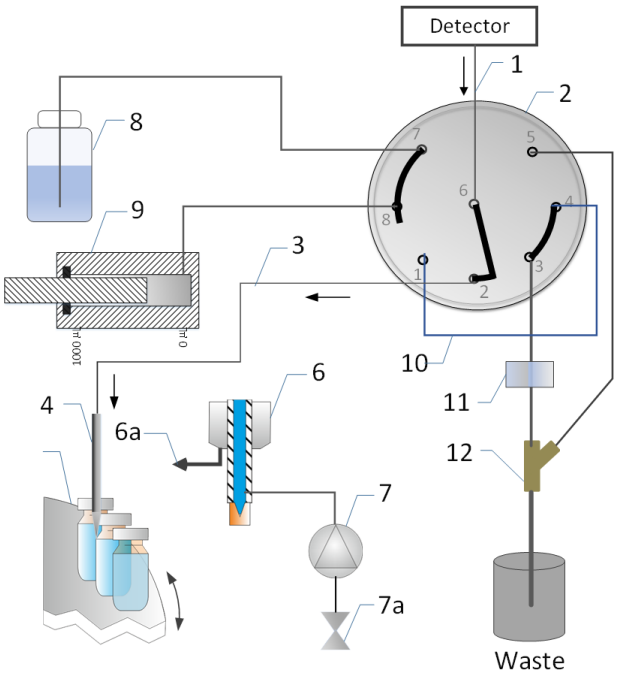

Figure 3: Fraction collection with fraction collection valve in collect position

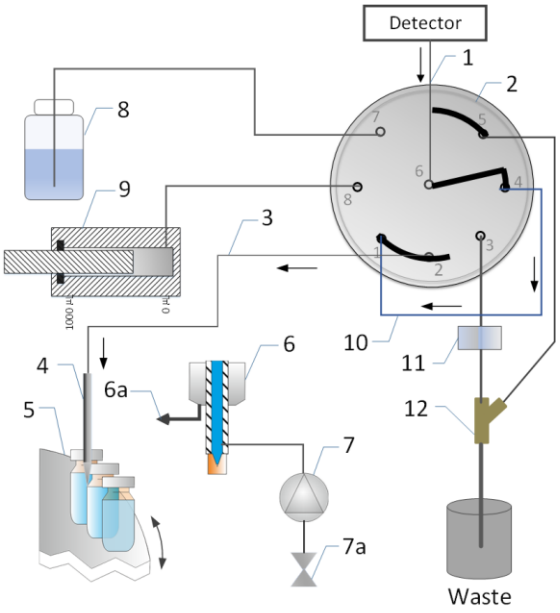

Figure 4: Flush with fraction collection valve in flush position

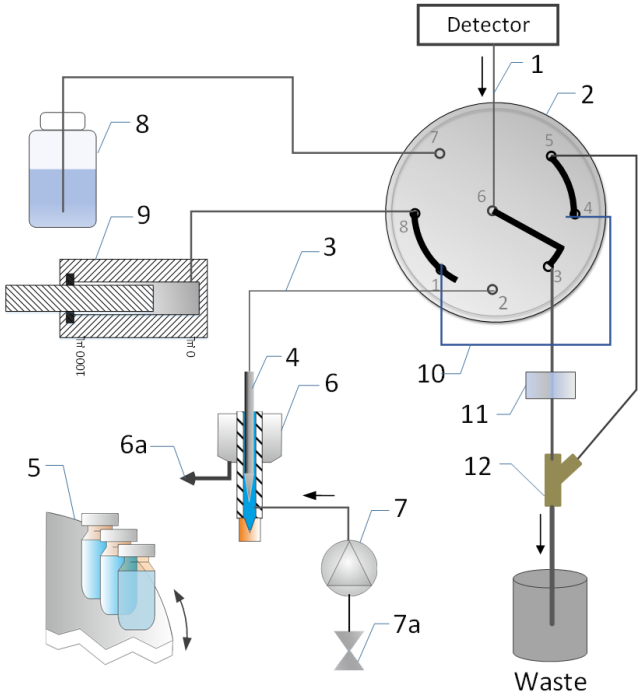

Figure 5: External Needle Wash in needle wash port with fraction collection valve in waste position

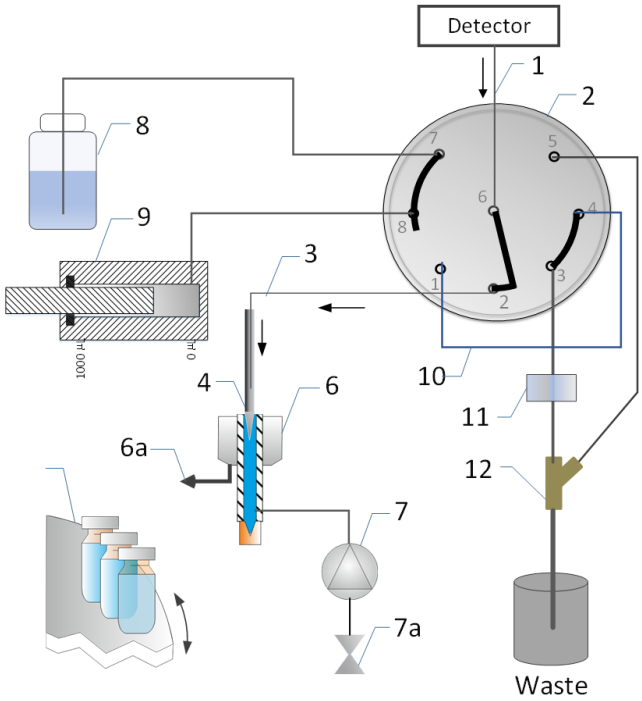

Figure 6: Internal Needle Rinse in needle wash port with fraction collection valve in collect position

Several draw and dispense strokes are executed during the purge flush pump operation to fill the flow path from flush solvent container, flush pump to flush buffer loop with fresh flush solvent.

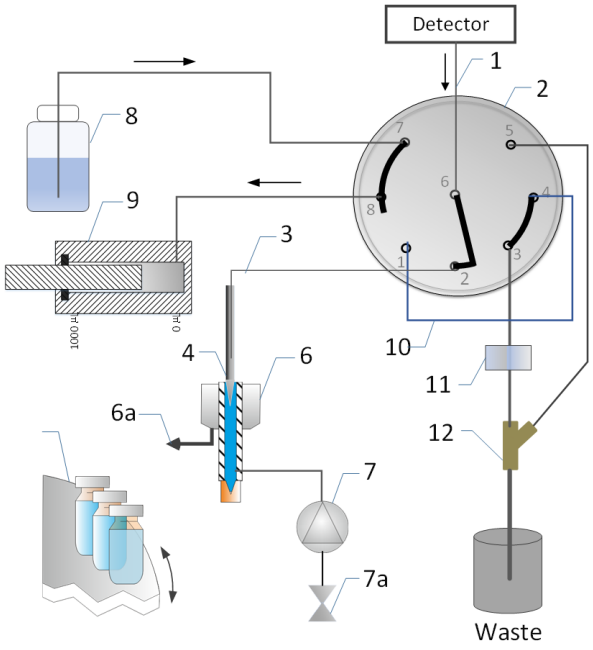

Figure 7: Draw of fresh flush solvent from solvent container to fill flush pump

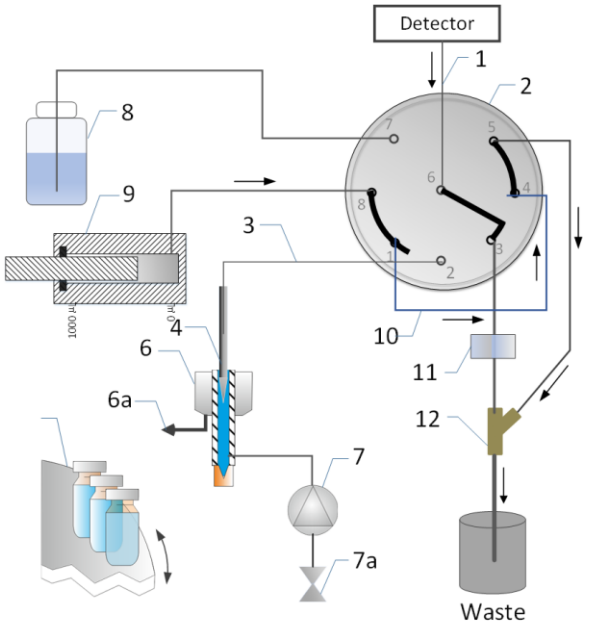

Figure 8: Dispense liquid out to flush buffer loop and drain to waste

3.3 Interior Components

General Interior View

The user-accessible components of the device are located directly behind the front doors:

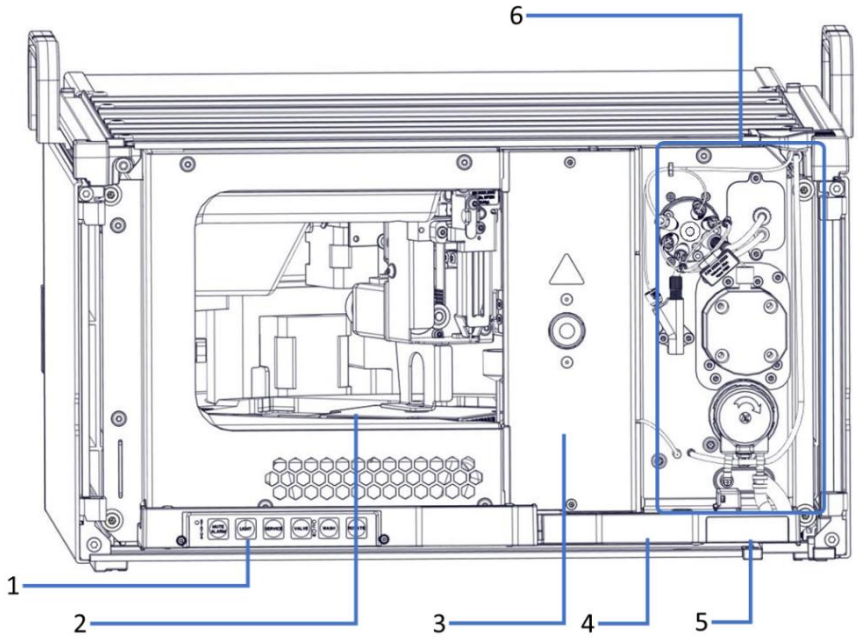

Figure 9: Interior view

No.	Description
1	Keypad with status indicators
2	Fraction collector compartment with carousel
3	Removable front plate
4	Front leak tray
5	Type label, indicating the part number, module name, and serial number
6	Right interior side with flow components

Flow Components

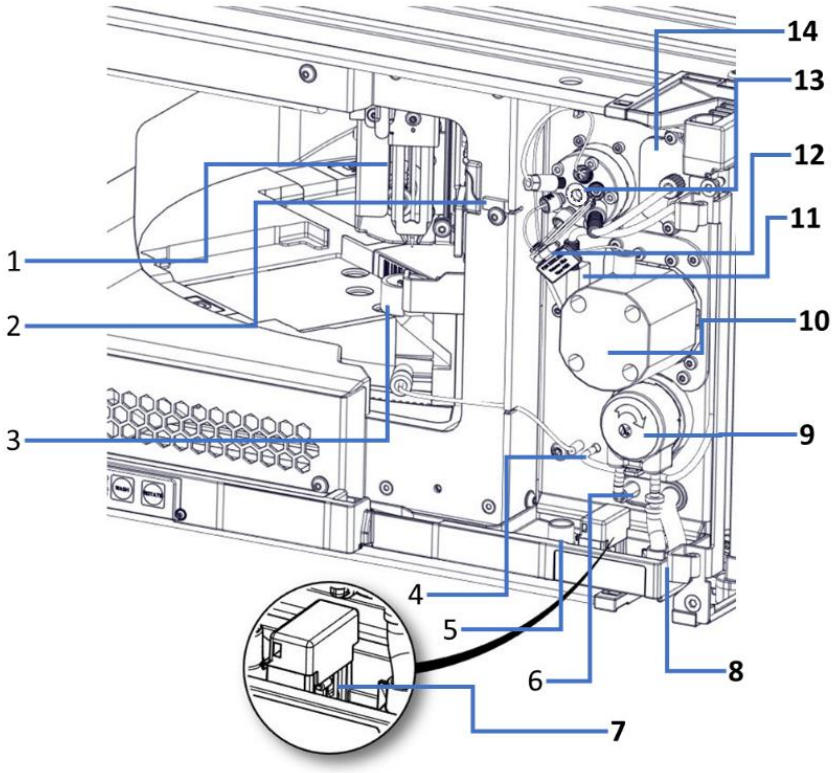

Figure 10: Detailed view on the right interior side

No.	Description	No.	Description
1	Needle unit (with needle and pusher) installed on needle drive	8	Connection ports for needle wash port outlet tubing and drain pump waste tubing
2	Needle capillary securing plate	9	Drain pump
3	Needle wash port	10	Flush pump
4	Needle wash pump (installed behind the panel)	11	Y-connector (PEEK)
5	Guide hole for capillary from other module	12	Flush buffer loop (connecting between fraction collection valve port 1 and port 4)
6	Guide hole for wash port outlet tubing and condensation tubing	13	Fraction collection valve
7	Front leak sensor	14	Air bubble sensor (installed around the tubing and located behind the panel)

3.4 Fraction Collector Compartment

The fraction collector compartment of the device accommodates a carousel with four color-coded segments and a needle drive to move needle unit in Y and Z directions.

The device supports the same sample racks and well plates with a footprint as specified by the Society for Biomolecular Screening (SBS footprint) like the Vanquish Split Samplers.

Besides, the Fraction collector compartment provides the following features:

- Thermostatting. See Thermostatting (▷ page 43).
- Rack type identification and verification, empty segment detection and inventory management. See Carousel (▷ page 44).
- Compartment light.

3.4.1 Thermostatting

Temperature control is available for the fraction collector compartment. Circulating air is used to cool or heat the fraction collector compartment to the set temperature, thus allowing precise equalization of the sample temperature.

To achieve an optimum thermostatting performance, keep the front doors of the device closed during fraction collection. Open the front doors only if required, for example to load the device with sample containers.

The device allows thermostatting in the range of +4 °C and +40 °C. Cooling of the collected fractions is possible to max. 23 K below ambient temperature.

Depending on the ambient humidity, condensation liquid may occur during cooling. A condensation drain system in the device actively removes any occurring condensation liquid from the fraction collector compartment.

The drain system includes a drain pump and one inlet tubing going to the rear side of the device to drain out condensation water accumulated inside the fraction collector compartment at fixed intervals.

3.4.2 Carousel

The carousel separates into four color-coded segments, in the following order of collection red (R), yellow (Y), blue (B) and green (G). This ensures shortest distances between fractions and racks for optimized performance. For more details about positions with respect to different collection modes see Important Operating Parameters (page 114).

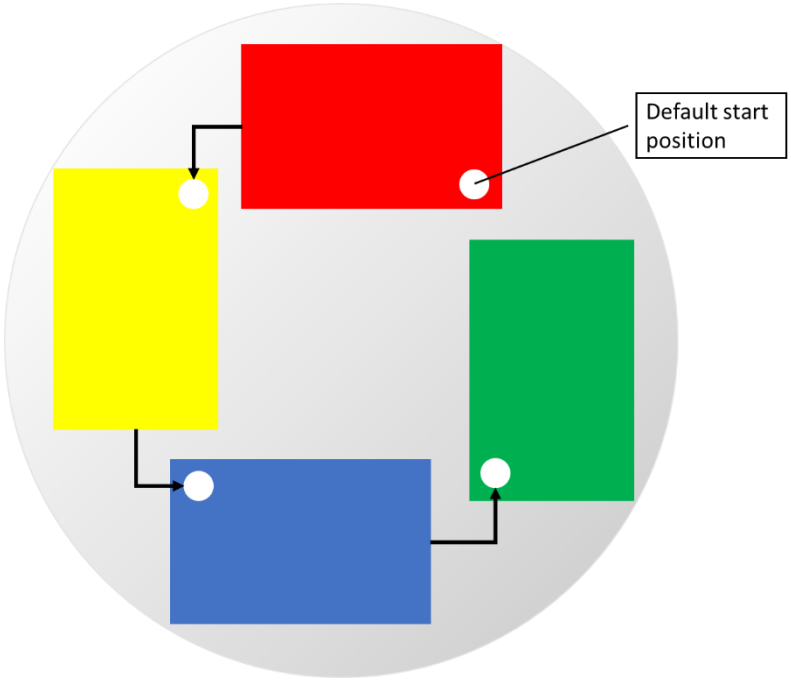

Figure 11: Order of carousel segments

Each segment includes a positioning area that accommodates space for one sample rack or well plate, barcode label indicating empty, alignment frame for easy aligning racks and well plates and a color code for the segment.

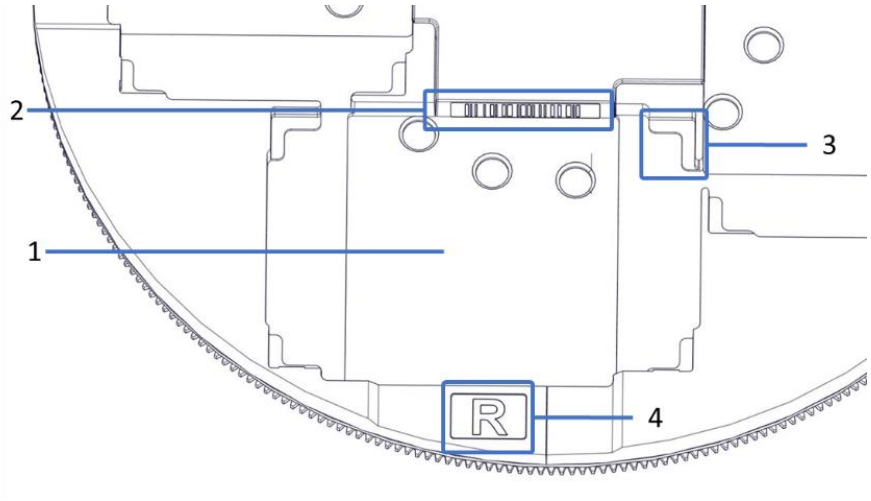

Figure 12: Detailed view on segment in the carousel

No.	Description
1	Positioning area Space to position a sample rack or well plate
2	Barcode label 'empty' Label that identifies that the segment is empty for the barcode reader
3	Alignment frame Angles to align the sample rack or well plate within easily.
4	Color code for the segment (*here:* **R** for the red segment)

3.4.3 Rack Type Identification

A barcode reader inside the fraction collector compartment allows automatic identification of the rack type for sample racks and well plates on which a Vanquish rack type 2D barcode is present.

During operation, the barcode reader performs an inventory scan and reads the Vanquish rack type barcode if present. The barcode reader automatically verifies the rack type and orientation. The information is sent to the Chromeleon software.

To allow the identification of the sample rack or well plate type, use sample racks and well plates with such barcodes for rack type identification.

Each segment accommodates a barcode label that informs the barcode reader that the segment is empty if no sample rack or well plate is installed. See Carousel (▷ page 44).

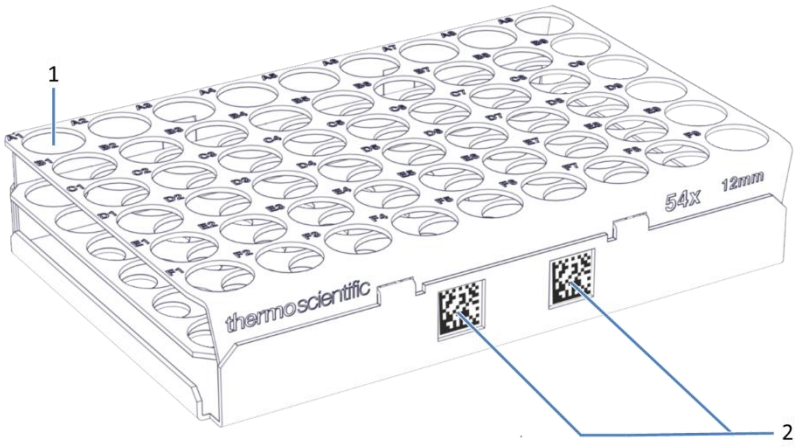

Figure 13: Sample rack with barcodes for rack type identification

No.	Description
1	Position A1
2	Vanquish rack type barcode

3.4.4 Condensation Drainage

A leak sensor is embedded inside the fraction collector compartment. The sensor detects liquid accumulated inside the fraction collector compartment due condensing water when the device is operated in cooling mode under humid conditions.

If liquid is detected, the drain pump is triggered immediately to transfer the liquid to the drain port, from which the liquid is guided to the waste reservoir through the drain system of the Vanquish system. If the liquid is drained and the sensor gets dry, then the drain pump will resume idle state. For more details, see Messages (Code 9004) (▷ page 214).

3.5 Leak Detection

Leaks are a potential safety issue.

The front leak sensor monitors for liquid leaks from the flow connections. The liquid is collected in the front leak tray and guided to the drain port. From the drain port, the liquid is guided to waste through the drain system of the Vanquish system.

When the front leak sensor detects leakage, the status indicators change to red and beeping starts to alert you. Follow the instructions in this manual to find and eliminate the source for the leakage. For more details, see Resolving Front Leakage (▷ page 221).

3.6 Operation

The device is designed to be operated from a computer configured with the Chromeleon Chromatography Data System (CDS). The Chromeleon software provides complete instrument control, data acquisition, and data management.

For general information how to set up a system in Chromeleon, refer to the *Chromeleon Installation Guide*. For information about setting up the Vanquish system in Chromeleon, refer to the *Vanquish System Operating Manual*. Details on control and operation of the device are available in the *Chromeleon Help* and the Technical Note 72940.

A keypad is available inside the device, allowing you to perform certain basic functions directly from the device.

4 Unpacking and Transport

This chapter provides information for unpacking the device and informs you about the scope of delivery.

4.1 Unpacking the Device

Damaged Packaging, Defective on Arrival

Inspect the shipping container for signs of external damage and, after unpacking, inspect the device for any signs of mechanical damage that might have occurred during shipment.

If you suspect that the device may have been damaged during shipment, immediately notify the incoming carrier and Thermo Fisher Scientific about the damage. Shipping insurance will compensate for the damage only if reported immediately.

CAUTION—Heavy Load, Bulky device

The device is too heavy or bulky for one person alone to handle safely. To avoid personal injury or damage to the device, observe the following guidelines:

- Physical handling of the device, including lifting or moving, requires a team effort of two persons.
- A team effort is in particular required when lifting the device into the system stack or when removing it.
- Use the carrying handles that were shipped with the device to move or transport the device. Never move or lift the device by the front doors. This will damage the doors or the device.

Tools required

Screwdriver, Torx® T20

Follow these steps

1. Place the shipping container on the floor and open it.
2. Remove the ship kit from the shipping container.
3. Remove the device from the shipping container: Grasp the device by the carrying handles. Slowly and carefully, lift the device out of the shipping container.

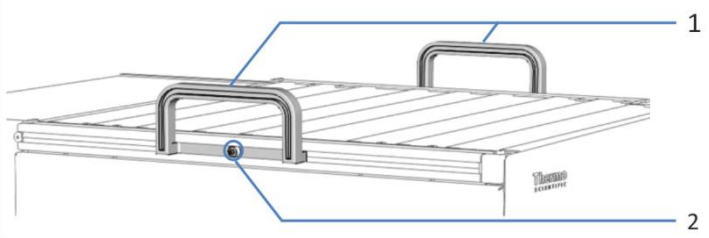

Figure 14: Carrying handles on the device

No.	Component
1	Carrying handles
2	Attachment screw (one on each carrying handle)

4. Place the device on a stable surface.
5. *If applicable*

   Remove any additional packing material. Leave any protective films attached to the surfaces of the device until it is properly positioned in the system stack.
6. Transport the device by the carrying handles to the installation site, if it is not already there, and place it in the system stack. See System Arrangement (▸ Page 63).
7. On each carrying handle, loosen the attachment screw until the carrying handle is moveable in the rail. Do not remove the screws from the carrying handles completely.
8. Slide off the carrying handles from the rails towards the rear of the device.

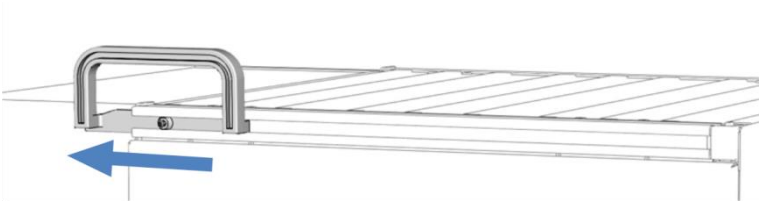

Figure 15: Sliding off the carrying handle from the left rail

TIP Keep the shipping container, the carrying handles with the attachment screws, and all packing material. These items will be needed if the device is transported to a new location or shipped.

9. Some surfaces including the doors of the device are covered by a protective film during shipment. Remove the protective film from all surfaces as applicable.

10. Remove any remaining shipping locks or protective covers from the fraction collector as required. Shipping locks are marked for removal.

Remove the shipping locks and protection foams

1. Remove two white protective foams from R and G segments of the carousel.

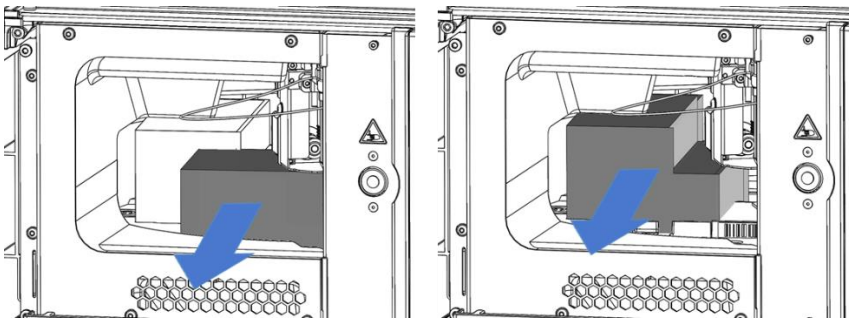

Figure 16: Remove two carousel protection foams

2. Remove the shipping lock fixing needle arm. Unscrew three screws on the shipping lock completely with the screwdriver, then remove the shipping lock.

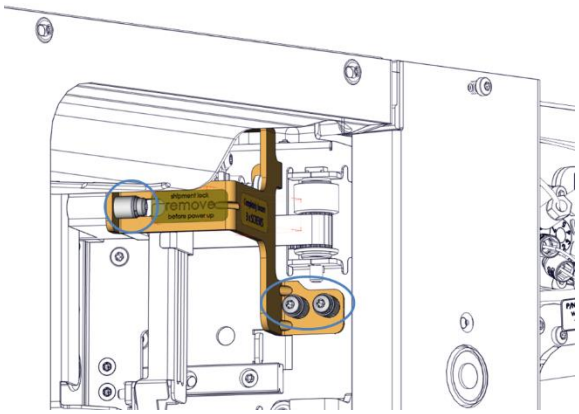

Figure 17: Remove needle arm shipping lock

3. Remove the shipping lock fixing carousel.

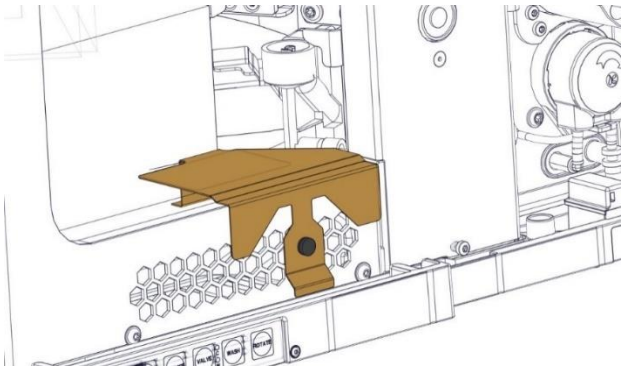

Figure 18: Remove carousel shipping lock

4.2 Scope of Delivery

The following items are included in the delivery:

- Fraction collector
- Ship kit
  For details about the kit content, see Ship Kit (▷ page 241).
- Safety notes and test report

5 Installation

This chapter specifies the requirements for the installation site and describes how to set up, install, and configure the device in the Vanquish system and in the chromatography software.

5.1 Safety Guidelines for Installation

Pay attention to the following safety guidelines:

Observe all warning messages and precautionary statements presented in Safety Precautions (page 23).

WARNING—Sharp Tip of the Needle

The needle has a sharp tip that can cause injury to the skin.

To avoid personal injury, never touch the needle tip.

CAUTION—Heavy Load, Bulky device

The device is too heavy or bulky for one person alone to handle safely. To avoid personal injury or damage to the device, observe the following guidelines:

- Physical handling of the device, including lifting or moving, requires a team effort of two persons.
- A team effort is in particular required when lifting the device into the system stack or when removing it.
- Use the carrying handles that were shipped with the device to move or transport the device. Never move or lift the device by the front doors. This will damage the doors or the device.

CAUTION—Electric Shock or Damage to the Device

After the power to the device is turned off, the device is still energized as long as the power cord is connected. Repair work on the device while the device is connected to power could lead to personal injury.

- Always unplug the power cord before starting repair work inside the device.
- If you were instructed to remove any housing covers or panels, do mot connect the power cord to the device while the cover or panels are removed.

5.2 Installing the Device

The Vanquish system is installed and set up by a Thermo Fisher Scientific service engineer, including all modules and options or parts shipped with them. The service engineer checks that the installation is correct and that the Vanquish system and modules operate as specified. The engineer also demonstrates the basic operation and main features.

If personnel other than a Thermo Fisher Scientific service engineer installs the device, follow the steps below.

1. Pay attention to the safety guidelines and observe all site requirements. See Safety Guidelines for Installation (▷ page 56) and Site Requirements (▷ page 59).
2. Set up the device hardware. See Setting Up the Hardware (▷ page 63).
3. Set up the flow connections. See Setting Up the Flow Connections (▷ page 68).
4. Turn on the device

TIP Before turning on the power to a Vanquish system module for the first time, verify that the chromatography software is installed on the data system computer. When the power is turned on, the required USB drivers are automatically found and the Windows® operating system can detect the device.

5. Set up the device in the software. See Setting Up the Device in the Software (▷ page 95).
6. *Recommended:*

   Perform Instrument Installation Qualification.

   Follow the instructions in the *Instruments Installation Qualification Operating Instructions*. The manual provides information about the required materials and detailed instructions.
7. *Recommended:*

   Perform Operational Qualification.

   The qualification kit includes all materials required for the qualification and detailed instructions.

Moving the device after Installation

If you have to move the device after it has been set up and installed in the Vanquish system, prepare the device for transport and move it to the new location. Follow the instructions in Transporting or Shipping the Device (▸ page 201).

TIP When the power is turned off to the device, the left front door of the device is opened automatically for proper ventilation of the fraction collector compartment and cannot be closed while the power is turned off.

5.3 Site Requirements

The operating environment is important to ensure optimal performance of the device. This section provides important requirements for the installation site. Note the following:

- Operate the device only under appropriate laboratory conditions.
- The device is intended to be part of the Vanquish system. Observe the site requirements for the Vanquish system as stated in the Vanquish System *Operating Manual*.
- For specifications, see Specifications (▷ page 233) in this operating manual and the Operating Manuals for the other modules in the Vanquish system.
- For general residual hazards, see General Residual Hazards (▷ Page 26).

5.3.1 Power Considerations

The power supply of the device has wide-ranging capability, accepting any line voltage in the range specified for the device.

CAUTION—Electric Shock or Damage to the device

- Connecting the device to a line voltage higher or lower than specified could result in personal injury or damage to the device.
- Connect the device to the specified line voltage only.
- Never connect the device to a power socket that is shared with other equipment (for example, multiple sockets).
- Do not use extensions cords.
- After the power to the device is turned off, the device is still energized as long as the power cord is connected. Repair work on the device while the device is connected to power could lead to personal injury. Therefore, always unplug the power cord before starting repair work inside the device. If you were instructed to remove any covers or panels, do not connect the power cord to the device while the cover or panels are removed.

5.3.2 Power Cord

The power cords are designed to match the wall socket requirements of the country in which they are used. The end of the power cords that plugs into the power socket on the device is identical for all power cords. The end of the power cords that plugs into the wall socket is different.

WARNING—Electric Shock or Damage to the device

Never use a power cord other than the power cords provided by Thermo Fisher Scientific for the device.

- Only use a power cord that is designed for the country in which you use the device.
- Do not use extensions cords.
- Never plug the power cord to a power socket that is shared with other equipment (for example, multiple sockets).
- Operate the device only from a power outlet that has a protective ground connection.
- In case of emergency, it must be possible to reach the power cord easily at any time to disconnect the device from the power line.

WARNING—Electric Shock or Damage to a Product

Misuse of the power cords could cause personal injury or damage the instrument. Use the power cords provided by Thermo Fisher Scientific only for the purpose for which they are intended. Do not use them for any other purpose, for example, for connecting other instruments.

5.3.3 Condensation

NOTICE—Condensation in the device can damage the electronics.

- When using, shipping, or storing the device, avoid or minimize conditions that can lead to a build-up of condensation in the device. For example, avoid significant or fast changes in environmental conditions.
- If you suspect that condensation is present, allow the device to warm up to room temperature. This may take several hours. Wait until the condensation is gone completely before connecting the device to the power line.

5.4 Accessing the Interior Components

Opening the Front Doors

To access the interior components in the device, open the front doors. To allow easy access from the front, the user-accessible components and flow connections in the device are located directly behind the doors.

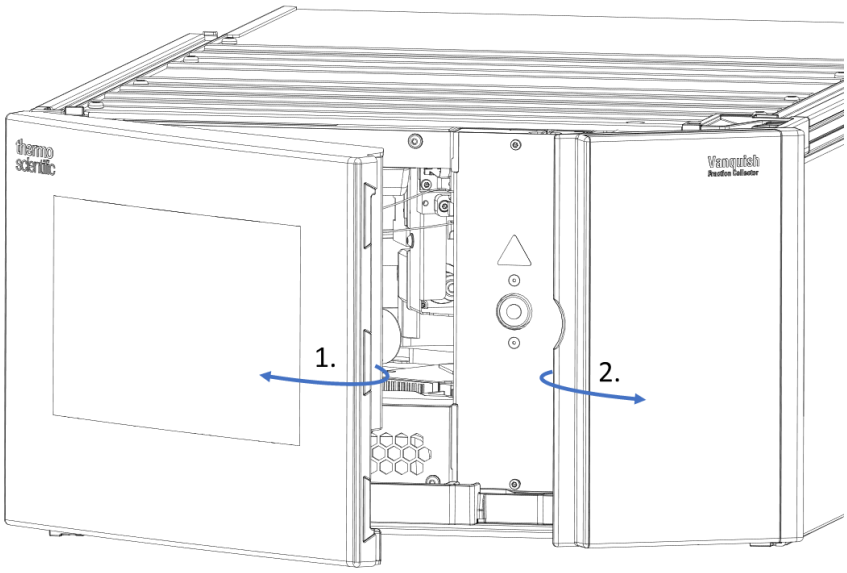

Figure 19: Opening the front doors

Front Door Opening Mechanism

The left front door of the device is equipped with a mechanism that opens the door automatically for proper ventilation of the fraction collector compartment when the device is turned off.

When the device is turned on, the left front door can be closed. If a power failure occurs or if the power cord is disconnected while the device has been turned on, the mechanism opens the left front door automatically.

5.5 Setting Up the Hardware

This section describes how to set up the hardware and provides information about the device connectors and cables.

5.5.1 System Arrangement

The device is part of the Vanquish system. The system modules are arranged in a system stack, with the arrangement depending on the system configuration and the lab environment. For reducing the overall height of the system, a two-stack configuration is recommended. Two stacks require a second System Base. A second Solvent Rack can be added optionally.

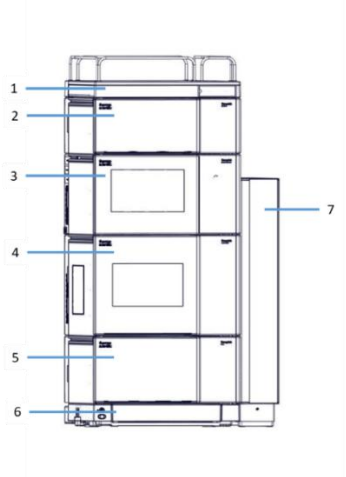

Figure 20: Vanquish system, standard configuration (examples): left - one stack, right - two stacks

No.	Description	No.	Description
1	Solvent Rack	5	Pump
2	Detector	6	System Base
3	Fraction Collector	7	Column Compartment
4	Autosampler		

WARNING—Risk of tilting system stack

As for one stack configuration, the overall height exceeds 100 cm. It is required to use a stack stabilizer kit to prevent any potential risk of tilting for the one stack configuration.

For instructions how to set up the system stack, refer to the *Vanquish System Operating Manual*.

5.5.2 Connecting the Device

Device Connectors

The following connectors are provided on the device:

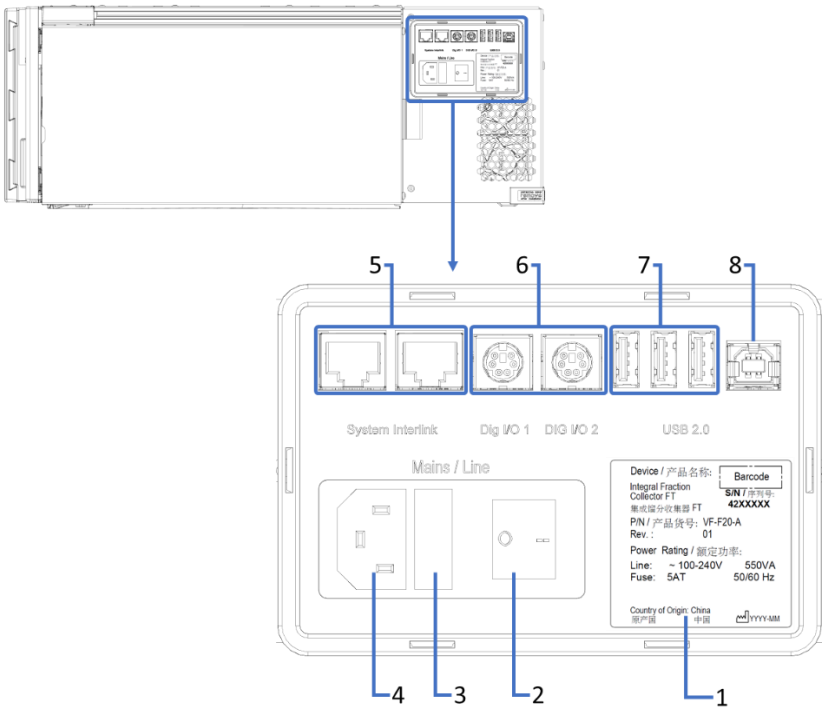

Figure 21: Electrical connectors on the right side of the device

No.	Description
1	Rating plate, indicating serial number, part number, module name, revision number (if any), line and fuse rating, and the manufacturer's address
2	Main power switch (on/off control)
3	Fuse holder
4	Power-inlet connector
5	System Interlink port Only allows power on/off control for the device from the Vanquish system base and device communication so far.
6	Digital I/O ports (Dig I/O) Allow exchange of digital signals with external instruments Each digital I/O port provides one input and one relay output. For debugging purposes only.
7	USB hub ("A" type connector) Allows connection to other modules in the Vanquish system
8	USB (Universal Serial Bus) port ("B" type connector) Allows connection to other modules in the Vanquish system or the computer on which the data management system is installed, such as the Chromeleon software

TIP Thermo Fisher Scientific recommends using the USB ports only as described above. If the USB ports are used for any other purpose, Thermo Fisher Scientific cannot ensure proper functionality.

Connecting the USB and system interlink cables

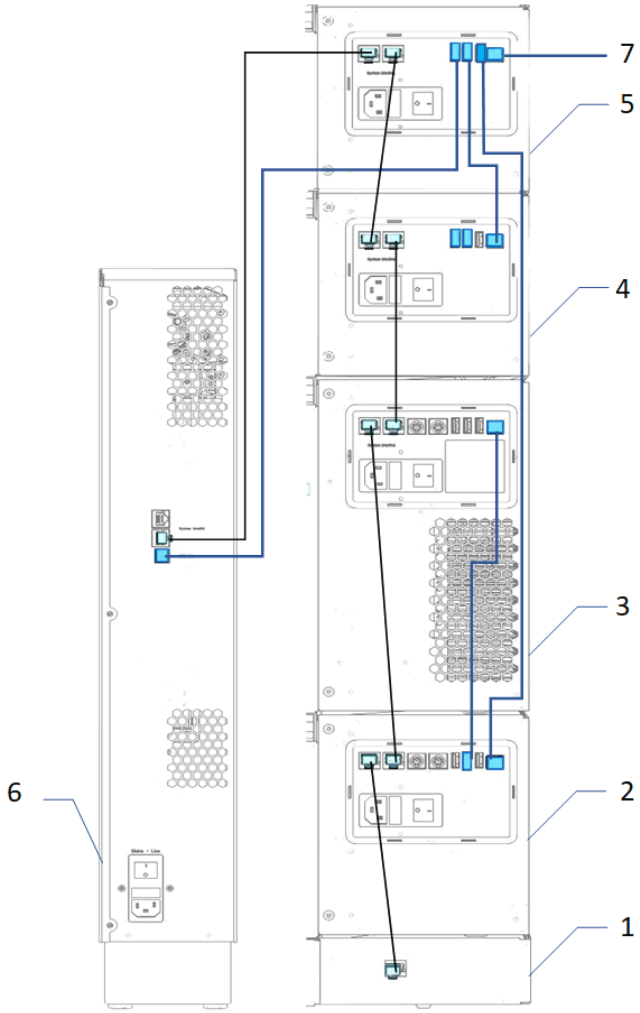

Figure 22: USB and system interlink cable connections

No.	Description
1	System Base
2	Pump
3	Autosampler
4	Fraction Collector
5	Detector
6	Column Compartment
7	Connection to computer

Follow these steps

NOTICE

- Never use defective communication cables. If you suspect that a cable is defective, replace the cable.
- To ensure trouble-free operation, use only the cables provided by Thermo Fisher Scientific for connecting the device.

1. Place the device in the system as required by the system configuration. For details, refer to System Arrangement (▶ Page 63).
2. Connect the required interface cables to the device. For information about how to connect the device to other modules in the Vanquish system or to the chromatography data system computer, refer to *the Vanquish System Operating Manual.*
3. Verify that the power switch on the device is set to OFF.
4. Connect the power cord to the power-inlet connector on the device.

NOTICE

Before connecting the device to the power line, be sure that no condensation is present in the device. Condensation in the device can damage the electronics. If you suspect that condensation is present, allow the device to warm up to room temperature. This may take several hours. Wait until the condensation is completely gone before proceeding.

5. Connect the free end of the power cord to an appropriate power source.

5.6 Setting Up the Flow Connections

This section describes how to set up the flow connections to and from the device and additional flow connections if required.

5.6.1 General Information and Guidelines

Certain flow connections between components on the fraction collector are already installed when the device is shipped.

When setting up the flow connections, follow these rules and recommendations:

Flow connections can be filled with hazardous substances. Observe the warning messages and precautionary statements presented in Safety Precautions (▸ page 23).

- Dirty components can contaminate the chromatography system. Contamination leads to poor performance of the modules and entire system or can even cause damage to the modules and system. Therefore:
  - Always wear appropriate gloves.
  - Place the components only on a clean, lint-free surface.
  - Keep your tools clean.
  - Use only lint-free cloth for cleaning.
- For installation instructions and guidelines and for handling recommendations, see Connecting Fittings, Capillaries, and Tubing (▸ page 71).

NOTICE
When you install devices or components to the system, always flush them to waste before connecting them in the system flow path. To flush the Vanquish modules, follow the instructions in the *Vanquish System Operating Manual*.

TIP Components or connections in the flow path to other system modules may be closed with plugs to protect the component or connection during transport.
When you remove the plugs to connect the device in the system, keep the plugs. You may need them to close the connections again, for example, for future transport.

Follow these steps

To set up the additional flow connections and complete the installation, follow these steps:

1. Connect the device to the drain system. see Guiding Liquids to Waste (▸ page 79).
2. Connect the needle wash reservoir. See Connecting the Needle Wash Reservoir (▸ page 82).
3. Set up the fraction collection valve connections. See Fraction Collection Valve (▸ page 86).

5.6.2 Guiding Capillaries and Tubing Through the System

Flow connections between the modules of the Vanquish system are guided through either the tubing chase in the devices or the guide holes or capillary clips of the devices.

Tubing Chase, Tubing Guide, Tubing Bracket

To guide certain tubing and lines (solvent tubing, wash liquid tubing, detector waste line) from the top module to the bottom module in the Vanquish system stack, the stackable modules have a tubing chase on the inside right.

The tubing chase provides four tubing guides. Each guide can hold up to three tubing or lines.

In each module, push the tubing (or line) into the appropriate guide.

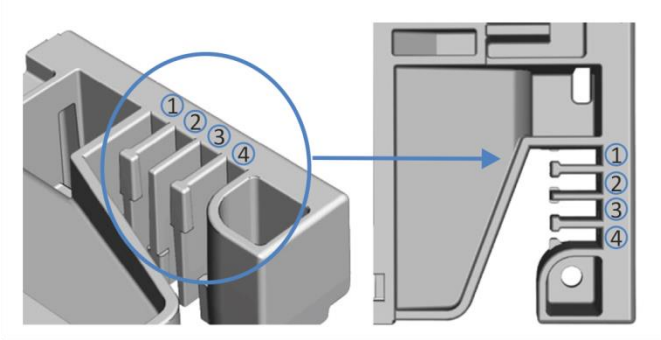

Figure 23: Tubing chase with tubing guides (left: view from inside, right: view from top)

No.	Use for
1	Solvent tubing (up to three solvent lines, preferably routed to the upper degas chambers)
2	Solvent tubing (up to three solvent lines)
3	Wash liquid tubing (Autosampler seal wash, fraction collector needle wash)
4	Detector and fraction collector waste lines

Tubing brackets are available for holding the tubing in place. Slip the bracket side onto the drain pipe.

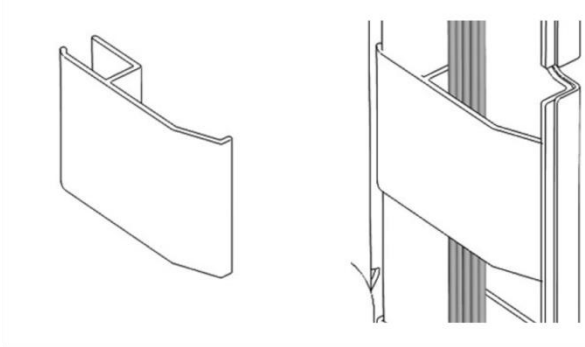

Figure 24: Tubing bracket (left), tubing bracket installed (right)

Guide Holes and Capillary Clips

Guide holes and capillary clips are provided at specific positions on the system modules. Route flow connections from one module to the next module in the Vanquish system through the appropriate guide hole or capillary clip when instructed to do so in the manual.

5.6.3 Connecting Fittings, Capillaries, and Tubing

This section provides information about how to connect and handle capillaries, fittings, and tubing.

5.6.3.1 General Guidelines

When connecting capillaries and tubing, follow these general recommendations:

- Use only the capillaries and tubing (for example, solvent lines or waste lines) that are shipped with the device or additional or spare capillaries and tubing as recommended by Thermo Fisher Scientific.
- The connectors must be free from contaminants. Even minor particles may cause damage to the system or lead to invalid test results.
- Do not install capillaries or tubing that is stressed, nicked, kinked, or otherwise damaged.
- Install capillaries and fittings only at the positions for which they are intended.

5.6.3.2 Connecting Delay Capillary and Waste Line

A delay capillary is used to connect HPLC detector outlet and fraction collection valve central port (Inlet).

A detector waste line is shipped with HPLC detector. However, if a fraction collector is installed in the HPLC system, the waste line will be used to connect with the Y-connector outlet of the fraction collector and routed to waste reservoir.

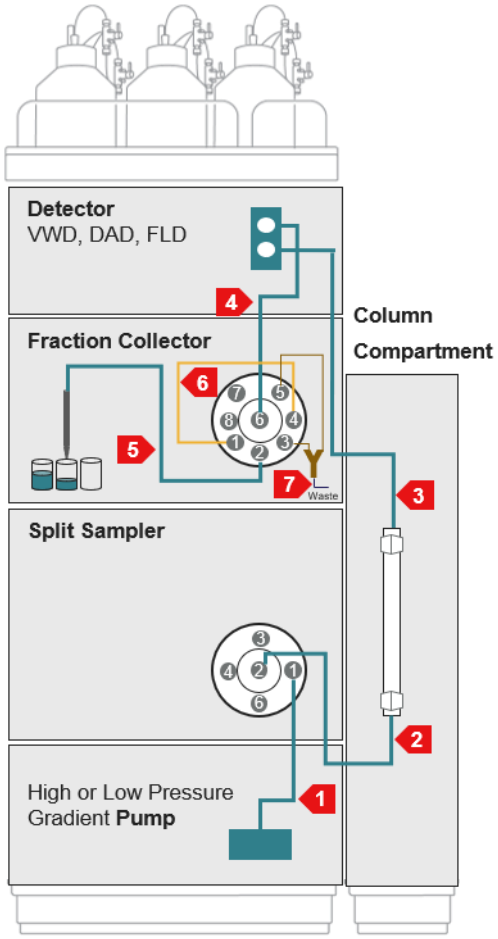

Figure 25: Flow path connection in a one stack configuration

For a one stack configuration with a *Vanquish Horizon or Flex UHPLC system* the flow path connection are as follows:

No.	Description	Shipped with
1	0.10 x 350 mm, MP35N	System Base Vanquish Horizon/Flex
2	Active or passive pre-heater, MP35N	System Base Vanquish Horizon/Flex
3	**Depending on detector:** • 0.10 x 300 mm, MP35N, insulated or Post Cooler • 0.10 x 300 mm, MP35N • 0.10 x 350 mm, MP35N • 0.10 x 450 mm, MP35N	• Diode Array Detector HL • Diode Array Detector FG • Variable Wavelength Detector F • Fluorescence Detector F & D-PMT
4	**Depending on fraction collection mode and flow rate** *Delay capillary for time-based fractionation:* • Up to 2 mL/min: 0.1 x 350 mm, MP35N • 2 - 10 mL/min: 0.18 x 350 mm, MP35N	Integral Fraction Collector FT
	Delay capillaries for peak-based fractionation • Up to 0.5 mL/min: 0.18 x 1200 mm, MP35N • 0.5 - 1 mL/min: 0.25 x 1500 mm, MP35N • 1 - 2 mL/min: 0.5 x 800 mm, PEEK • 2 - 10 mL/min: 1 x 1000 mm, PEEK	Optional, needs be ordered separately
5	**Depending on flow rate** Needle capillary for up to 5 mL/min, 0.18 x 415 mm, PEEK	Integral Fraction Collector FT
	Needle capillary for 5 - 10 mL/min, 0.25 x 415 mm, PEEK	Optional, needs be ordered separately
6	**Depending on flow rate** Flush buffer loop for up to 5 mL/min, 50 µL, PEEK	Integral Fraction Collector FT
	Flush buffer loop for 5 - 10 mL/min, 100 µL, PEEK	Optional, needs be ordered separately
7	Waste line	Detector

For a one stack configuration with a *Vanquish Core HPLC system* the flow path connection are as follows:

No.	Description	Shipped with
1	0.18 x 350mm, SST	System Base Vanquish Core
2	Passive pre-heater, SST	System Base Vanquish Core
3	**Depending on detector:** • 0.13 x 300 mm, SST • 0.13 x 300 mm, SST • 0.13 x 350 mm, SST • 0.13 x 450 mm, SST	• Diode Array Detector CG • Multiple Wavelength Detector CG • Variable Wavelength Detector C • Fluorescence Detector C & D-PMT
4	**Depending on fraction collection mode and flow rate** *Delay capillary for time-based fractionation:* • Up to 2 mL/min: 0.1 x 350 mm, MP35N • 2 - 10 mL/min: 0.18 x 350 mm, MP35N	Integral Fraction Collector FT
	Delay capillaries for peak-based fractionation • Up to 0.5 mL/min: 0.18 x 1200 mm, MP35N • 0.5 - 1 mL/min: 0.25 x 1500 mm, MP35N • 1 - 2 mL/min: 0.5 x 800 mm, PEEK • 2 - 10 mL/min: 1 x 1000 mm, PEEK	Optional, needs be ordered separately
5	**Depending on flow rate** Needle capillary for up to 5 mL/min, 0.18 mm, PEEK	Integral Fraction Collector FT
	Needle capillary for 5 - 10 mL/min, 0.25 mm, PEEK	Optional, needs be ordered separately
6	**Depending on flow rate** Flush buffer loop for up to 5 mL/min, 50 µL, PEEK	Integral Fraction Collector FT
	Flush buffer loop for 5 - 10 mL/min, 100 µL, PEEK	Optional, needs be ordered separately
7	Waste line	Detector

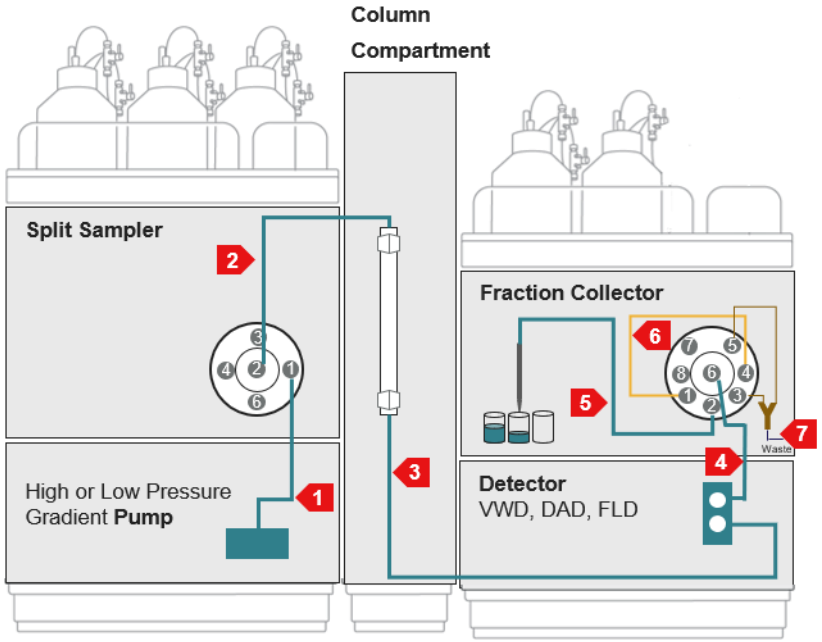

Figure 26: Flow path connection in a two stacks configuration

For a two stacks configuration with a *Vanquish Horizon or Flex UHPLC system* the flow path connection are as follows:

No.	Description	Shipped with
1	0.10 x 350 mm, MP35N	System Base Vanquish Horizon/Flex
2	Active or passive pre-heater, MP35N	System Base Vanquish Horizon/Flex
3	**Depending on flow rate:** • Up to 2 mL/min: 0.1 x 550 mm, MP35N • 2 - 10 mL/min: 0.18 x 550 mm, MP35N	Integral Fraction Collector FT
4	**Depending on fraction collection mode and flow rate** *Delay capillary for time-based fractionation:* • Up to 2 mL/min: 0.1 x 350 mm, MP35N • 2 - 10 mL/min: 0.18 x 350 mm, MP35N	Integral Fraction Collector FT
	Delay capillaries for peak-based fractionation • Up to 0.5 mL/min: 0.18 x 1200 mm, MP35N • 0.5 - 1 mL/min: 0.25 x 1500 mm, MP35N • 1 - 2 mL/min: 0.5 x 800 mm, PEEK • 2 - 10 mL/min: 1 x 1000 mm, PEEK	Optional, needs be ordered separately
5	**Depending on flow rate** Needle capillary for up to 5 mL/min, 0.18 x 415 mm, PEEK	Integral Fraction Collector FT
	Needle capillary for 5 - 10 mL/min, 0.25 x 415 mm, PEEK	Optional, needs be ordered separately
6	**Depending on flow rate** Flush buffer loop for up to 5 mL/min, 50 µL, PEEK	Integral Fraction Collector FT
	Flush buffer loop for 5 - 10 mL/min, 100 µL, PEEK	Optional, needs be ordered separately
7	Waste line	Detector

For a two stacks configuration with a *Vanquish Core HPLC system* the flow path connection are as follows:

No.	Description	Shipped with
1	0.18 x 350mm, SST	System Base Vanquish Core
2	Passive pre-heater, SST	System Base Vanquish Core
3	**Depending on flow rate:** • Up to 2 mL/min: 0.1 x 550 mm, MP35N • 2 - 10 mL/min: 0.18 x 550 mm, MP35N	Integral Fraction Collector FT
4	**Depending on fraction collection mode and flow rate** *Delay capillary for time-based fractionation:* • Up to 2 mL/min: 0.1 x 350 mm, MP35N • 2 - 10 mL/min: 0.18 x 350 mm, MP35N	Integral Fraction Collector FT
	Delay capillaries for peak-based fractionation • Up to 0.5 mL/min: 0.18 x 1200 mm, MP35N • 0.5 - 1 mL/min: 0.25 x 1500 mm, MP35N • 1 - 2 mL/min: 0.5 x 800 mm, PEEK • 2 - 10 mL/min: 1 x 1000 mm, PEEK	Optional, needs be ordered separately
5	**Depending on flow rate** Needle capillary for up to 5 mL/min, 0.18 mm, PEEK	Integral Fraction Collector FT
	Needle capillary for 5 - 10 mL/min, 0.25 mm, PEEK	Optional, needs be ordered separately
6	**Depending on flow rate** Flush buffer loop for up to 5 mL/min, 50 µL, PEEK	Integral Fraction Collector FT
	Flush buffer loop for 5 - 10 mL/min, 100 µL, PEEK	Optional, needs be ordered separately
7	Waste line	Detector

5.6.3.3 *Connecting Viper Capillaries*

This section describes how to connect Viper™ capillaries. All Viper flow connections in the Vanquish system are designed to be finger-tight.

To connect Viper capillaries with knurl, follow these steps:

NOTICE

- Tighten or loosen Viper capillaries *only* with your fingers. Do not use tools other than the knurl that comes with the capillary.
- To avoid damage to the capillary or connection, tighten and loosen the Viper capillaries only when the system pressure is down to zero.

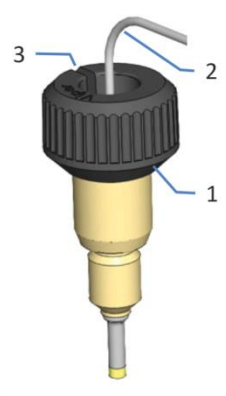

Figure 27: Viper fitting with knurl

No.	Description
1	Knurl
2	Capillary
3	Slot

1. Insert the Viper capillary into the connection port.
2. Tighten the connection by the knurl.

TIP Note the slot in the knurl. For narrow connections, you can easily remove the knurls from neighboring capillaries through this slot and attach them again later.

3. Check whether the connection leaks. If leakage exists, follow the steps further down.

Resolving Leakage of Viper Fittings with Knurls

1. Resolving Leakage of Viper Fittings with Knurls
2. Tighten the connection a little more.

3. If leakage continues, remove the capillary.
4. Clean the capillary ends carefully by using a lint-free tissue wetted with isopropanol.
5. Reinstall the capillary.
6. If the connection continues to leak, install a new Viper capillary.

5.6.4 Guiding Liquids to Waste

Waste liquids from the needle wash system and the drain pump in the device are routed through separate drain ports directly into the drain system.

Leaking liquids of the device are collected in the leak tray and flow off through the funnel at the bottom right of the leak tray into the drain system.

A waste line is connected to the fraction collector Y-connector, then route the waste line through the tubing guides of the system modules to the Vanquish system base. On the system base, route the waste line through the dedicated waste outlet and connect the waste line to the waste container as described in the *Vanquish System Operating Manual.*

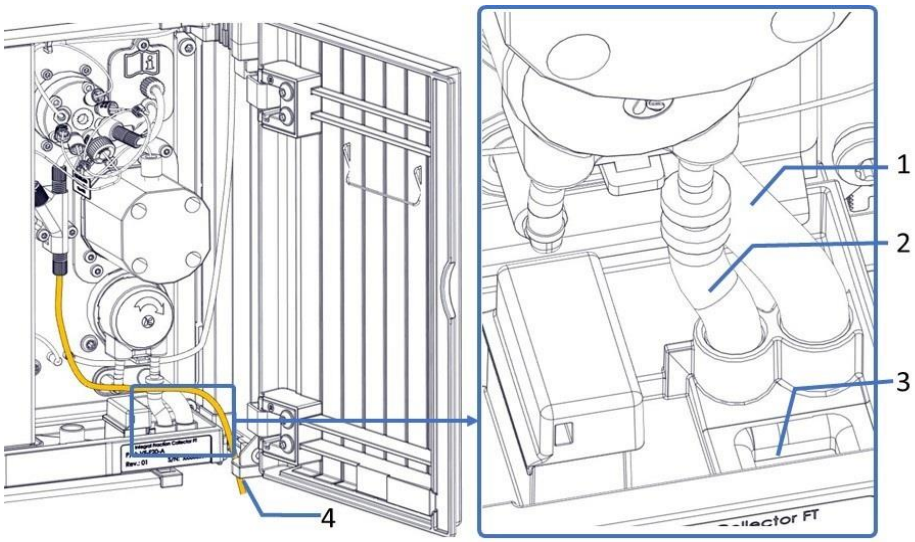

Figure 28: Drain ports in the leak tray and waste line from Y-connector to waste container

No.	Description
1	Drain port for needle wash system
2	Drain port for drain pump
3	Funnel to drain system
4	Waste line from the device Y-connector to waste container

TIP If you have to cut tubing to length, use a tubing cutter. Make sure that the cut is at right angle to the length of the line.
The waste line should go straight to the system base and to waste. Make sure that the line is positioned straight in the tubing guides.

5.7 Needle Wash System

The device is equipped with a needle wash system, which consists of needle wash reservoir, needle wash pump, needle wash lines, needle wash port and waste line. When the device is shipped, the needle wash components are installed within the device.

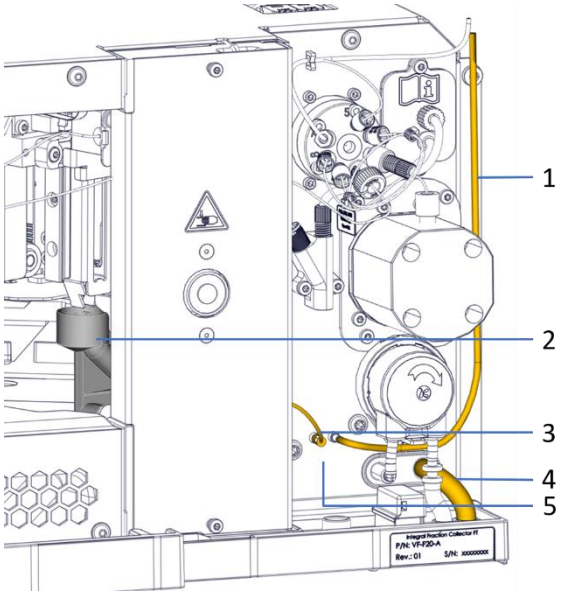

Figure 29: Needle wash components in the device

No.	Description
1	Needle wash inlet line (up to needle wash reservoir)
2	Needle wash port
3	Needle wash outlet line (from wash pump outlet to needle wash port)
4	Needle wash waste line
5	Needle wash pump (installed behind the panel)

5.7.1 Choosing the Needle Wash Liquid

Use needle wash liquid that fulfills the following requirements:

- Before filling the needle wash reservoir, rinse the reservoir thoroughly. Make sure that no particles, dust or algae are present.
- *Recommendation: 10% methanol in water.*

  when using 100% water as needle wash liquid:
  Replace the needle wash liquid daily.
- Use a needle wash liquid that is suitable for your application and that removes residual sample from the needle sufficiently.

After shipment of the device

Check if the needle wash waste line is properly connected to the drain port and has not popped out during shipment of the device.

5.7.2 Connecting the Needle Wash Reservoir

Parts and tools required

- Needle wash reservoir
- Needle wash inlet line (the silicon tubing)
- Retaining guide (1/8'')
- Reservoir cap
- Cap plugs
- Tubing cutter (optional)

Preparations

Prepare the needle wash liquid and needle wash reservoir. Observe the needle wash liquid guidelines in Choosing the Needle Wash Liquid (page 82).

Follow these steps

Setting up the needle wash system comprises the following steps:

1. Setting up the needle wash line in the fraction collector.

2. Connecting the needle wash reservoir.

3. Purging the needle wash system.

Follow the steps in the respective sections further down.

Setting up the Needle Wash Line in the Fraction Collector

1. Connect the needle wash line to the needle wash pump outlet port in the device.

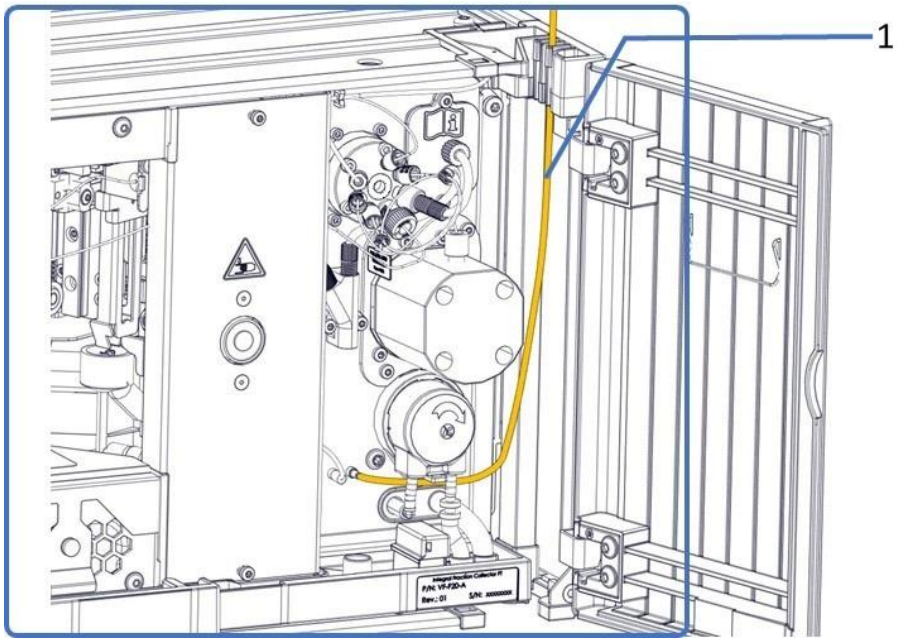

Figure 30: Needle wash line connection

No.	Description
1	Needle wash line (up to needle wash reservoir)

2. Route the needle wash inlet line from the device to the solvent rack, through the tubing guides of the modules and the guide hole in the solvent rack.

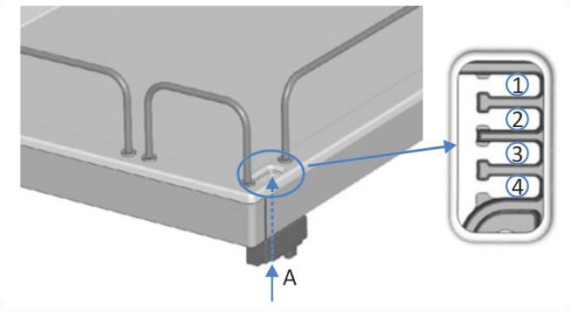

Figure 31: Guide hole and tubing guides in the solvent rack

No.	Description
A	Guide hole
1+2	Not to be used for wash liquid line; reserved for other tubing
3	Tubing guide for wash liquid line
4	Not to be used for wash liquid line; reserved for other tubing

Connecting the Needle Wash Inlet Line to the Needle Wash Reservoir

1. Connect the needle wash reservoir to the line:

   a) Rinse the needle wash reservoir thoroughly with a high-purity solvent.

   b) Fill the needle wash reservoir with fresh needle wash liquid.

   c) Feed the needle wash line through the retaining guide and through an open hole in the cap of the needle wash reservoir. The retaining guide keeps the tubing in place in the reservoir. Close any open holes in the reservoir cap with cap plugs.

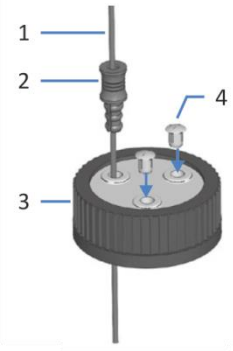

Figure 32: Securing the needle wash line with the reservoir cap

No.	Description	No.	Description
1	Needle wash inlet line	3	Reservoir cap
2	Retaining guide (1/8'')	4	Cap plugs

2. Fill the needle wash reservoir with needle wash liquid. Mind the requirements outlined in the previous section.
3. Tighten the reservoir cap hand-tight. Press the retaining guide into the hole in the reservoir cap to ensure that the tubing is kept in place in the cap.
4. Close any open holes in the reservoir cap with cap plugs.
5. Place the needle wash reservoir in the solvent rack. Position the needle wash line straight in the tubing guides.
6. Check the needle wash line across the entire flow path:
   a) Make sure the line is not bent, pinched or squeezed at any point in the flow path.
   b) If you have to cut tubing to length, use a tubing cutter. Make sure that the cut is at right angle to the length of the line.

Purging the Needle Wash System

After the device has been turned on, purge the needle wash system using Chromeleon to fill the needle wash port with the fresh needle wash liquid. During purging, the needle wash port is flushed continuously until the fresh needle wash liquid is present.

5.8 Fraction Collection Valve

There are three capillaries or tubing that are required to assembly to the fraction collection valve when installing the device for the first time.

- Flush Solvent tubing (to flush solvent reservoir)
- Delay capillary
- Needle capillary (to needle unit inside fraction collector compartment)

5.8.1 Port assignments of the Fraction Collection Valve

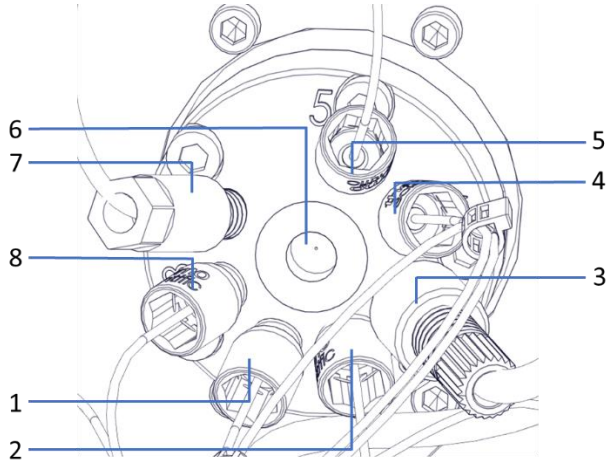

Figure 33: Fraction collection valve with connected capillaries except port 6

The fraction collection valve ports are assigned as follows:

Port	Connected Component	Port	Connected Component
1	to flush buffer loop (pre-installed)	5	to Y-connector (pre-installed)
2	to needle Capillary	6	Central port, inlet from detector
3	to Y-connector via air bubble sensor (pre-installed)	7	to flush solvent
4	to flush buffer loop (pre-installed)	8	to flush pump (pre-installed)

5.9 Flush System

5.9.1 Choosing the Flush Solvent

Use the flush solvent that fulfills the following requirements:

- Before filling the flush solvent reservoir, rinse the reservoir thoroughly. Make sure that no particles, dust or algae are present.
- *Recommendation: solvent A or A1, solvent B or B1, or a user defined separate combination of A(1) and B(1)*

  when using 100% water as flush solvent:
  Replace the flush solvent daily.
- Use a flush solvent that is suitable for your application and that removes residual fraction from the flush buffer loop sufficiently.

5.9.2 Connecting Flush Solvent Reservoir

Parts required

- Flush solvent reservoir
- Flush solvent tubing
- Retaining guide, 1/16''
- Solvent line filter
- Filter frit
- Solvent line adaptor (1/8'' - 1/16'')
- Reservoir cap
- Cap plugs

Preparations

1. Prepare the flush solvent and flush solvent reservoir. Observe the flush solvent guidelines in Choosing the Flush Solvent (▶ page 87).
2. Assemble the filter holder and solvent line adapter, wearing appropriate clean gloves.

   a) Place the frit in the filter holder (bottom part).

b) Make sure that the frit is in a level position.

c) Screw the filter top to the filter bottom.

d) Insert the solvent line adapter into the top hole of solvent line filter, top.

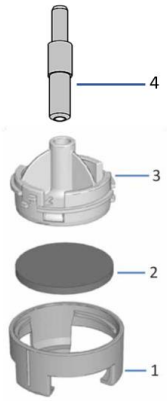

Figure 34: Assembling the filter holder and solvent line adapter

No.	Description
1	Solvent line filter, bottom holder
2	Solvent frit
3	Solvent line filter, top holder
4	Solvent line adapter, 1/16''

Follow these steps

Setting up the flush system comprises the following steps:

1. Setting up the flush solvent tubing in the fraction collector.
2. Connecting the flush solvent reservoir.
3. Purging the flush pump.

Follow the steps in the respective sections further down.

Setting up the Flush Solvent Tubing in the Fraction Collector

1. Connect the flush solvent tubing to the fraction collection valve port 7 and push the tubing into the tubing holder.

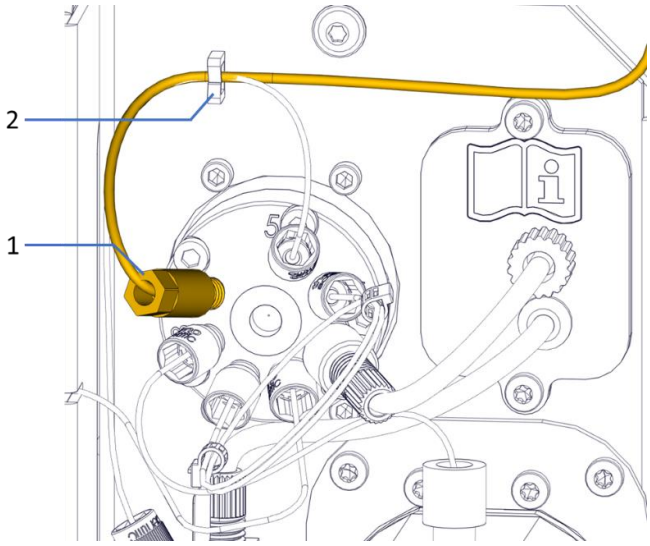

Figure 35: Holder for the flush solvent tubing

No.	Description
1	Flush Solvent Tubing
2	Tubing Holder

2. Route the flush solvent tubing from the device to the solvent rack, through the tubing guides of the modules and the guide hole in the solvent rack.

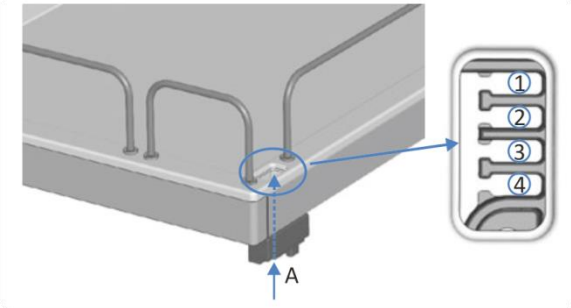

Figure 36: Guide hole and tubing guides in the solvent rack

No.	Description
A	Guide hole
1+2	Not to be used for wash liquid line; reserved for other tubing
3	Tubing guide for wash liquid line
4	Not to be used for wash liquid line; reserved for other tubing

Connecting the Flush Solvent Reservoir

1. Connect the flush solvent reservoir to the line:

   a) Rinse the flush solvent reservoir thoroughly with a high-purity solvent.

   b) Fill the flush solvent reservoir with fresh flush solvent.

   c) Feed the flush solvent tubing through the 1/16'' retaining guide and through an open hole in the cap of the flush solvent reservoir. The retaining guide keeps the tubing in place in the reservoir. Close any open holes in the reservoir cap with cap plugs.

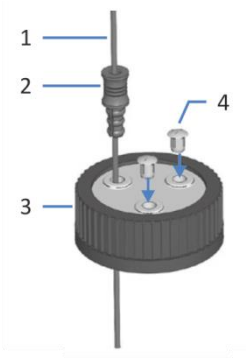

Figure 37: Securing the flush solvent tubing with the reservoir cap

No.	Description	No.	Description
1	Flush solvent tubing (OD 1/16'')	3	Reservoir cap
2	Retaining guide, 1/16''	4	Cap plugs

2. Close any open holes in the reservoir cap with cap plugs.
3. Slide the filter holder and adapter onto the end of the flush solvent tubing.
4. Tighten the reservoir cap hand-tight. Press the retaining guide into the hole in the reservoir cap to ensure that the tubing is kept in place in the cap.
5. Place the flush solvent reservoir in the solvent rack. Position the solvent lines straight in the flush solvent reservoir and tubing guides.
6. Check the flush solvent tubing across the entire flow path:

a) Make sure the tubing is not bent, pinched or squeezed at any point in the flow path.

b) If you have to cut tubing to length, use a tubing cutter. Make sure that the cut is at right angle to the length of the line.

Purging the Flush Pump

After the device has been turned on, purge the flush pump using Chromeleon to fill the flush pump with the fresh flush solvent. During purging, the flush pump and flush buffer loop are washed continuously until all flush purge lines are filled with the fresh flush solvent.

5.9.3 Connecting the Delay Capillary

Parts required

Delay Capillary

Follow these steps

1. Remove the detector waste line if it has been installed onto detector flow cell outlet or the outlet (OUT) on the flow cell connection unit.

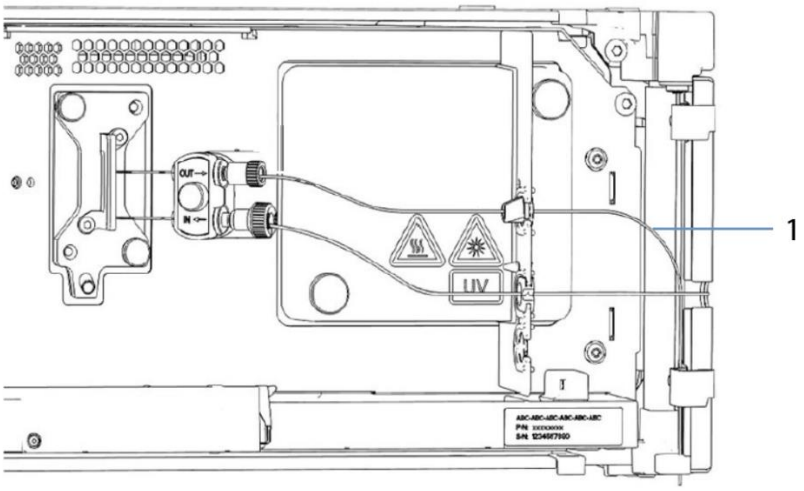

Figure 38: Removing the detector waste line

No.	Description
1	Detector waste line

2. Connect the delay capillary between the detector flow cell outlet or the outlet (OUT) on the flow cell connection unit and the fraction collection valve central port.

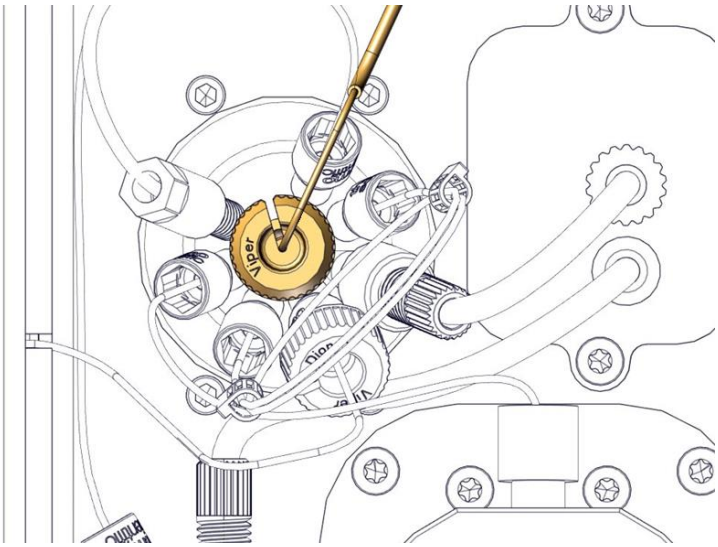

Figure 39: Connecting delay capillary to central port of fraction collection valve

3. Route the delay capillary through the recess in the partition panel of the detector.

4. Route the delay capillary between detector and the fraction collector depending on length of the delay capillary that is used.

5.9.4 Connecting the Flush Buffer Loop

Parts required

Needle capillary

TIP Make sure to check the flow rate of application and choose the proper needle capillary according to application flow rate range. Meanwhile, the installed flush buffer loop must be compatible with specific needle capillary. See below table for details.

Flow rate	Needle Capillary ID	Flush Buffer Loop Volume	Remark
0.05 – 5 mL/min	0.18 mm	50 µL	Included in ship kit
5 – 10 mL/min	0.25 mm	100 µL	Needs to be ordered separately

Tools required

Screwdriver, Torx T10

NOTICE

The device shall be powered off while replacing the needle capillary.

Follow these steps

Install the needle capillary. See Replacing the Needle Capillary (page 180).

NOTICE

Make sure no extra stress, damage and kink defects for needle capillary during the installation process.

5.10 Turning On the Device

NOTICE
The shipping locks must be properly unpacked before you turn on the device to avoid damage to the device.

TIP Before turning on the power to a Vanquish system module for the first time, verify that the chromatography software is installed on the data system computer. When the power is turned on, the required USB drivers are automatically found and the Windows® operating system can detect the device.

To turn on the power to the device, follow these steps:

1. Check that the power button on the front left of the Vanquish system base (system power button) is pressed in. If the power button stands out, press the power button to turn on the power on the system base.
2. Turn on the device with its main power switch.

Turn the device off with the main power switch, when instructed to do so, for example, during maintenance. Pressing the system power button will not be sufficient to turn off the power to the device completely.

For power on/off control during device operation, see Power On/Off Control (▶ page 105).

5.11 Setting Up the Device in the Software

This manual assumes that the chromatography software is already installed on the data system computer and a valid license is available.

For more information about setting up the *Vanquish system* in the software, refer to the *Vanquish System Operating Manual*.

The Help for the software that you are using provides detailed information about the settings on each property page.

Check the setting of the needle capillary

The **NeedleCapillary** property must be set correctly in the software according to needle capillary installed on device, see Connecting Fittings, Capillaries, and Tubing (▶ page 71). The needle capillary included in the default shipment is ID 0.18 mm. This is also the default setting for needle capillary in the Chromeleon.

If the needle capillary with ID 0.25 mm is installed the new capillary dimensions must be set in Chromeleon accordingly.

Follow these steps

1. Check the marker physically located on the needle capillary. It is either ID 0.18 mm or ID 0.25 mm. The default needle capillary installed in the device is ID 0.18 mm.

2. In Chromeleon Console click **Command** icon or press F8.

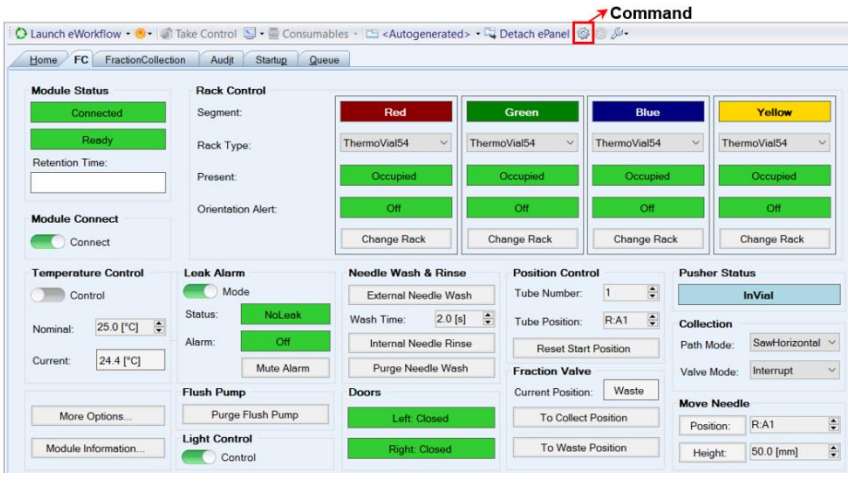

Figure 40: Selecting the Command configuration page

3. Find the **NeedleCapillary** parameter in Property and check if the correct needle capillary is set and select the correct needle capillary if required. The capillary marker on the needle capillary indicates the dimensions.

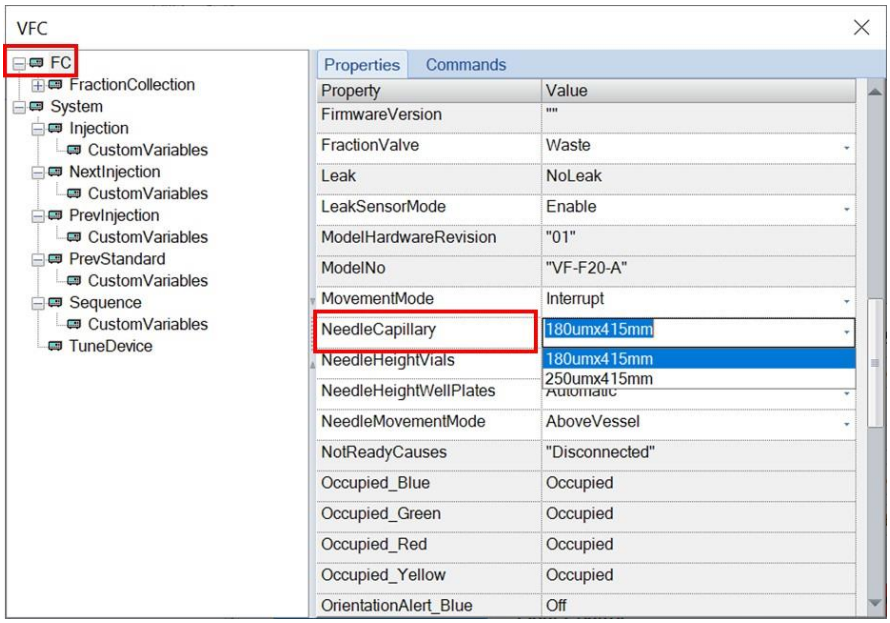

Figure 41: Set the type of needle capillary.

For more details, see Optional Accessories (▷ Page 243).

6 Operation

This chapter describes the elements for device control, provides information for routine operation and for shutdown.

6.1 Introduction to this Chapter

The information in this chapter assumes that the initial setup of the device has already been completed. If this is not the case, refer to the instructions in Installation (page 55) before proceeding.

For a basic description of instrument control and automated sample analysis with the Chromeleon software, refer to the *Vanquish System Operating Manual*. Details on control and operation of the device are available in the *Chromeleon Help*.

Software descriptions in this manual refer to Chromeleon 7. Terminology may be different to that of other software versions.

6.2 Safety Guidelines for Operation

When operating the device, pay attention to the following safety guidelines:

Observe all warning messages and precautionary statements presented in Safety Precautions (▶ page 23).

WARNING—Moving Parts

Parts inside the device are moving when the device prepares and performs the analyses of the sample. These moving parts can pose a pinch point hazard that may cause personal injury.

- Keep the device front doors closed when the device prepares and performs the fraction collection.
- During these phases, the LED bar on the device is illuminated blue.

WARNING—Flammable and Hazardous Vapors from Spills

Flammable or hazardous vapors from sample spills can accumulate inside the device. This can pose health and safety risks.

- Ensure that the sample racks and well plates are properly positioned in the segments.
- When you use sample racks, fill the sample rack with the vials before placing the sample rack in the carousel.
- Do not open the device front doors and remove any sample racks or collection containers during the phases when parts inside the device are moving. During these phases, the LED bar is illuminated blue.
- Every time the doors are closed, the device performs an inventory scan of the sample racks or well plates inside the fraction compartment.
- If a spill occurs inside the device, turn the device power off. Clean up the spill and leave the device door open. Allow sufficient time for the spill to dry and any vapors to disperse before putting the device back into use.

CAUTION—High Luminosity of LED

The high luminosity produced by the LED illuminating the inside of the device can be harmful to the eyes.

- Do not look directly into the light produced by the LED.
- Do not use light-focusing instruments for viewing the light beam.

NOTICE

Pay attention also to the following guidelines:

- Keep the device doors closed during the fraction collection processing. If the doors are opened during processing, the fraction collection processing is interrupted (without setting collection mode OFF). An acoustic signal alerts that the doors are open. The device stops the current movement of the needle arm and carousel, with fraction collection valve switched to waste position as well. If the doors are not closed within two minutes, then the sequence will stop too. If the doors are closed within two minutes, the fraction collection processing will continue by following the right moment collection requirement from the system.
- When operating the chromatography system, always set the lower pressure limit for the pump. This prevents damage resulting from leakage or from running the pump dry.
- If there is evidence of leakage in the device, turn off the pump flow and remedy the situation immediately.
- Always verify that the fraction collector is turned on before the pump flow is on and pressure builds up. If the device is turned off, for example, after a power failure, stop the pump flow and wait until the pressure is down to zero before turning on the device other modules again.

6.3 Control Elements

The device is designed to be operated mainly from a computer running with the chromatography software.

In addition, the following elements are available on the device:

- Keypad
  The keypad buttons allow you to perform certain functions directly from the device.
- Status indicators
  The LEDs (Light Emitting Diodes) on the status indicator LED bar on the front side of the device and the **STATUS** LED on the keypad provide a quick visual check of the operational status of the device.

6.3.1 Keypad

The keypad inside the device allows you to perform certain functions directly from the device. When you press a button, a short beep confirms that the function is performed.

When the device is connected in the Chromeleon software, some functions may not be available from the keypad (see further down in this section).

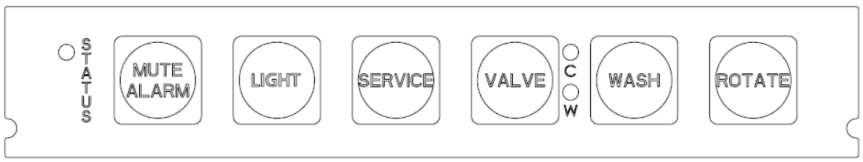

Figure 42: Keypad

STATUS

The **STATUS** LED provides a quick visual check of the operational status of the device.

When the doors are closed, the LED bar on the front side indicates the operational status.

For status details, see Status Indicators (▸ page 103).

MUTE ALARM

Beeping alerts you when the device detects a problem, for example leakage. To turn off the beep for the current alarm, press this button. Eliminate the source for the alarm within 10 minutes. Otherwise, beeping starts again. If the device detects a different problem, beeping alerts you again immediately.

LIGHT

This button allows to turn on or off the cabin light.

SERVICE

The **SERVICE** button allows the device to move needle into service position and switch fraction collection valve to waste position for the purpose of the replacement of needle unit, or needle capillary, and fixing shipping lock for the device transportation.

Pressing the **SERVICE** button, a second time, allows the device to move needle to parking position.

VALVE

The **VALVE** button allows switching the fraction collection valve between Waste and Collect position. The LEDs next to the **VALVE** button indicate the position of the fraction collection valve when they are illuminated green. If both LEDs are off, it means the fraction collection valve is in Flush position.

LED (green)	Position
LED **C**	The fraction collection valve is in Collect position.
LED **W**	The fraction collection valve is in Waste position.
Both LEDs **off**	The fraction collection valve is in Flush position.

WASH

Pressing the **WASH** button initiates a manual needle wash cycle, in which the outer needle surface is washed in the needle wash port. The wash cycle is performed with the wash settings as defined in Chromeleon.

After the needle wash cycle, the needle moves to the parking position if the left door is open.

ROTATE

The **ROTATE** button allows rotating the carousel counterclockwise to the next loading position.

When the device is connected in the Chromeleon software

The button functionality is as follows when the device is connected in the Chromeleon software:

- No injection (sample) or sequence is running:
  All functions are available from the keypad.
- An injection (sample) or sequence is running with device collection mode set to OFF:
  All functions are available from the keypad.
- An injection (sample) or sequence is running without device collection mode set to OFF:
  The **MUTE ALARM** function remains available from the keypad, allowing you to turn off the beep for the current alarm.

  In addition, the **LIGHT** button remains available from the keypad allowing you to control the cabin light.

  All other buttons are disabled.
- The device is running a manual flush purge function:
  The **VALVE** and **SERVICE** buttons cannot not be operated.

6.3.2 Status Indicators

The status LED bar on the front side of the device and the **STATUS** LED on the inside keypad provide information about the device status.

LED Bar

The LED bar colors provide the following information:

LED Bar	Description
Off (dark)	The power to the device is turned off.
Dimmed	The doors of the device are open.
Yellow, flashing slowly	The power to the device is turned on, but the device is not connected in the Chromeleon software.
Yellow	The device is connected in the Chromeleon software but is not equilibrated.
Green, flashing	The device is equilibrating. If you use fraction collector compartment thermostatting, the thermostatting temperature is not yet achieved.
Green	The device is equilibrated, but no data acquisition is running. If you use fraction collector compartment thermostatting, the thermostatting temperature is achieved.
Blue, running	The device performs fraction collecting while a sequence is running.
Blue	A sample or sequence is running, including data acquisition.
Red	A problem or error has occurred. For the related message, check the Chromeleon Audit Trail. For remedial action, see the Troubleshooting section in this operating manual.

STATUS LED

The **STATUS** LED on the left side of keypad provides the following information:

STATUS LED	Description
Off (dark)	The power to the device is turned off.
Green	The device is functioning properly.
Red	A problem or error has occurred. For the related message, check the Chromeleon Audit Trail. For remedial action, see Troubleshooting (▶ page 211).

6.4 Power On/Off Control

The power switch on the device is the main switch for power on/off control. The main power switch is turned on during initial installation of the device.

For easier handling, you can use the power button on the front left of the Vanquish system base (system power button) for power on/off.

Observe the following:

- All modules in the Vanquish system that are connected to the system base via system interlink cables are turned on or off simultaneously when the system power button is pressed.
- When the power is on, the system power button is pressed in. When the power is off, the system power button stands out.
- If the main power switch on a device is off, you cannot turn on the device with the system power button.
- To turn off a device completely, you *have to* turn it off with the main power switch on the device. Pressing the system power button will not be sufficient to turn off the power to the device completely.

Upon power up, the device performs a self-test. If the self-test is not successful, the status indicators are red and the device is not ready for use. Check the Chromeleon Audit Trail for the related message and take appropriate remedial actions.

At the end of the power up, the device sets the fraction collection valve to waste position and needle unit to home position. If the compartment door(left) is open, then the needle unit moves to parking position to leave customers manual operation space.

6.5 Preparing the Device for Operation

This section gives information on any additional steps that are required to prepare the device for operation.

Before Operating the Device for the First Time

Prepare the device for the first-time operation, observing the following:

NOTICE Flush the system flow path thoroughly before operating the device for the first time:

- When you install devices or components to the system, always flush them to waste before connecting them in the system flow path. To flush the Vanquish modules, follow the instructions in the Vanquish System Operating Manual.
- Some components of the device are filled with isopropanol when the device is shipped from the manufacturing site. When operating the device for the first time, use solvents that are miscible with isopropanol. If they are not, use an appropriate intermediate solvent.

- Inspect components and fluidic connections prior to fluidic operation.

  1. Verify that all necessary solvents are available in the solvent rack and properly connected to the device.
  2. Verify that waste line has been properly directed to waste container.

Before Starting Fraction Collection

- Check the liquid level in the solvent reservoirs. Verify that the amount of solvent is sufficient for the collection.
- Load the carousel with well plates or racks with empty.

NOTICE Before starting a sample or sequence, verify that the rack types set in Chromeleon match the rack types in the fraction collector compartment.

- Verify that the doors of the modules in the Vanquish system are closed.
- Make sure that the system is properly equilibrated.

System Equilibration

System equilibration should include the following operations:

- Purging the pump (*all* channels, including those not used for the application).
- In Chromeleon, purge the needle wash system (of autosampler and fraction collector) to fill the needle wash port with the fresh needle wash liquid. During purging, the needle wash port is flushed continuously until the fresh needle wash liquid is present.
- In Chromeleon, purge the flush pump. The flush pump and flush buffer loop, and all other flush purge lines are sufficiently flushed, and clean solvent is ready in both flush pump and flush buffer loop. See Flush System (▷ Page 171).
- Flushing the entire chromatography system with the starting solvent to rinse out any solvent from a previous analysis run.
- In Chromeleon, run a manual needle internal rinse cycle with the starting solvent to rinse out any other liquids from the internal surface of needle capillary and needle of the fraction collector.
- Warming up (or cooling down) all temperature-controlled devices in the system to the starting temperature. Temperature-controlled devices can be, for example,
  - Column compartment and post-column cooler.
  - Sample compartment thermostatting in the device.
  - Fraction collector compartment thermostatting in the device.
  - Flow cell in a fluorescence detector.
- Turning on the lamp (or lamps) in the UV/VIS detector.
- Monitoring the pump pressure and pressure ripple and checking that the pressure is stable and the ripple within reasonable limits for the application.

- Monitoring the detector signal and checking whether the detector signal is stable so that the drift and signal noise are within reasonable limits for the application.
- Performing an autozero of the detector baseline.

TIP The Chromeleon software supports procedures for automatically starting a chromatography system in the software (*Smart Startup*). The startup procedure includes the operations for system equilibration. For details, refer to the *Chromeleon Help*.

6.5.1 Thermostatting the Fraction Collector Compartment

To use thermostatting, define the following parameters:

- Temperature control
  To thermostat the fraction collector compartment, enable the temperature control (**Temperature Control = On**).
- Target temperature
  Define the temperature setpoint to which the fraction collector compartment is to be cooled or heated (**Temperature Nominal**). Observe the following:
  - Ensure that the thermostatting temperature is suitable for your samples and within the specified temperature range of the device.
  - When you enter a temperature while the temperature control is disabled, temperature control will be enabled.
  - If the device is turned off and on again, the temperature control will be disabled.

6.5.2 Loading the Carousel

The carousel separates into four color-coded segments: red (**R**), green (**G**), blue (**B**) and yellow (**Y**).

For further information on the sample compartment in general, the carousel as well as the rack type identification, see Fraction Collector Compartment (▷ Page 43).

Parts required

- Sample racks and/or well plates
  Observe the following notes for selecting sample racks and/or well plates:
  - The device supports sample racks and well plates with a footprint as specified by the **Society for Biomolecular Screening** (**SBS** footprint).
  - Rack type identification
    To allow the identification of the sample rack or well plate type with the barcode reader in the device, use sample racks and well plates with such barcodes for rack type identification.

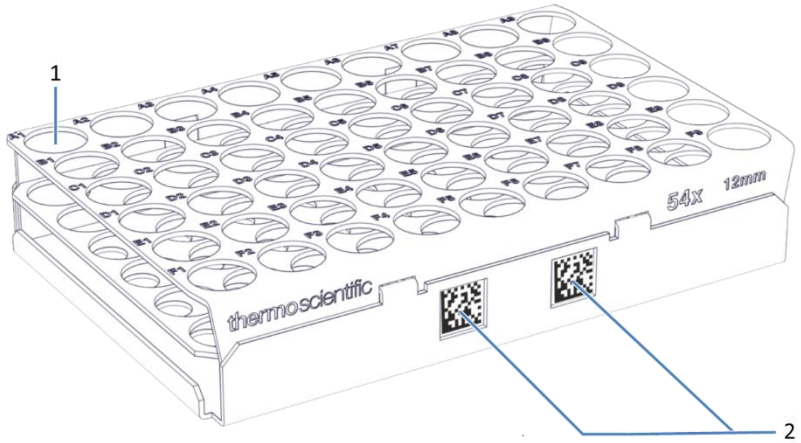

Figure 43: Sample rack with barcodes for rack type identification

No.	Description
1	Position A1
2	Vanquish rack type barcode

TIP For ordering information of sample racks and well plates for the device, refer to the re-ordering information that is included in the ship kit shipped with the Vanquish Split Sampler.

Preparations

- Check the set temperature for fraction collector compartment thermostatting and set the temperature as required, see Thermostatting the Fraction Collector Compartment (▷ page 108).
- For use of sample racks, position the vials according to your collection path mode in the sample rack.
- Before you open the device front doors, check the LED bar of the device. Do not open the front doors when the LED bar is illuminated blue. Parts of the device are moving.

TIP If you install sample racks or well plates without Vanquish rack type barcodes to the carousel, the rack type and rack orientation will not be identified automatically. It may be helpful to write down the rack types that are installed in the carousel to enter them manually in Chromeleon.

Follow these steps

1. Rotate the desired segment of the carousel to the front. You can rotate the carousel in the following ways:
   - Select the **Rotate** button on the keypad. Pressing the button rotates the carousel counterclockwise to the next loading position.
   - Use Chromeleon to move the required segment to the front.
   - Rotate the carousel manually to the desired direction.
2. Position the sample rack or well plate in the selected segment with A1 being in the top left sample position. The sample rack or well plate must sit in the alignment frame and rest on the alignment points of the segment.

TIP To avoid damage to the device or wrong results, position sample racks and well plates always in the correct orientation in the carousel, with position A1 on the top left position.

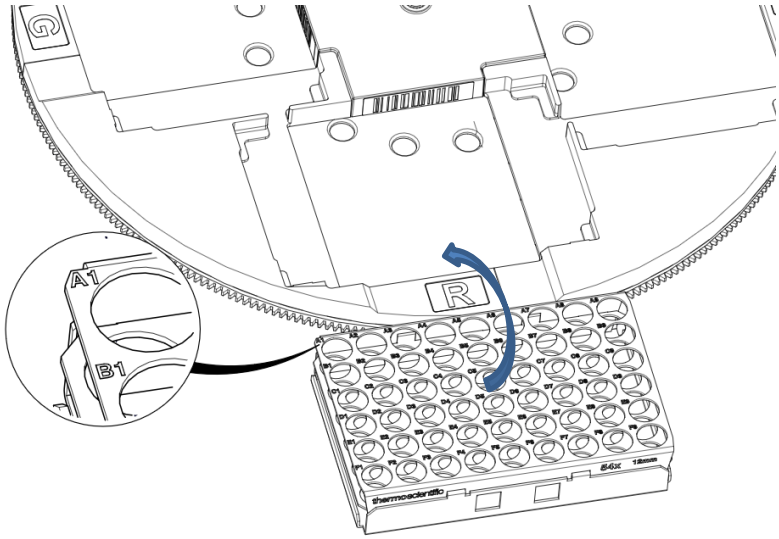

Figure 44: Correct orientation in the carousel (here with a sample rack)

3. Rotate to the next loading position and load it as required. When you have loaded the segments as required, continue with the next step.

4. Close the front doors of the device. The device starts an inventory scan of the sample racks or well plates in the fraction collector compartment.

5. Continue as required by the sample racks or well plates that are installed in the carousel. See Rack Type Settings (▷ Page 111).

6.5.3 Rack Type Settings

Depending on the sample racks or well plates installed in the carousel, proceed as required:

- *Sample racks or well plates with Vanquish rack type barcodes are used.*
  During the inventory scan, the device rotates the carousel and detects the container type for sample racks and well plates with a Vanquish rack type barcode. Wait until the rack identification is completed.

The rack types are entered automatically for the **RackType** parameter of each segment in Chromeleon. Note the following:

If no sample rack or well plate is installed in a segment of the carousel, the rack type for this segment is displayed as empty (**Empty**).

- *Sample racks or well plates without rack type barcodes are used.* No rack type identification or rack orientation is available. Make sure that the sample rack or well plate is installed in correct orientation. The rack type will be identified as **Unknown**. Manually select the rack types for each segment in Chromeleon.

To change a sample rack or well plate, use the **Change Rack** command for the respective segment in Chromeleon.

For details on the rack type settings, refer to the *Chromeleon Help*.

6.5.4 Needle Positioning Mode and Needle Height

There are two needle positioning modes that can be set in an instrument method: **AboveVial** and **InVial**.

AboveVial mode means the needle tip stays above vials or well plates during fraction collection, while **InVial** mode means the needle tip descends into vials or well plates during fraction collection.

For both modes, default needle heights are defined in the system according to rack types. Rack type identification enables auto needle height default setting. However, it is also allowed to manually set specific needle heights with settable range defined by the system.

Below table is listed with auto needle height default values and settable ranges for different rack types that are provided by Thermo Scientific.

Rack Type	AboveVial Mode		InVial Mode	
	Default Needle Height [mm]	Needle Height settable range [mm]	Default Needle Height [mm]	Needle Height settable range [mm]
ThermoVial54	34	10-50	10	10-45
ThermoVial96_6mm	34	10-50	10	10-45
ThermoVial96_7mm	42	10-50	10	10-45
ThermoVial96_8mm	42	10-50	10	10-45
ThermoVial9	48	10-50	10	10-45
ThermoVial16	48	10-50	10	10-45
WellPlate24	46	10-50	Mode is not supported	
WellPlate48	46	10-50	3	3-41.5
WellPlate96	n.a.	10-50	3	3-41.5
WellPlate384	n.a.	10-50	3	3-41.5

For **AboveVial** mode the default needle height value considers a distance of 2 mm between the height of the vial and the needle tip to ensure no needle obstruction can happen.

For the use of well plates in **AboveVial** mode the plate height must be configured into the system manually. For details of needle positioning mode settings, refer to the *Chromeleon Help.*

NOTICE
It is highly recommended to use the Vanquish rack type barcoded sample racks and well plates. Following actions may cause needle damage, sample loss and solvent spraying:

- Using unknown racks or well plates
- Not properly setting the needle height parameters
- Not properly placing the racks or well plates in fraction collector compartment.

6.6 Important Operating Parameters

The parameters described in this section should be considered for routine operation of the device. You can usually access these parameters from the Chromeleon user interface.

If a parameter listed below is not available in Chromeleon, consider updating the firmware and Chromeleon version.

For more information, refer to *Chromeleon Help and documents* and to the Technical Note 72940.

Parameters		Description
Rack type (blue, green, red, yellow)		The rack type specifies the type of sample rack or well plate that is installed in the respective segment (**RackType_Blue**, **_Green**, **_Red** or **_Yellow**). For details on the rack type settings, see Rack Type Settings (page 111).
Change rack		Rotate the required segment of the carousel to the front to install or remove a sample rack or well plate.
Tube position		The tube position identifies the position into which the next fraction is collected. The **Tube Position** consists of the color code for the segment and the position on the sample rack or well plate, which are separated by a colon (for example, **B:E8** for segment B, sample position E8).
	Reset start position	Set the start position to the first available position of the carousel. The segments are checked in Red, Yellow, Blue, and Green order to determine the start position. For example, **R:A1** should be the new position if there is a rack or well plate on Red segment.
Temperature control		Enable or disable the temperature control for the sample compartment. As a standard, the temperature control is disabled.
	Temperature nominal	The temperature setting defines the setpoint to which the fraction collector compartment is to be cooled or heated. The default temperature is set to 25 °C (**Temperature Nominal = 25**). For details, see Thermostatting the Fraction Collector Compartment (page 108).

Parameters		Description
Purge flush pump		By selecting the **Purge Flush Pump** button on the ePanel FC tab, all flow path from flush solvent reservoir to flush pump and flush buffer loop is filled up with flush solvent.
Needle wash and rinse		For details on washing the needle with fresh needle wash liquid, see Performing A Needle Wash Cycle (page 169).
	External needle wash	Select **External Needle Wash** button on ePanel FC tab to move the needle to wash port and perform a manual needle wash procedure with the wash time and wash speed that is currently defined by **External Needle Wash Speed** and **External Needle Wash Time** in command list (F8).
	Purge needle wash	To purge the needle wash system with fresh needle wash liquid, for example after replacing the needle wash liquid, you can select the **Purge Needle Wash** button on the ePanel FC tab for the device. Chromeleon turns on the needle wash pump and performs a needle wash cycle with dedicated wash settings for purging the needle wash system. After purging, the needle wash pump is turned off again and the previous wash settings are restored. As a standard, the needle wash pump is turned off (**Wash Pump = Off**).
	Internal needle rinse	Perform a manual internal needle rinse. Select the **Internal Needle Rinse** button to perform a manual needle rinse cycle using mobile phase. The needle will be inserted into needle wash port during rinsing and 2x the needle volume (30 µL) will be rinsed with flow from the HPLC pump. The duration of rinse with therefore depend on the set flow rate of the HPLC pump. If the pump motor is off or the flow rate is set to 0 mL/min and Internal Needle Rinse is triggered an error message will be issued (Code 9055. Internal needle rinse failed. Pump speed is 0.).

Parameters		Description
	Wash mode	The wash mode defines if and when an automatic external needle wash is to take place during collection. The following wash modes are available: • **No Wash**: Needle wash is switched off during collection. • **Before Collection**: The needle is washed at the beginning of the injection. • **End of Collection**: The needle is washed at the end of the injection. • **Both**: The needle is washed at the beginning and end of the injection. An automatic needle wash is performed with the pre-defined wash time and wash speed. As a standard, the wash mode is set to **No Wash** in Chromeleon.
	Rinse mode	The rinse mode defines if and when an automatic needle rinse is to take place during the collecting sequence. The following rinse modes are available: • **No Rinse**: The needle rinse in the needle wash port is not part of the collecting injection. • **Before Collection**: The needle is rinsed at the beginning of the collecting injection. • **End of Collection**: The needle is rinsed at the end of the collecting injection. • **Both**: The needle is rinsed at the beginning and end of the collecting injection. An automatic needle rinse is performed with the pre-defined rinse volume. As a standard, the rinse mode is set to **No Rinse** in Chromeleon.
Light control		The fraction collector compartment light is turned on as a standard when the device is shipped (**Light = On**).

Parameters	Description
Collection path mode	Defines how the needle moves across the racks. **Vertical**: The needle follows a vertical meander-shaped path (Figure 45). **Saw Vertical**: The needle follows a vertical saw-shaped path (Figure 46). **Horizontal**: The needle follows a horizontal meander-shaped path (Figure 47). **Saw Horizontal** (default): The needle follows a horizontal saw-shaped path (Figure 48).
Collection valve mode	Defines whether the fraction collection valve stays at collection position or switches to waste position when the needle moves from one vial to next vial. **Interrupt** (default): In this mode, the fraction collection valve switches to waste position when the needle moves to the next vial, during which the flow is directed to waste container. **Continue**: In this mode, the fraction collection valve remains at collection position when the needle moves from vial to vial, during which the flow keeps spraying out from the needle.
Needle positioning mode	This property refers to the pusher position and needle height during fraction collection. Different parameters as explained in the next rows can be set to change the needle height in different needle positioning mode (In Vial or Above Vial) in Instrument Method Wizard or Editor.

Parameters		Description
	In Vial	In **InVial** mode, the needle height specifies the distance between the bottom of the sample container, as measured from the interior, and the tip of the needle. Needle Height for Vials: The needle height is pre-defined as **Automatic**, which corresponds to a needle height of **10.0 mm**. This value ensures that the needle does not touch the bottom of most common collection containers. See Needle Positioning Mode and Needle Height (Page 112) for the supported racks. Needle Height for Well Plates: The needle height is pre-defined as **Automatic**, which corresponds to a needle height of **3.0 mm**.
	Above Vial	The **Use Safe Needle Height** option can be checked to keep the needle 2mm above vials based on automatic rack type identification function. If this option is checked, **Needle Height for Vials** and **Needle Height for Well Plates** become read-only, otherwise they can be changed for optimized heights. In **Above Vial** mode, well plate heights range between 10 mm and 50 mm and cannot be automatically recognized, so it is necessary to manually input the specified or measured well plate height for **96 Well Plate** or **384 Well Plate** on More Options SubPanel of the FC ePanel. For **24 Well Plate** and **48 Well Plate** the well plate height is set in the firmware to a constant value of 44 mm and cannot be changed by the user.
Puncture offset		The puncture offset defines how much the needle opens the septum. The carousel moves by the specified value while the needle is in the septum, thus enlarging the hole in the septum for equalizing the pressure. The puncture offset is defaulted to 0.
Leak detection		Leak detection is enabled as a standard when the device is shipped (**Leak Sensor Mode = Enabled**). This is the preferred setting.

Parameters		Description
Delay volume		The Fraction Delay Volume is the fluidic volume travelled by a peak after triggering the set start threshold conditions between a detector and the separation point of the downstream fraction collection valve. The volume can be logged automatically if the **Vanquish Fraction Collector Delay Volume Determination** operational qualification is performed. Before running the OQ test, it is recommended to perform first an Instrument Installation Qualification to ensure that the standard HPLC system is basically ready to operate in its intended use. For details, see Delay Volume Determination (DVD) (page 123). The **Delay Volume** can be changed by specifying delay Capillary inner diameter (ID) and length (L).
	Delay capillary IDxL	Select either **Custom** or predefined **Delay Capillary IDxL**. If the predefined **Delay Capillary IDxL** is selected**,** the **Delay Volume** is automatically updated.
	Delay capillary ID Delay capillary L	If **Custom** as **Delay Tubing Capillary IDxL** is selected, then need to manually input **Delay Capillary ID** and **Delay Capillary L**. The **Delay Volume** is calculated and displayed accordingly.
Fraction collection options		
	Off (do not collect at all)	Select this option to disable fraction collection.
	Collect by peak	When this option is selected, fraction collection starts depending on the specified detection channels and peak detection settings.
	Collect by time	Fraction collection is independent of peak detection. When this option is selected, use the **Collection period** input field to specify the time in [s] after which a new tube will be used.
	Tube wrapping	Select this check box to return to the first tube after the last tube is filled. If this check box is cleared, the Chromeleon Queue will be aborted when the last tube is reached.

Parameters		Description
	Fraction pooling	Select this check box to return to the first tube position whenever a new sample is started. This is also referred to as pooling.
	Concatenating	Concatenating fraction collection can be enabled by using custom injection variables in Chromeleon sequence view and associate the values to **StartFractionPosition** and **FractionRange** properties in the Script Editor of Chromeleon Console. Refer to *Chromeleon Online Help* for details.

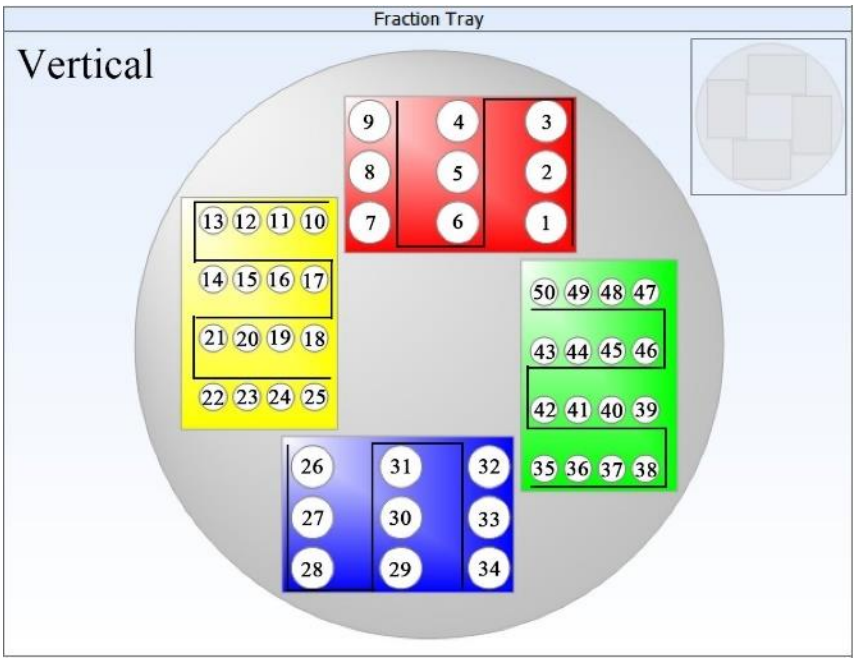

Figure 45: Collection path mode = vertical

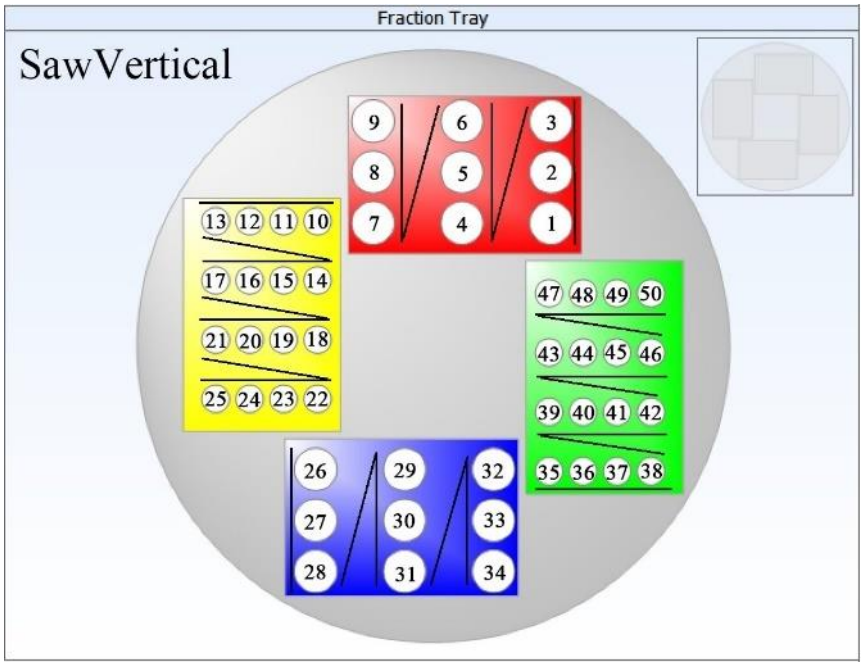

Figure 46: Collection path mode = saw vertical

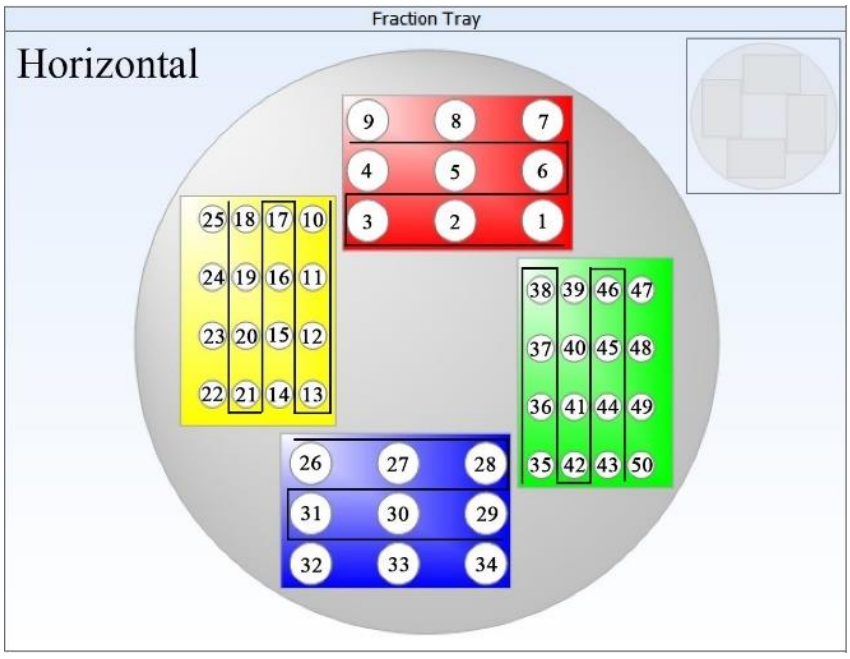

Figure 47: Collection path mode = horizontal

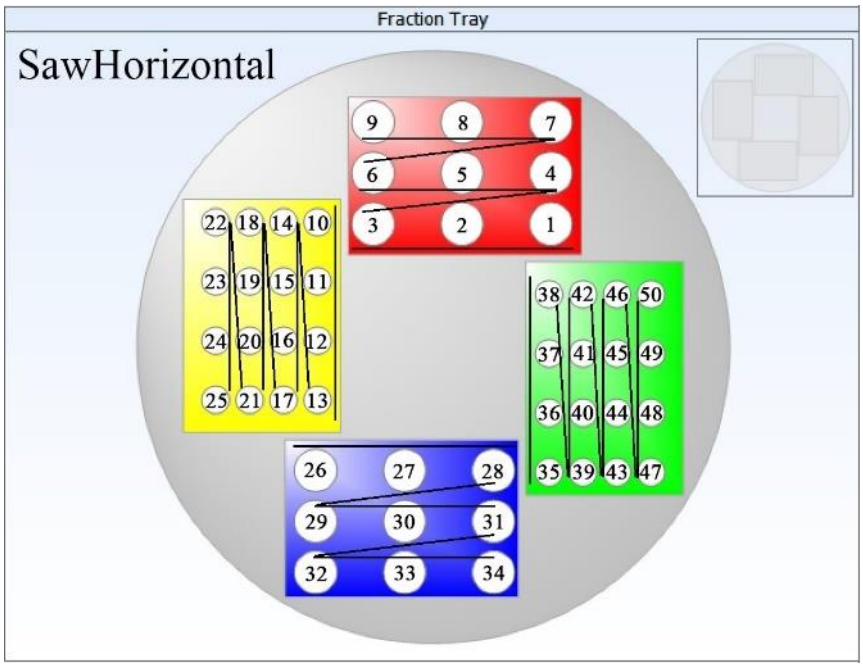

Figure 48: Collection path mode = saw horizontal

6.7 Delay Volume Determination (DVD)

6.7.1 Delay Volume and Time

The Delay Volume is the fluidic volume between a detector and the separation point of the downstream fraction collection valve. It is essential to determine the volume and set it in the system before starting fraction collection operation.

The product provides the feature Automated Delay Volume Determination (DVD), with which the delay volume can be determined conveniently and set in the system automatically.

The delay time can be automatically calculated and set in the system based on the delay volume and specified method configuration, e.g. pump flow rate and detector response time.

The correct delay time ensures optimal fraction collection of the target peak with high recovery and low carry over.

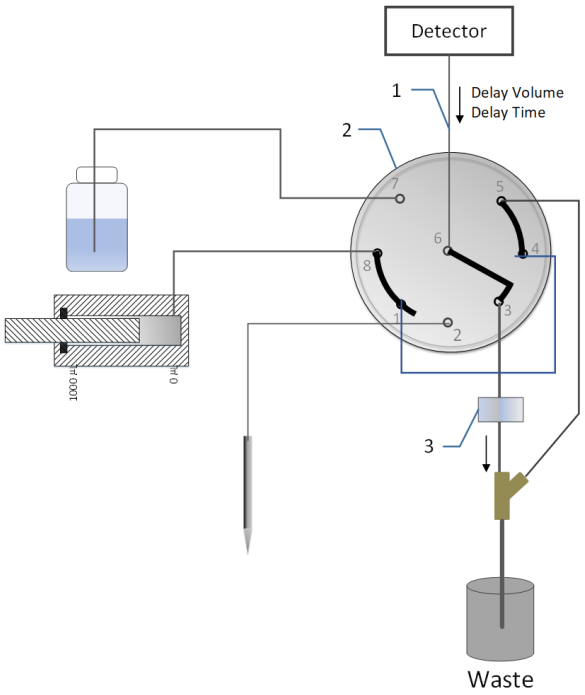

Figure 49: Fraction collection valve located at waste position when running delay volume determination

No.	Description	No.	Description
1	Delay capillary	3	Air bubble sensor
2	Fraction collection valve		

When collection is triggered during a run, the fraction collection valve is switched from waste position to collection position using the following delay time calculations:

- *Peak-based:*
  Start of fraction collection: $t = t_{\text{peak start}} + \text{Delay time}$
  End of fraction collection: $t = t_{\text{peak end}} + \text{Delay time}$

- *Time-based:*
  Start of fraction collection: $t = t_{\text{collection time window start}} + \text{Delay time}$
  End of fraction collection: $t = t_{\text{collection time window end}} + \text{Delay time}$

6.7.2 When to Perform DVD Function

It is necessary to re-measure the delay volume if any of the below conditions are met.

- Initial installation of a new HPLC system with an Integral Fraction Collector (VF-F20-A)
- Replacing a detector flow cell
- Replacing a delay capillary
- Replacing a fraction collection valve
- Replacing an air bubble sensor

Important!

- Only qualified Thermo Fisher engineer can replace the fraction collection valve and the air bubble sensor.
- Never move or uninstall the fitting on port 3 of fraction collection valve. The flow path on this port have been performed calibration during in-house production process or in-field service.
- Do not pull the tubing (transparent waste line, OD 1/8'') connecting with the faction valve port 3, on which an air bubble sensor is installed.

6.7.3 How to Perform DVD Function

The product provides an automated Delay Volume Determination feature by running the Delay Volume Determination test case on **Chromeleon 7 Console**.

In Chromeleon 7.3.1 CDS and later click **Tools > Instrument Qualification > Instrument Qualification Wizard** > *Select* **Operational Qualification** > **Choose an Instrument** > *Select* **General** > *Select* **Vanquish Fraction Collector Delay Volume Determination.**

In Chromeleon 7.3.2 CDS and later or Chromeleon 7.2.10 MUh CDS and later click **Tools > Instrument Qualification > Instrument Qualification Wizard** > *Select* **Operational Qualification** > **Choose an Instrument** > *Select* **Special Test** > *Select* **Vanquish Fraction Collector Delay Volume Determination.**

Then follow below steps to complete DVD function.

NOTICE

Prior to performing DVD flush the whole system with pure water to remove air from the fluidic path.

1. Use purified water as mobile phase for running DVD function.
2. The procedure requires user intervention after 1 min to install the **DVD capillary** (included in ship kit, P/N 6040.2330, Viper Cap. ID x L: 0.13 x 850 mm, SST) and put an empty vial at position R:A9 in Chromeleon 7.3.2 CDS and later (R:A1 in Chromeleon 7.3.1 CDS and later) issued by respective messages in Chromeleon.
3. After the DVD capillary was installed and the empty vial was put in the correct position the remaining sequence runs automatically.
4. The overall procedure takes approximately 30 minutes.

NOTICE

- If the DVD is applied during daily application instead of the first time system installation, the capillaries between autosampler and detector as well as the column need to be uninstalled.
- The DVD capillary connects autosampler and detector directly.
- Make sure the column is bypassed.

5. After the DVD is performed, users can check the measured Delay Volume **in Chromeleon** > **FC ePanel tab** > **More Options dialog**.

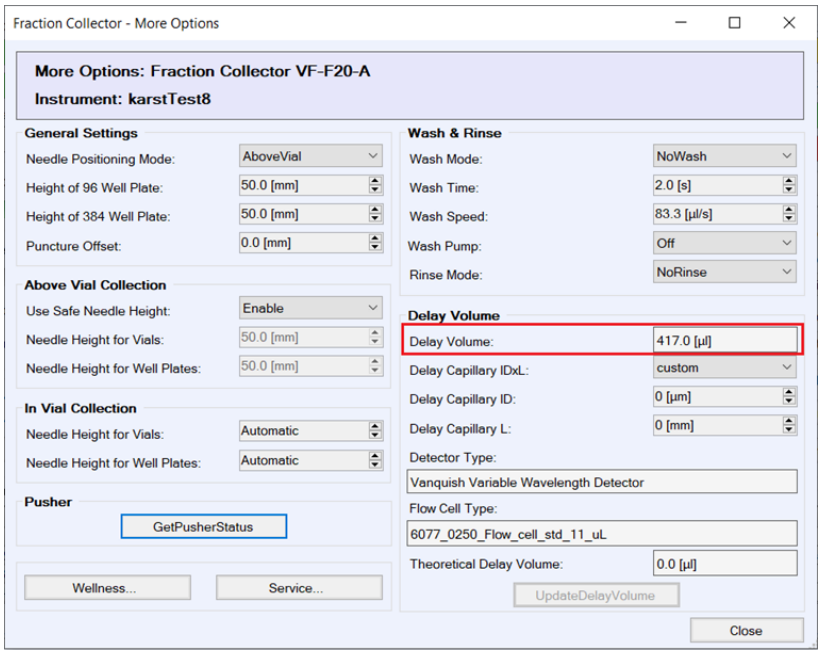

Figure 50: Checking the measured delay volume in the FC ePanel tab

6. After the successful DVD, the method specific delay volume and delay time will be automatically updated in the **Instrument Method Wizard**. The method specific delay time considers the set pump flow rate and detector response time.

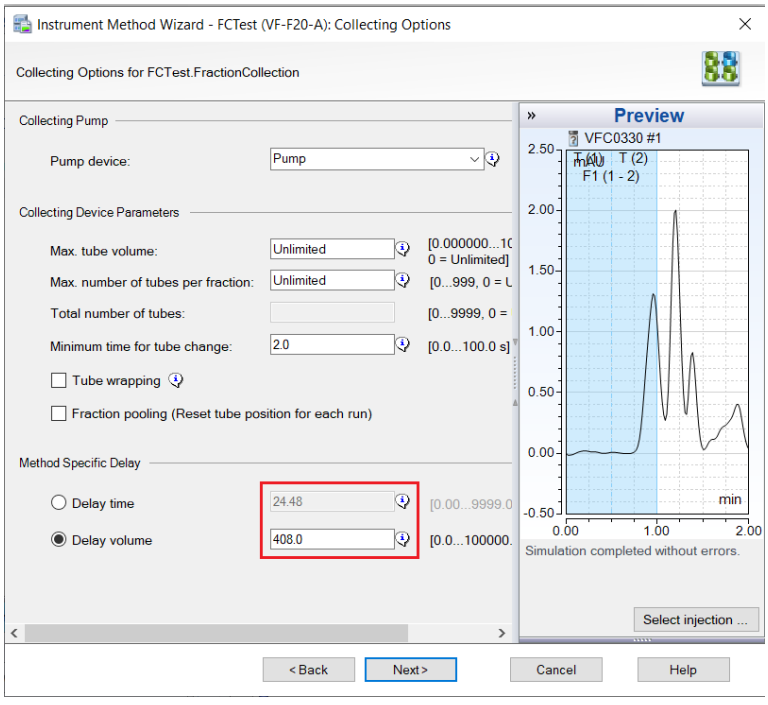

Figure 51: Method specific delay volume and time

7. After the DVD, the DVD Report can be exported. The DVD results are also reported in the audit trail.
8. Remove the DVD capillary and set up usual HPLC system to recover application work.

NOTICE

- Users can enter a different method specific delay volume or time in the method editor manually. However, that will not overwrite the value of the delay capillary volume measured with DVD or set from the dropdown in **Command** list (F8). When a new method is created, that value of the delay capillary volume is used again as default to calculate and auto-set the method specific delay volume and method specific delay time.
- The value of the delay capillary volume can only be changed by running DVD or selecting the capillary from the dropdown in Command list (F8).
- If a method specific delay time is set manually, it must be larger than 0.
- Delay volume has to be determined for the first time installation, otherwise the fraction collection operation will possibly fail.

For DVD further information, refer to *Chromeleon Help and documents.*

6.7.4 Delay Volume Capillary Drop Down Menu

A custom delay capillary can be defined, or the measured delay volume can be overwritten by the delay volume capillary selection in **Chromeleon** > **FC ePanel tab** > **More Options dialog**.

To overwrite the volume, users can set **Delay Capillary IDxL** to **custom** and set **Delay Capillary ID** and **Delay Capillary L**, or select one of the six pre-defined capillaries in **Delay Capillary IDxL**:

- 100 µm x 350 mm
- 180 µm x 350 mm
- 180 µm x 1200 mm
- 250 µm x 1500 mm
- 500 µm x 800 mm
- 1000 µm x 1000 mm
- custom

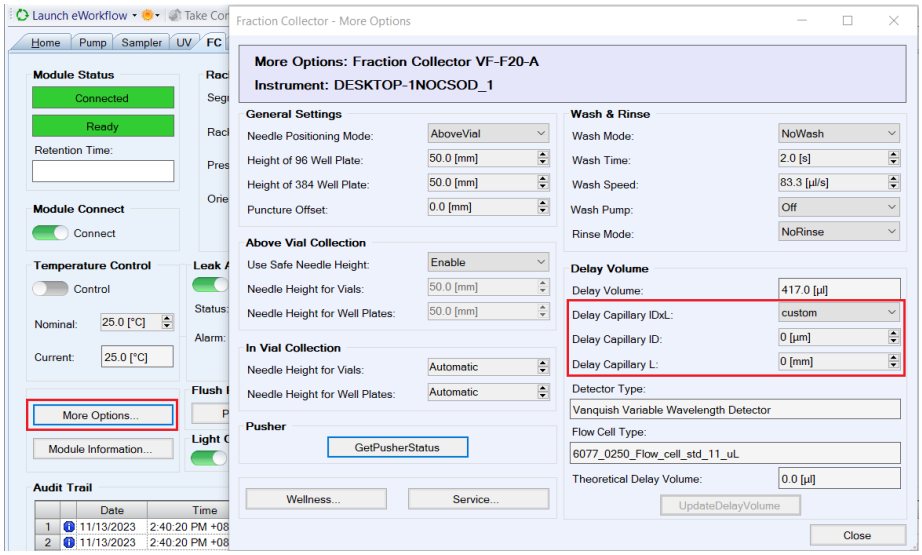

Figure 52: Delay volume capillary drop down menu

6.7.5 Vanquish Modules enabling Delay Volume Determination

Delay volume determination is enabled by the following Vanquish model numbers.

Module	Model No.	
Pump	Binary Dual Isocratic Quaternary	VH-P10-A, VF-P10-A, VC-P10-A VF-P32-A, VC-P32-A, VC-P33-A VC-P40-A VF-P20-A, VC-P20-A, VC-P21-A
Autosampler	VH-A10-A, VF-A10-A, VH-A40-A, VF-A40-A, VC-A12-A, VC-A13-A	
Charger	VH-A90-A	
Detector	Diode Array Variable Wavelength Multi-Wavelength	VH-D10-A, VF-D11-A, VC-D11-A VC-D40-A, VF-D40-A VC-D12-A
Fraction Collector	VF-F20-A	

Delay volume determination is not enabled by the detector model numbers below.

Module	Model No.	
Detector	Fluorescence Charged Aerosol	VF-D50/51-A, VC-D50/51-A VH-D20-A, VF-D20-A

NOTICE

- **Delay Volume Determination** option will *not* be displayed in the **Instrument Qualification Wizard** if the HPLC system configuration includes any of the unspecified models. For this case a software tool (*Vanquish Fraction Collector Delay Volume Calculator*) is provided to manually calculate the theoretical delay volume. See Delay Volume Calculator (▶Page 132)
- The DVD function is not enabled when an HPLC configuration with two detectors is present. If the system configures more than one detector, **Delay Volume Determination** option will not be displayed in the **Instrument Qualification Wizard.**

6.7.6 Vanquish Detector Flow Cells enabling Delay Volume Determination

The table below shows the list of Vanquish detector flow cells that enable DVD measurement.

Part Number	Description	Used with
6077.0250	Standard flow cell, SST, 10mm	VF-D40 VC-D40
6077.0360	Semi-micro flow cell, SST, 7mm	VF-D40 VC-D40
6083.0510	Standard flow cell, SST, 10mm	VF-D11 VC-D11 VC-D12
6083.0520	Semi-analytical flow cell, SST, 7mm	VF-D11 VC-D11 VC-D12
6083.0530	Semi-micro flow cell, SST, 7mm	VF-D11 VC-D11 VC-D12
6083.0550	Semi-micro biocompatible flow cell, MP35N, 7 mm	VF-D11 VC-D11 VC-D12
6083.0100B	LightPipe flow cell, 10mm, standard	VH-D10
6083.0200B	LightPipe flow cell, 60mm, high sensitivity	VH-D10

NOTICE

Delay Volume Determination option will *not* be displayed in **Instrument Qualification Wizard** if an unspecified flow cell is used with the detector. For this case a software tool (*Vanquish Fraction Collector Delay Volume Calculator*) is provided to manually calculate the theoretical delay volume. See Delay Volume Calculator (▶Page 132)

6.7.7 Delay Volume Calculator

The delay volume calculator is provided to calculate the delay volume for the Vanquish Fraction Collector in case an automated delay volume determination is not possible due to the presence of a Vanquish Fluorescence Detector or a flow cell in the instrument configuration disabling the delay volume determination measurement. It is an independent tool additionally executed besides the Chromeleon 7 Chromatography Data System. It is recommended to run the calculator on the same computer or on a computer with remote access to the computer where the Chromeleon 7 Chromatography Data System is operated to utilize the copy/paste function within the calculator.

The table below shows the list of Vanquish detector flow cells that disable DVD measurement.

Part Number	Description	Used with
6074.0285	UV-monitor, 45 nL	VF-D40 VC-D40
6074.0320	Semi-preparative flow cell, biocompatible, PEEK, 0.4 mm	VF-D40 VC-D40
6077.0200	Standard flow cell, biocompatible, PEEK, 10 mm	VF-D40 VC-D40
6077.0300	Semi-micro flow cell, biocompatible, PEEK, 7 mm	VF-D40 VC-D40
6079.4230	Standard flow cell, biocompatible, fused silica, 8 µL	VF-D50 VF-D51 VC-D50 VC-D51
6079.4330	Micro flow cell, biocompatible, fused silica, 2 µL	VF-D50 VF-D51 VC-D50 VC-D51
6083.0510A	Standard flow cell, SST, 10 mm	VF-D11 VC-D11 VC-D12
6083.0520A	Semi-analytical flow cell, SST, 7 mm	VF-D11 VC-D11 VC-D12
6083.0530A	Semi-micro flow cell, SST, 7 mm	VF-D11 VC-D11 VC-D12
6083.0540 6083.0540A	Standard flow cell, biocompatible, 10 mm	VF-D11 VC-D11 VC-D12
6083.0550A	Semi-micro biocompatible flow cell, MP35N, 7 mm	VF-D11 VC-D11 VC-D12

The calculator is distributed along with the device firmware and Chromeleon driver in the Vanquish Fraction Collector software package and can be executed from any directory of choice. It is recommended to use computer desktop as directory for quickest access. For more details please read the release notes provided with the Vanquish Fraction Collector software package and/or Chromeleon release.

How to Use the Tool

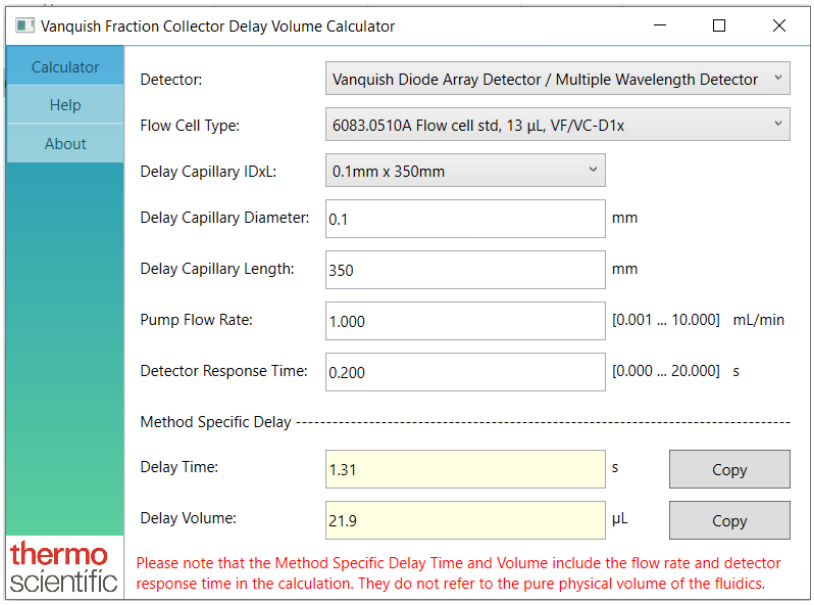

Figure 53: Vanquish Fraction Collector Delay Volume Calculator

1. Select the **Detector** configured in the Vanquish system from the drop-down list.
2. Select the **Flow Cell Type** installed in the detector from the drop-down list.
3. Select the installed **Delay Capillary IDxL** from the drop-down list. This will automatically fill the **Delay Capillary Diameter** and **Delay Capillary Length**.

   If **Custom** is selected as **Delay Capillary IDxL** the values for **Delay Capillary Diameter** and **Delay Capillary Length** need to be entered manually.
4. Define the **Pump Flow Rate** to be applied in the instrument method.

5. Define the **Detector Response Time** to be applied in the instrument method.

6. The calculator displays the resulting **Delay Time** and **Delay Volume** in the *Method Specific Delay* section.

7. Click the **Copy** button next to the calculated values for **Delay Time** or **Delay Volume**.

8. Create or open the desired instrument method and paste the value on the **Collecting Options** page in the **Method Specific Delay** section.

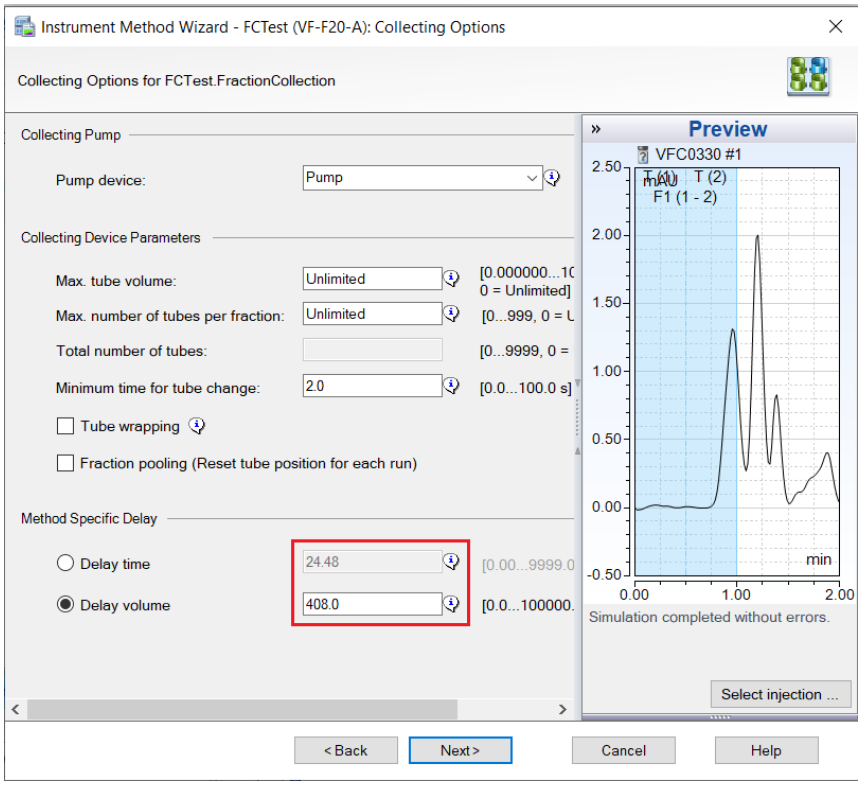

Figure 54: Collecting Options page in the instrument method

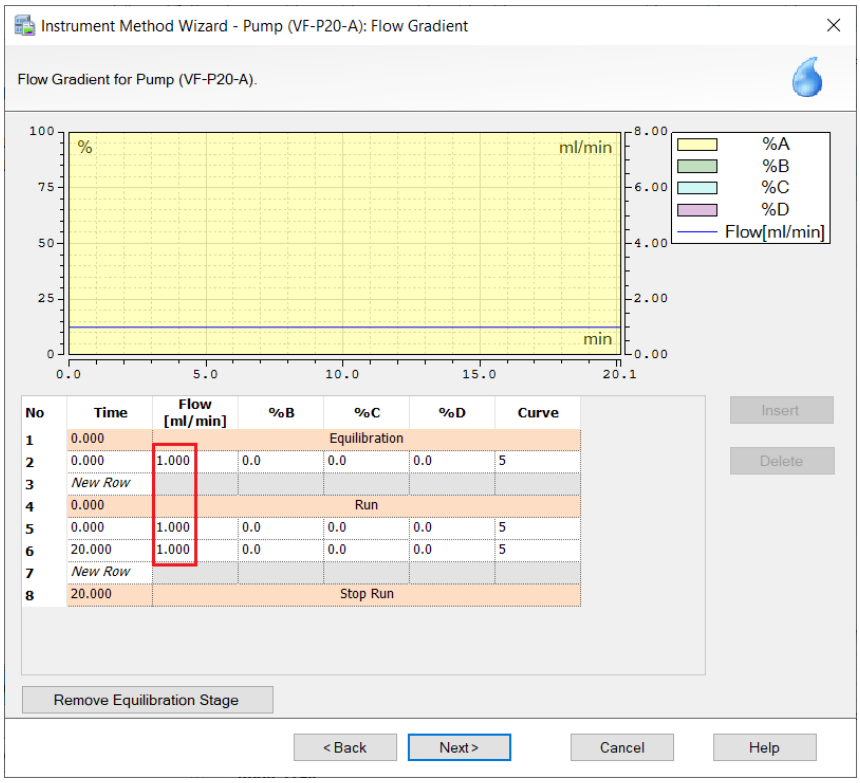

Figure 55: Pump Flow Rate on Flow Gradient page in instrument method

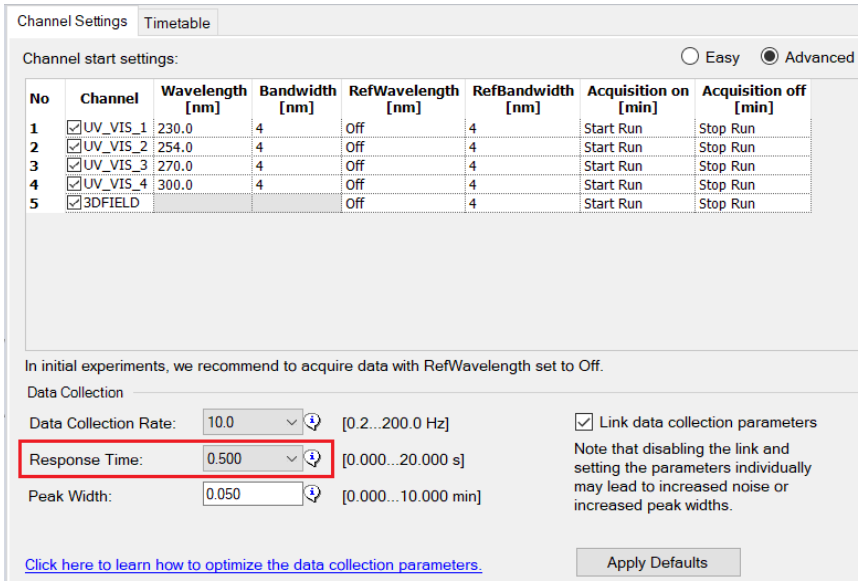

Figure 56: Detector Response Time in Channel Settings in Instrument Method

6.8 Vial Pusher Positions

There are two positions for the vial pusher during operation: **AboveVial** and **InVial**. During shipment the pusher is in the **InVial** position. The default setting in Chromeleon is also **InVial**.

For optimal collection performance for **AboveVial** mode, the default distance between needle tip and the top of the sample container is 2 mm with needle tip protruding out of the pusher as the lowest point of the whole needle unit.

For **InVial** mode the pusher needs to be at the lowest point. The purpose is to hold the vial down when the needle is pulled out from the vial septa.

Between different injections in one sequence, the system will detect if the physical pusher position aligns with needle positioning mode. If not, Chromeleon will issue a message to remind users to adjust to correct position. For more information, refer to *Chromeleon Help*.

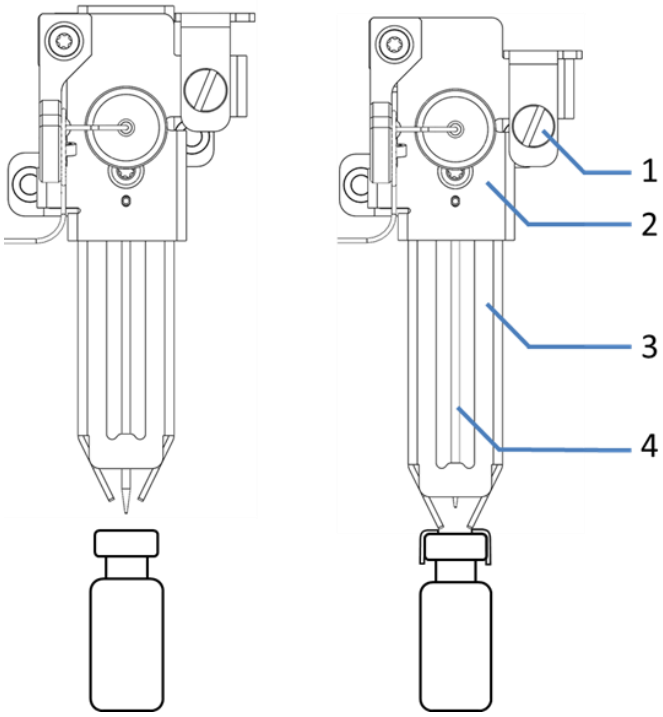

*Figure 57: left - **AboveVial** pusher position, right - **InVial** pusher position*

No.	Description	No.	Description
1	Lock pin	3	Pusher
2	Pusher cover	4	Needle

6.8.1 Adjust to AboveVial Pusher Position

Preparations

1. Open the left front door.
2. Press the service button on keypad to move the needle unit into service position.

NOTICE To avoid personal injury, do not put hands into the compartment when the needle unit is moving.

Follow these steps

1. Raise the lock pin upwards by hand. The pusher will be moved up accordingly.

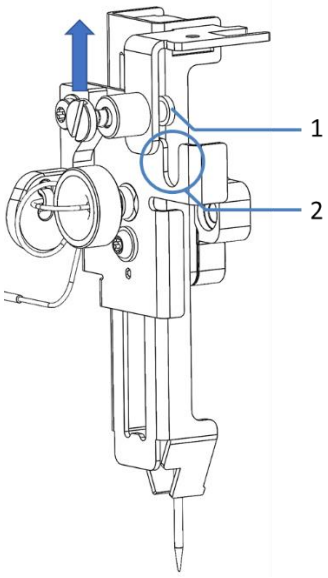

Figure 58: Moving the pusher up by hand

No.	Description	No.	Description
1	Lock tab	2	U-shape slot

2. Press the lock pin and move it down to engage the lock tab with the U-shape slot.

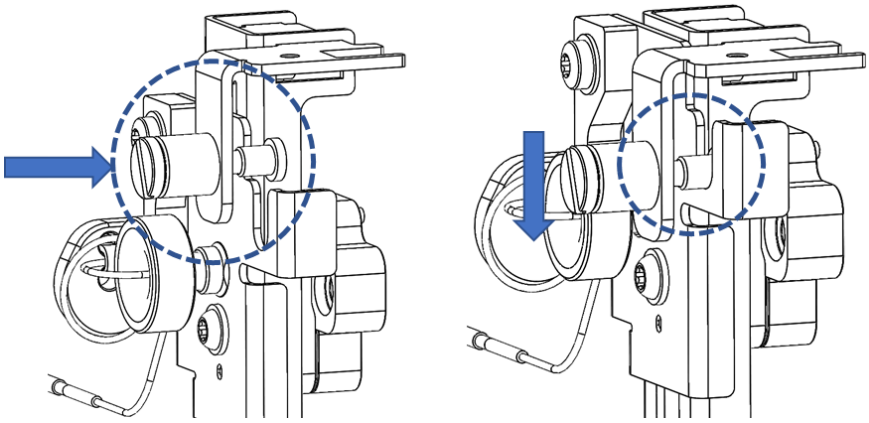

Figure 59: Engaging the lock tab with U-shape slot

3. Release the lock pin and check that the needle tip protrudes out of the pusher. Then close the left front door.

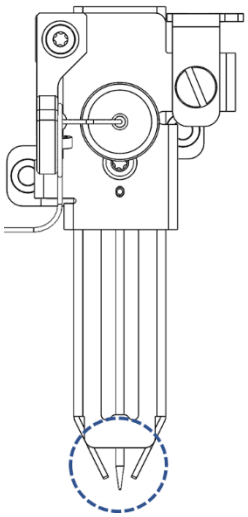

Figure 60: Checking the needle tip below the pusher

4. Verify the correct pusher position is set correctly in Chromeleon.

6.8.2 Adjust to InVial Pusher Position

Preparations

1. Open the left front door.
2. Press the service button on keypad to move the needle unit into service position.

NOTICE To avoid personal injury, do not put hands into the compartment when the needle unit is moving.

Follow these steps

1. Raise the lock pin upwards by hand. The Lock tab will pop out from the U-shape slot accordingly.

TIP Do not press the lock pin. Just lift it up.

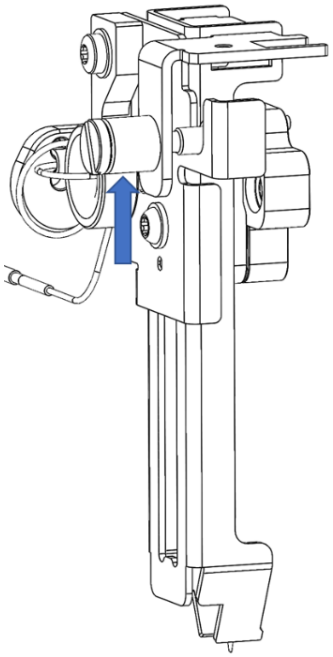

Figure 61: Moving the lock pin up by hand

2. Release the lock pin. The pusher is released to **InVial** position.
3. Physically check that the needle tip does not protrude out of the pusher and close the left front door.

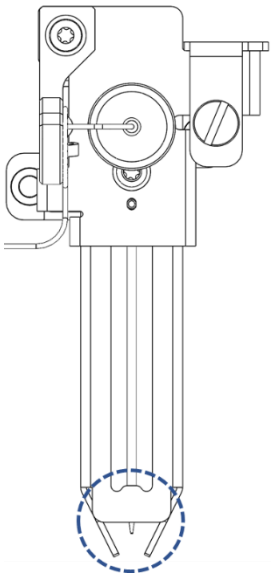

Figure 62: Checking the needle tip higher than the pusher tip

4. Verify the correct pusher position is set correctly in Chromeleon.

6.8.3 Vial Pusher Position Status

The position of the vial pusher is visualized on the FC ePanel indicating whether the current physical status matches the setting in More Options on the ePanel and the method to be run.

If the Fraction Collector is in idle status, every time after the left door is closed, the vial pusher position is automatically updated.

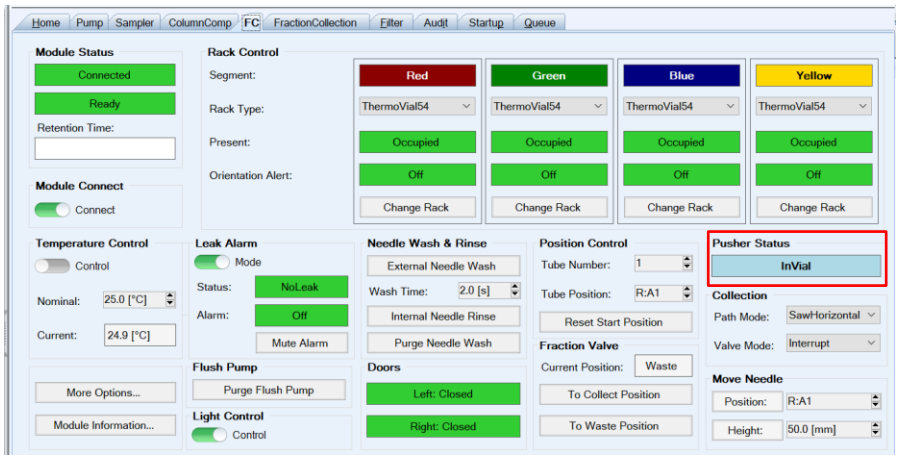

Figure 63: Vial Pusher Position on ePanel (InVial)

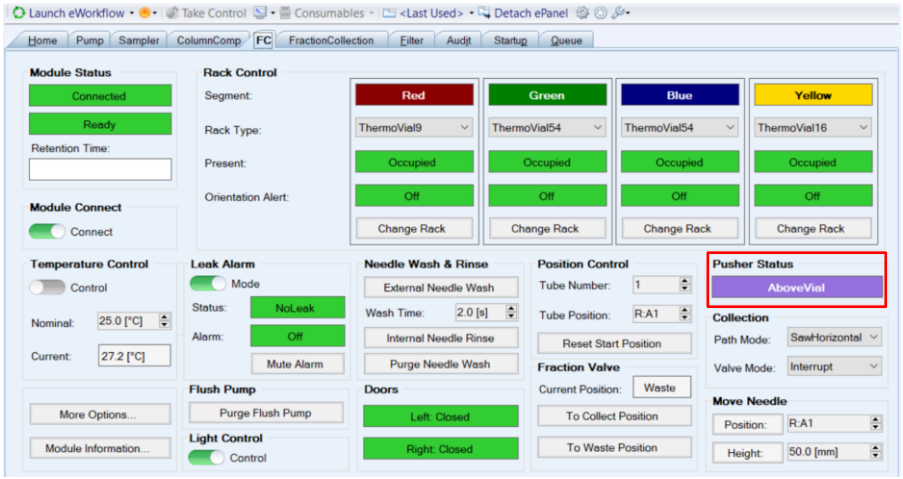

Figure 64: Vial Pusher Position on ePanel (AboveVial)

6.9 Optimizing the Performance of the Device

This section provides information for best performance of the device and gives hints on what you can do to optimize the performance further.

General Guidelines

To optimize the device performance, consider the following general guidelines:

- Leave the device doors closed during fraction collection processing to avoid any interruptions.
- Perform needle wash and rinse for lowest possible carry over. The needle wash and needle rinse ensure that the needle is properly cleaned from the remaining last fraction, both inside and outside of the needle.
- According to application purpose, flush function helps to achieve both higher recovery and minimized carryover.
- Before you switch the fraction collection valve, make sure that the pump flow is turned on. Avoid switching the fraction collection valve without flow, i.e. switching the fraction collection valve dryly.
- Monitor the usage of specific device components that are subject to wear and stress and schedule appropriate maintenance intervals. See Predictive Performance (page 158).
- Observe the general guidelines and recommendations in the *Vanquish System Operating Manual* on the use of solvents and additives in the chromatography system.

6.10 Shutting Down the Device

If the device will not be operated for some time, follow the instructions on shutting down the device in this section.

TIP The Chromeleon software provides procedures for automatically preparing the chromatography system for shutdown. The procedures include, for example, operations for reducing the flow rate, reducing the temperature in temperature-controlled devices, and turning off the detector lamps.
For information about **Smart Shutdown** and **Smart Standby**, refer to the *Chromeleon Help*.

6.10.1 Short-Term Shutdown (Interruption of operation)

To interrupt operation of the device for a short period (short-term shutdown), for example, overnight, observe these guidelines for the Vanquish system modules, as required by your system arrangement:

TIP Purge the needle wash port with an organic solvent, such as isopropanol, before you interrupt operation to avoid organic growth in the needle wash system.
Purge the flush pump to flush buffer loop with an organic solvent, such as isopropanol, before you interrupt operation to avoid organic growth in the flush buffer loop system.
Run an internal needle rinse cycle with an organic solvent, such as isopropanol, before you interrupt operation to avoid organic growth inside the needle capillary and needle.
Keep in mind that organic content in the solvent can vaporize during interruption, thus decreasing the solvent level.

- Apply a flow of 0.05 mL/min and have the pump deliver an appropriate solvent.
- Check the lower pressure limit for the pump and adapt the value if necessary. If the pressure falls below the lower limit, the pump stops the flow.
- Set the injection valve in the autosampler to the Inject position.
- Set the fraction collection valve in the device to the Waste position.

- Make sure that the temperature of the column does not exceed 40 °C.
- When resuming operation, let the flow equilibrate and verify that the operating parameters for the other system modules are set as required before proceeding.

6.10.2 Long-Term Shutdown

Shutting Down the device

TIP Shutting down the device affects the operation of the system. When shutting down the device, also observe the shutting down instructions for the other Vanquish system modules and take appropriate action (refer to the *Operating Manuals* for the modules).

To interrupt operation for a longer period, follow the instructions below.

1. Check that the fraction collection valve is set to Collect position.
2. Flush the system with an appropriate, pure solvent (minimum HPLC-grade).

TIP With a fraction collector installed in a Vanquish Core system that has been modified for using normal-phase compatible solvents and additives, refer to the information about the flushing liquid in the *Considerations with Normal-Phase Compatible Solvents and Additives* section in the *Vanquish System Operating Manual*.

Observe the following:

Situation after Shutdown	If no additive is used	If an addititive is used
Device remains in the laboratory after shutdown	Flush the system, for example with methanol. 100% acetonitrile should not be used.	Flush the system with several volumes (for example, 1.0 mL/min for 10 minutes with the standard system) of methanol and water (50:50) to prevent salt buildup in the fluidics. If the solvents in the device are not miscible with water, use an appropriate intermediate solvent.

Situation after Shutdown	If no additive is used	If an addititive is used
Device shall be transported or shipped after shutdown	Flush the system with isopropanol.	Flush the system first with several volumes (for example, 1.0 mL/min for 10 minutes with the standard system) of methanol and water (50:50) to prevent salt buildup in the fluidics. If the solvents in the device are not miscible with water, use an appropriate intermediate solvent. Afterward, flush the system with isopropanol.

1. Set the fraction collection valve to Waste position.
2. Turn off the pump flow to the device. Wait until the system pressure is down to zero before you continue the shutdown of the device.
3. *If the device shall be transported or shipped after shutdown*
   - Flush the needle wash system with an organic needle wash solvent, such as isopropanol, before you interrupt operation to avoid organic growth in the needle wash system.
   - Purge flush pump to flush buffer loop with an organic solvent, such as isopropanol, before you interrupt operation to avoid organic growth in the flush buffer loop.
   - Run an internal needle rinse cycle with an organic solvent, such as isopropanol, before you interrupt operation to avoid organic growth inside the needle capillary and needle of the fraction collector.
4. Empty condensation drain system:
   a) Leave the drain pump turned on until no condensation water is present in the waste tubing of the drain pump. Then turn off the drain pump.
   b) Remove the sample racks and sample containers from the fraction collector compartment.
   c) If condensation or spilled samples are present in the fraction collector compartment, clean and decontaminate the fraction

collector compartment before you proceed. Verify that the device has been cleaned and/or decontaminated as appropriate.

5. If the device shall be transported or shipped after shutdown, remove the needle capillary. Then secure the needle drive and carousel. For details, see Transporting or Shipping the Device (▸ page 201).

NOTICE If the needle drive is not secured during maintenance or transportation; it can damage the device. Secure the needle drive when instructed to do so to avoid damage to the device.

TIP When the power is turned off to the device, the left front door of the device is opened automatically for proper ventilation of the fraction collector compartment and cannot be closed while the power is turned off.

Restarting the device after long-term shutdown

To restart the device, follow these steps:

1. Remove all shipping protective parts and connecting required capillaries and tubing if the protective parts were installed and fluidics uninstalled before. For details, see Unpacking and Transport (▸ page 49) and Installation (▸ page 55).
2. Turn on the device with the main power switch.
3. Prepare and restart the other modules in the Vanquish system, following the instructions in the *Operating Manuals* for the modules. Pay special attention to the *Preparing the Module for Operation* section.
4. Turn on the pump flow and flush the flow path of the device.
5. Before starting an analysis, let the device equilibrate and be sure that it is ready for operation. see Preparing the Device for Operation (▸ page 106).

7 Maintenance and Service

This chapter describes the routine maintenance and the service procedures that the user may perform.

7.1 Introduction to Maintenance and Service

This chapter describes the routine maintenance and service and repair procedures that the user may perform.

Additional maintenance or service procedures must be performed only by service personnel certified by Thermo Fisher Scientific (for brevity, referred to as Thermo Fisher Scientific service personnel).

The device is designed for easy maintenance and service. The user-serviceable parts of the device can be accessed from the front. If not stated otherwise, the maintenance procedures do not require that you remove the device from the system.

The maintenance procedures do not require that you remove the doors. However, it is possible to remove a door if this should ever be required for a specific reason or procedure. If you need to remove a door, follow the related steps in Replacing the Doors (▷ page 199).

7.2 Safety Guidelines for Maintenance and Service

When performing maintenance or service procedures, pay attention to the following safety guidelines:

Observe all warning messages and precautionary statements presented in Safety Precautions (▸ page 23).

WARNING—High Voltage

High voltages are present inside the device that could cause an electric shock.

Do not open the housing or remove protective panels unless specifically instructed to do so in this manual.

WARNING—Sharp Tip of the Needle

The needle has a very sharp tip that can cause injury to the skin.

To avoid personal injury, never touch the needle tip.

WARNING—Tilting Liquid Reservoirs

Liquids in the reservoirs on the solvent rack might contain harmful substances. Spilling of these substances can pose health and safety risks.

To prevent the reservoirs from tilting, be careful not to pull on the liquid lines when performing maintenance.

WARNING—Escape of Hazardous Substances from Flow Connections

Flow and capillary connections can be filled with substances that can pose health risks. Solvent can spray when capillaries burst, slip out of their fittings, or are not properly tightened or when capillary connections are otherwise open.

- Wear appropriate protective equipment and follow good laboratory practice.
- Before starting maintenance or repair procedures, flush out harmful substances with an appropriate solvent.

CAUTION—Spraying Solvent

Solvents can spray when under high pressure.

- Stop the pump flow prior to opening the flow path.
- Wait until the system pressure is down to zero.
- When opening the flow path, wear appropriate protective equipment.

CAUTION—Hydrostatic Pressure

Solvent may spill when you open the flow path during pump operation. This is due to hydrostatic pressure in the system when the solvent reservoirs are located above the pump outlet.

Before you loosen a connection in the low-pressure flow path:

- Turn off the pump flow and wait until the system pressure is down to zero.
- Unscrew the caps of the solvent reservoirs and remove the solvent lines together with the caps from the reservoirs.
- Empty the solvents lines. Refer to the *Operating Manual* for the pump.
- Retighten the reservoir caps.

CAUTION—Electric Shock or Damage to the Device

After the power to the device is turned off, the device is still energized as long as the power cord is connected. Repair work on the device while the device is connected to power could lead to personal injury.

- Always unplug the power cord before starting repair work inside the device.
- If you were instructed to remove any housing covers or panels, do not connect the power cord to the device while the cover or panels are removed.

TIP When the power is turned off to the device, the left front door of the device is opened automatically for proper ventilation of the fraction collector compartment and cannot be closed while the power is turned off.

7.3 General Rules for Maintenance and Service

For successful maintenance and service procedures, follow these rules and recommendations:

- Before starting maintenance or service procedures, shut down the device when instructed to do so.
- Use only the replacement parts specifically authorized and qualified for the device by Thermo Fisher Scientific. For ordering information, see Consumables and Replacement Parts (▸ page 245).
- Follow all instructions step by step and use the tools recommended for the procedure.
- Before opening the flow path to replace capillaries in the system, turn off the pump flow and wait until the system pressure is down to zero.
- Dirty components can contaminate the chromatography system. Contamination leads to poor performance of the modules and entire system or can even cause damage to the modules and system. Therefore:
  - Always wear appropriate gloves.
  - Place the components only on a clean, lint-free surface.
  - Keep your tools clean.
  - Use only lint-free cloth for cleaning.

NOTICE

Flow connections and capillary connectors are highly sensitive to contamination. Dust and debris can contaminate these connections. Always install caps onto capillaries and plugs to open flow connections to protect them from contamination.

- If you need to return the device for depot repair, follow the instructions in Transporting or Shipping the Device (▸ page 201).

7.4 Routine and Preventive Maintenance

Optimum device performance, maximum uptime of the device, and accurate results can be obtained only if the device is in good condition and properly maintained.

7.4.1 Maintenance Plan

Perform the maintenance procedures in the table on a regular basis. The frequency given in the table is a suggestion. The optimum frequency for maintenance depends on several factors, such as the types and amounts of samples and solvents used with the device.

Frequency	What you should do...
Daily	Inspect the flow connections for signs of leakage or blockage.
	When you use buffers or salt solutions, flush the device thoroughly after use with an appropriate solvent that does not contain buffers or salts.
	Check the liquid level of the needle wash and flush solvent reservoir. Fill the solvent reservoirs with fresh liquid if required.
	Purge needle wash system to fill the needle wash port with the fresh needle wash liquid. During purging, the needle wash port is flushed continuously until the fresh needle wash liquid is present.
	In Chromeleon, purge the flush pump to remove potential air in flush fluidics. During purging, the flush pump and flush buffer loop are flushed continuously until the fresh flush solvent fills up the flush system.
	Check if particles, dust or algae are present in the needle wash liquid and flush solvent.
	Inspect vials and well plates that are stored inside the device for cracks or defects. Clean up spills if necessary.
Regularly	Inspect the flow connections for damage, such as cracks, nicks, cuts, or blockage.
	Replace the needle wash liquid and flush solvent in the needle wash and flush solvent reservoirs regularly, approximately every 1 or 2 weeks. See Needle Wash Liquid Guidelines (▷ Page 166).

Frequency	What you should do...
	To avoid fluid backup, it has to be ensured for the proper drainage of waste: Ensure the waste tubing does not crimp or bend. A crimp or bend can impede flow to the waste container. Ensure the exit of the waste tubing is not immersed in waste solvent. If necessary, shorten the tubing so that no portion of it drops below the top of the waste container. To avoid spills, empty the waste container at regular intervals. Place the waste container below the system stack.
	Check that all warning labels are still present on the device and clearly legible. If they are not, contact Thermo Fisher Scientific for replacement.
Annually	Have Thermo Fisher Scientific service personnel perform preventive maintenance once a year.

TIP Chromeleon supports functions for estimating the lifetime of consumables. See Predictive Performance (▸ page 158).

7.4.2 Cleaning or Decontaminating the Device

Cleaning and decontamination must be performed by qualified personnel wearing suitable personal protective equipment. Always observe national and local regulations.

NOTICE Wipe up all liquids spilled onto the system immediately. If surfaces are exposed for longer periods, these liquids can cause damage.

Decontamination

Decontamination is required, for example, when leakage or spillage has occurred, or before service or transport of the device. Use a suitable cleaning detergent or disinfectant to ensure that the treatment renders the device safe to handle.

Parts required

- Suitable cleaning detergent (or disinfectant)
- Purified water
- Lint-free cloths or wipes

CAUTION—Explosive Gas Mixtures from Alcoholic Cleaning Detergents

Alcohol-containing cleaning detergents may form flammable and explosive gas mixtures when exposed to air.

- Use such cleaning detergents only when required and only in adequately ventilated rooms.
- Avoid open flames or exposure to excessive heat during the cleaning process.
- Wipe the cleaned components thoroughly dry after cleaning. Do not operate the device before it is completely dry.

NOTICE Observe the following:

- Only use cleaning detergents that will not damage the surfaces of the system.
- Never use sharp tools or brushes for cleaning any surfaces.
- Do not use sprays for cleaning.
- Prevent cleaning detergent from entering the flow path.
- Do not use excessively wetted cloth or wipes for cleaning. Prevent any liquids from entering the functional components of the device. Liquids can cause a short circuit when getting in contact with the electronic components.

Preparations

Open the left front door to move the needle unit to the parking position.

1. Remove all sample containers and sample racks from the fraction collector compartment.
2. Press the Service button on the keypad to move the needle unit to the service position.
3. Turn off the power to the device and disconnect the power cord from the power source.
4. Secure the needle drive with needle arm shipping lock by fixing three screws. See Predictive Performance (▸ page 158)

Follow these steps

1. Wipe the surfaces clean with a clean, dry, soft, lint-free cloth or wipe. If necessary, slightly dampen the cloth or wipe with a solution of lukewarm water and a suitable cleaning detergent.
2. Allow the cleaning detergent to react as recommended by the manufacturer.
3. Wipe the cleaned surfaces with purified water to ensure that all cleaning detergent residues have been removed.
4. Wipe the surfaces dry using a soft, lint-free cloth or wipe.

7.4.3 Predictive Performance

General Overview

The Chromeleon software supports functions for estimating the lifetime of consumables and for monitoring and recording service and qualification information about the device. These functions, which are called Predictive Performance, allow you to schedule maintenance procedures based on the actual operating and usage conditions of the device.

On special wellness, service, and qualification panels, you can define intervals for replacing components that are subject to wear or stress and for service procedures or qualification procedures. In addition, you can set limits to alert you before and when the replacement, service, or qualification is due.

Color-coded bars on special panels provide visual feedback, allowing you to easily check and monitor the status. If a warning limit was set, a message in the Chromeleon Audit Trail alerts you when the action is due.

Some counters can be reset to zero after the required action was performed. To keep the Predictive Performance information up-to-date, consider resetting the counter when a maintenance, service, or qualification procedure has been performed.

For more information, refer to the *Chromeleon Help*.

Available Parameters for the Fraction Collector

The list shows the Predictive Performance counter for the device in Chromeleon. Consider resetting the parameter after performing the related maintenance procedure:

Predictive Performance Command	To perform
Log Drain Pump Tubing Change	After replacement of drain pump.
Log Flush Pump Change	After replacement of flush pump.
Log Fraction Valve Change	After replacement of fraction collection valve.
Log Needle Capillary Change	After replacement of needle capillary.
Log Needle Unit Change	After replacement of needle unit.
Log New Service	After annual maintenance by service personnel.

7.5 Before Maintenance

This section describes how to prepare the device before starting maintenance on the flow components in the device.

7.5.1 Preparing the Device for Maintenance

When

See the *Preparations* in the respective maintenance section to obtain if shutting down and preparing the device for maintenance is required for the procedure.

Follow these steps

1. Check that the fraction collection valve is set to waste position if the valve is not yet in this position.
2. Flush the device with an appropriate, pure solvent. If a buffer solution is part of the mobile phase, flush the device with several volumes of methanol/water (50:50) before shutting down the device.
3. Turn off the pump flow. Wait until the system pressure is down to zero before you continue the shutdown of the device.
4. Empty the flush purge system:
   a) Unscrew the cap of the flush solvent reservoir.
   b) Together with the cap, remove the flush solvent tubing from the reservoir.
   c) When you remove the flush solvent tubing from the tubing guides, be careful not to pull on other tubing in the guides.
   d) Place the flush solvent tubing in an empty reservoir.
   e) In Chromeleon, select the **Purge Flush pump** button on the ePanel to empty the flush purge system.
5. Empty the drain pump:
   Leave the drain pump turned on until no condensing water is present in the waste tubing of the drain pump. Then turn off the drain pump.

6. Press the Service button on the keypad to move the needle unit to service position and then press the service button again to move the needle unit to parking position.

7.5.2 Securing the Needle Drive

When

Before maintenance procedures or for transport, make sure to secure the needle drive.

NOTICE

If the needle drive is not secured during maintenance or transport, it can damage the device. Secure the needle drive when instructed to do so to avoid damage to the device.

When the device is powered off, the needle drive may move inside the fraction collector compartment when the device is tilted, moved from one place to another place.

7.6 Removing the Front Plate

When

1. For needle capillary installation
2. For easier access to inner fluidic components
3. For easier access to needle unit
4. For replacement if case of broken front plate cable

Parts required in case repair

Replacement front plate

Tools required

Screwdriver, Torx T10

Preparations

Turn off the device with its main power switch.

NOTICE The device shall be powered off while replacing the front plate.

Follow these steps

1. Loosen the two screws that attaches the removable front plate with the screwdriver. The screws shall remain in the front plate.

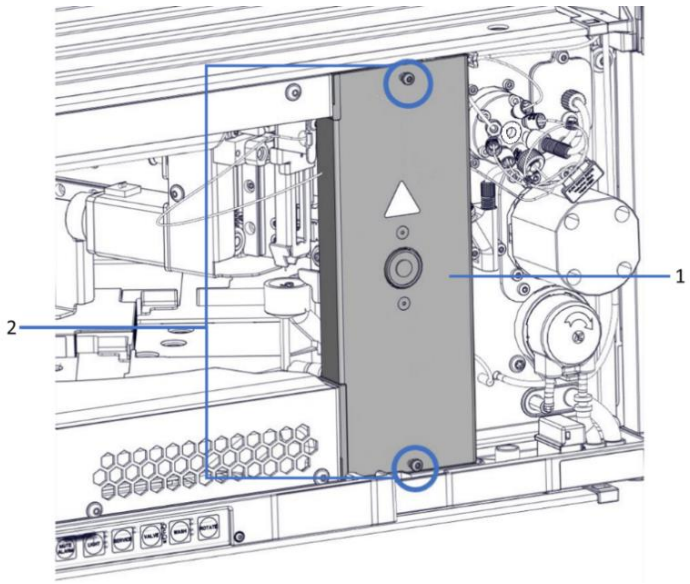

Figure 65: Loosening the two screws in front plate

No.	Description
1	Front plate
2	Screws

2. Pull the front plate outward and remove it from the slide-in module.

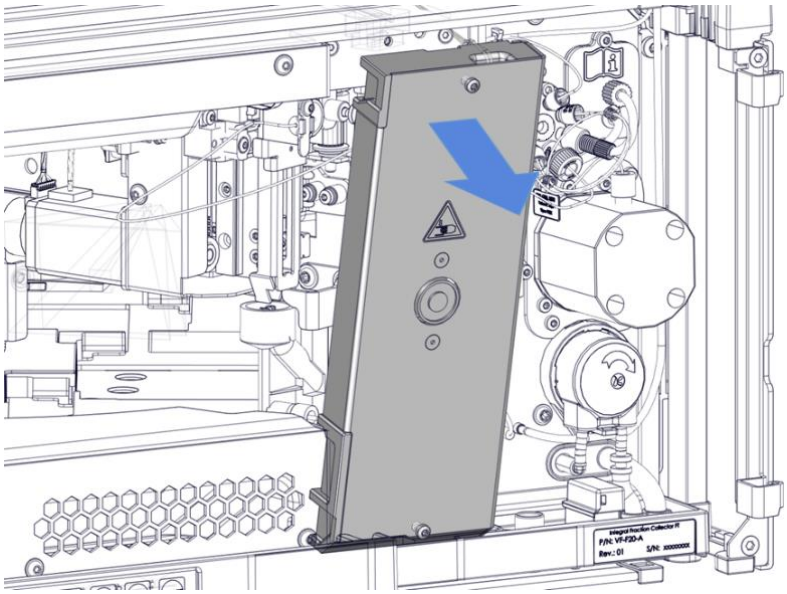

Figure 66: Pulling out the front plate

3. Pull out the cable connector from the front plate which is located at the top. Disconnect the cable connector.

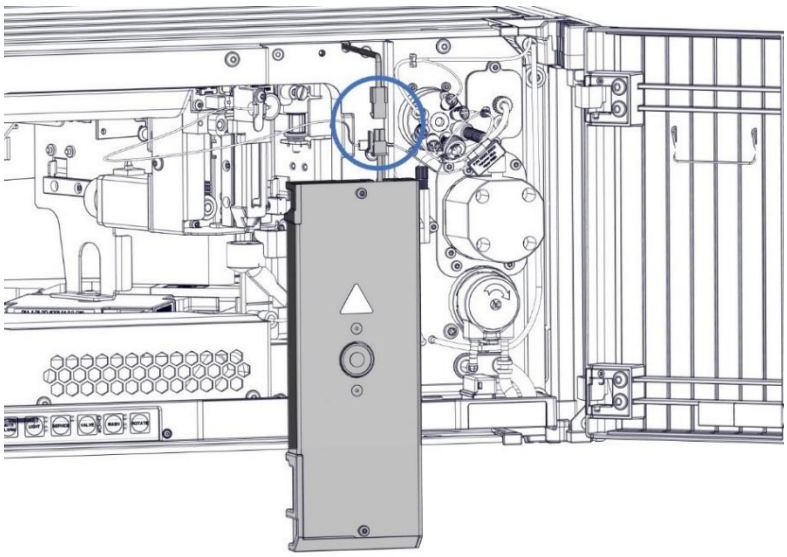

Figure 67: Disconnecting the cable connector

4. Take the new front plate, connect the cable connector and insert the connector and cables into the top slot of the front plate.

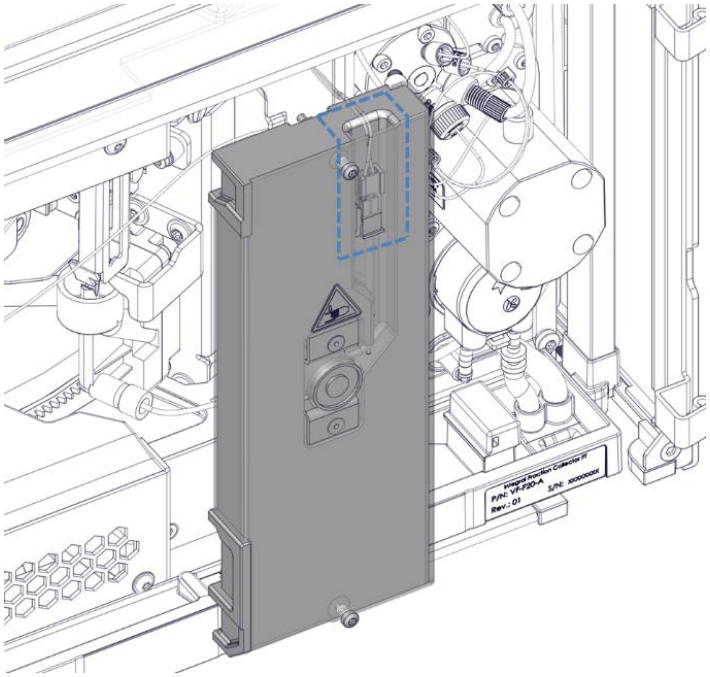

Figure 68: Connecting the cable connector and putting into the foam top slot

5. Align the removable front plate into place and push it slightly downward to the bottom.

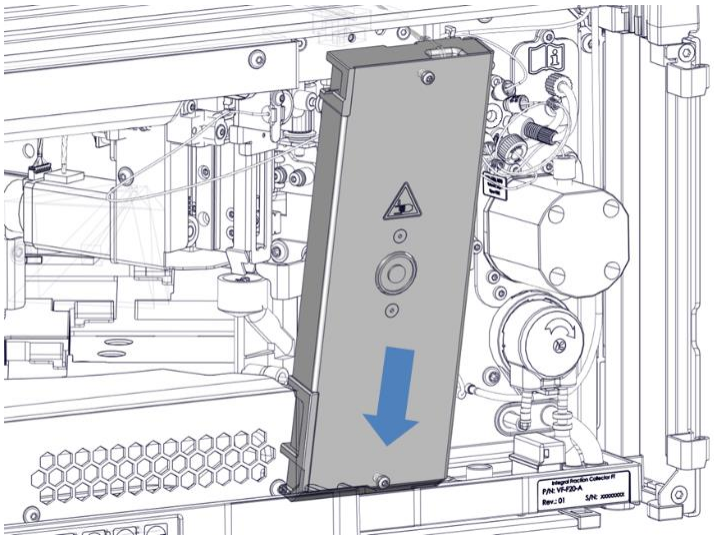

Figure 69: Putting front plate into place by slightly pushing downward to the bottom

6. Tighten the attachment screw to fix the front plate with the screwdriver.

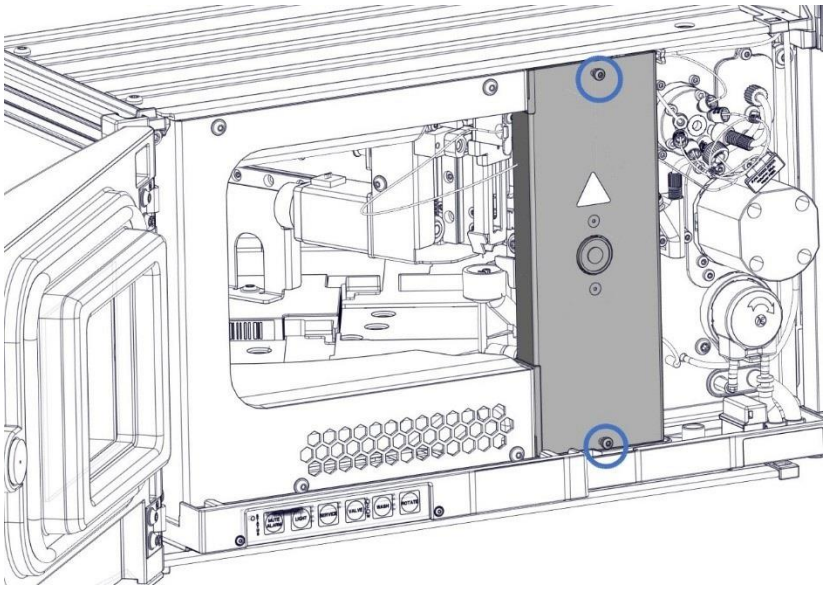

Figure 70: Tightening two screws and secure the front plate

7.7 Needle Wash Lines

Follow the instructions for the maintenance procedure that you want to perform:

- When you replace the needle wash liquid, observe the guidelines in Needle Wash Liquid Guidelines (▷ Page 166)
- When you replace needle wash lines, see Replacing Needle Wash Lines (▷ page 167)
- When you perform a needle wash cycle, purge or flush the needle wash system, see Performing A Needle Wash Cycle (▷ page 169)

7.7.1 Needle Wash Liquid Guidelines

When replacing the needle wash liquid, with the same liquid or when changing the needle wash liquid, observe the following:

- Before filling the needle wash reservoir, rinse the reservoir thoroughly. Make sure that no particles, dust or algae are present.
- *Recommended when using 100% water as needle wash liquid:*
  Replace the needle wash liquid daily.
- Use a needle wash liquid that is suitable for your application and that removes residual sample from the needle sufficiently.
- Check the liquid level of the needle wash reservoir. Fill the needle wash reservoir with fresh needle wash liquid if required.
- *If you want to use a completely different needle wash liquid:*
  Ensure that it is compatible with the wash liquid used or change to the new wash liquid stepwise.
- *After replacing the needle wash liquid:*
  In Chromeleon, purge the needle wash system to fill up the needle wash port with the fresh needle wash liquid. During purging, the needle wash port and the fluid path is flushed continuously until the fresh needle wash liquid is present.

7.7.2 Replacing Needle Wash Lines

When

If a needle wash line is clogged or damaged

Parts and additional items required

- Fresh needle wash liquid
- Replacement needle wash lines as required:
  - **Needle wash inlet line** from wash pump inlet to the needle wash reservoir in the solvent rack
  - **Needle wash outlet line** from wash pump outlet to the needle wash port inlet

Tools required

Tubing cutter (optional)

TIP If you have to cut Needle Wash Inlet Line to length, use a tubing cutter. Make sure that the cut is at right angle to the length of the line.

Preparations

1. Prepare fresh needle wash liquid. Observe the guidelines for the needle wash liquid in Needle Wash Liquid Guidelines (▷ Page 166).
2. Empty the needle wash system:
   a) Unscrew the cap of the needle wash reservoir.
   b) Together with the cap, remove the needle wash inlet line from the reservoir.
   c) When you remove the needle wash inlet line from the tubing guides, be careful not to pull on other tubing in the guides.
   d) Place the needle wash inlet line in an empty reservoir.
3. In Chromeleon, select the **Purge Needle Wash** button on the ePanel FC tab for the device to empty the needle wash system.
4. Turn off the device with its main power switch.

NOTICE The device shall be powered off while removing or replacing the front plate.

Follow these steps

1. Remove the front plate. See Removing the Front Plate (▷ Page 162).
2. Remove **needle wash outlet line** from the needle wash port inlet by unscrewing the fitting and pull out tubing from the needle wash pump outlet as shown below, then connect the **new needle wash outlet line** to the free needle wash port inlet and the free needle wash pump outlet and fit in the new needle wash outlet line into the slot on the housing.

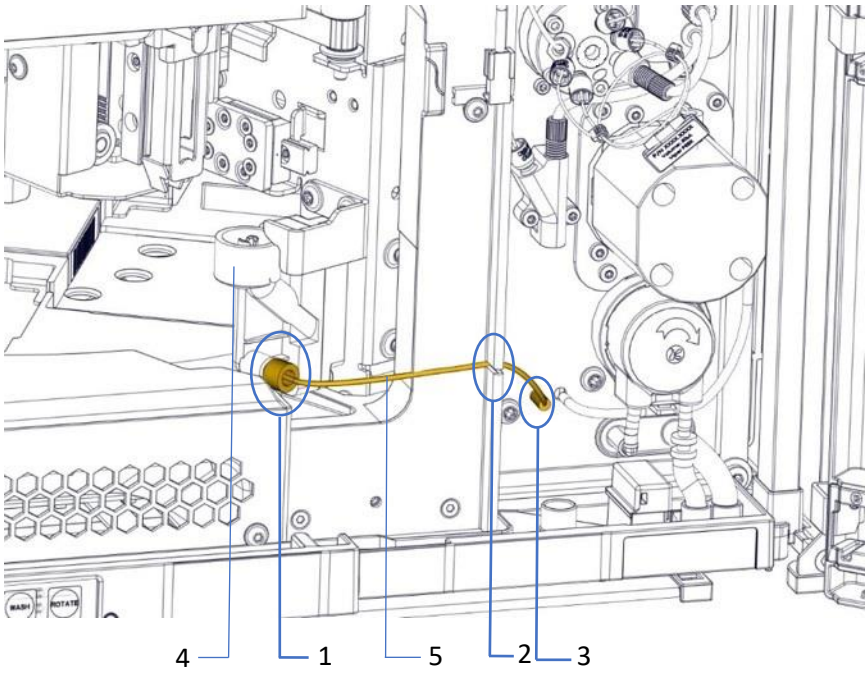

Figure 71: Needle wash outlet line

No.	Description	No.	Description
1	Needle wash port inlet	4	Needle wash port
2	The slot on the housing	5	Needle wash outlet line
3	Needle wash pump outlet		

3. Re-install the front plate. See Removing the Front Plate (▷ Page 162).

4. Replace **the needle wash inlet line** from the needle wash pump inlet to needle wash reservoir.

   a) First, remove the current needle wash inlet line.

   b) Then install the replacement needle wash inlet line. See Connecting the Needle Wash Reservoir (▸ page 80).

5. Power on the device. Close the compartment doors, then the device will run initialization automatically. Make sure no errors or warnings are reported in the Audit trail.

6. In the Chromeleon ePanel FC tab, run a **Purge Needle Wash** to fill the needle wash port with the fresh needle wash liquid. During purging, the needle wash port and the fluid path is flushed continuously until the fresh needle wash liquid is present at the wash port. For more details, see Important Operating Parameters (▸ Page 114).

7.7.3 Performing A Needle Wash Cycle

The needle wash cycle can be part of the sequence or can be performed manually. This section describes how to perform a manual needle wash cycle.

For information on automatic needle wash cycles using the wash modes in Chromeleon, see Important Operating Parameters (▸ page 114).

When

- Routine and preventive maintenance for the needle wash system
- Replacing the needle wash liquid
- Replacing needle wash lines

Preparations

- Observe the Needle Wash Liquid Guidelines. See Needle Wash Liquid Guidelines (▸ page 166).
- Purge the needle wash system to fill the needle wash port with fresh needle wash liquid, for example after replacing the needle wash liquid. In Chromeleon, select the **Purge Needle Wash** button on the ePanel FC tab.

Follow these steps

To wash the needle manually using the wash speed and wash time that are currently defined in Chromeleon, for example between sample sequences, perform one of the following options:

- On the keypad, select the **Wash** button.
- In Chromeleon, select the **External Needle Wash** button on the ePanel FC tab.

After the needle wash cycle has been completed, the needle moves up and stays at needle wash port or moves to parking position if the compartment door is open.

7.8 Flush System

Follow the instructions for the maintenance procedure that you want to perform:

- When you replace the flush solvent, observe the guidelines in Flush Solvent Guidelines (▷ page 171).
- When you replace flush purge lines, see Replacing Flush Purge Lines (▷ page 172).
- When you perform a flush purge cycle, see Performing A Flush Purge Cycle (▷ page 179).

7.8.1 Flush Solvent Guidelines

When replacing the flush solvent, with the same liquid or when changing the flush solvent, observe the following:

- Before filling the flush solvent reservoir, rinse the reservoir thoroughly. Make sure that no particles, dust or algae are present.
- Recommended when using 100% water as flush solvent replace the flush solvent daily if the flush function is adopted.
- Use a flush solvent that is suitable for your application and that removes residual fraction from flush buffer loop sufficiently.
- Check the liquid level of the flush solvent reservoir. Fill the flush solvent reservoir with fresh flush solvent if required.
- If you want to use a different flush solvent composition compared to the current flush solvent composition, ensure that it is compatible with the flush solvent used or change to the new flush solvent stepwise.
- After replacing the flush purge liquid
  In Chromeleon, select **Purge Flush Pump** on the ePanel FC tab to fill the flush pump with fresh flush solvent. During purging, the flush pump and flush buffer loop are washed continuously until all flush purge lines are filled with the fresh flush solvent. See Performing A Flush Purge Cycle (▷ page 179).

7.8.2 Replacing Flush Purge Lines

When

If one of flush purge lines is clogged or damaged.

Parts and additional items required

- Fresh flush solvent
- Replacement flush purge lines include following four capillaries:
  - Flush solvent tubing (from fraction collection valve port 7 to flush solvent reservoir)
  - Flush pump to fraction collection valve capillary
  - Flush buffer loop (from fraction collection valve port 1 to port 4)
  - Flush waste tubing (from fraction collection valve port 5 to Y-connector)

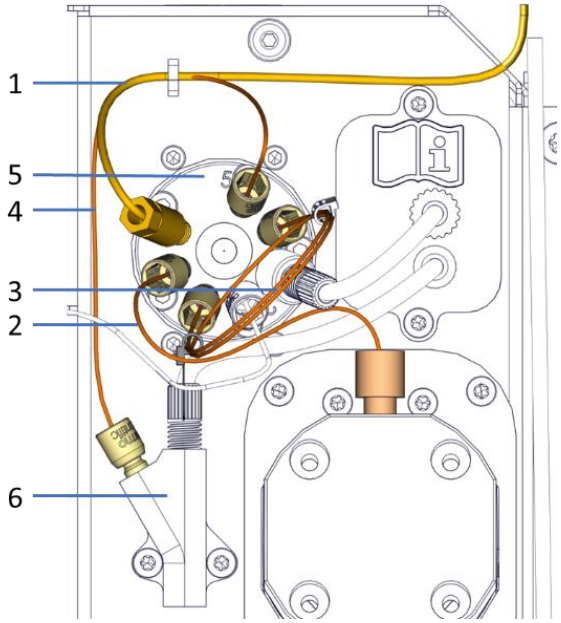

Figure 72: Configuration of flush purge lines

No.	Description	No.	Description
1	Flush solvent tubing (from fraction collection valve port 7 to flush solvent reservoir)	4	Flush waste tubing (from fraction collection valve port 5 to Y-connector)
2	Flush pump to fraction collection valve capillary (from flush pump to fraction collection valve port 8)	5	Fraction collection valve
3	Flush buffer loop (from fraction collection valve port 1 to port 4)	6	Y-connector

Tools required

Tubing cutter (optional)

TIP If you have to cut tubing to length, use a tubing cutter. Make sure that the cut is at right angle to the length of the line.

Preparations

1. Prepare fresh flush solvent. Observe the guidelines for the flush solvent. For details, see Flush Solvent Guidelines (▸ page 171).
2. Empty the flush purge system:

a) Unscrew the cap of the flush solvent reservoir.

b) Together with the cap, remove the flush solvent tubing from the reservoir.

c) When you remove the flush solvent tubing from the tubing guides, be careful not to pull on other tubing in the guides.

d) Place the flush solvent tubing in an empty reservoir.

3. In Chromeleon, select the **Purge Flush pump** button on the ePanel to empty the flush purge system.

4. Turn off the device with its main power switch.

5. Take one **Viper knurled head** from other Viper capillaries as a tool for following actions, e.g. from the delay capillary connecting detector outlet and fraction collection valve central port. The knurl needs to be fit with Viper fitting first before tightening or loosening it.

Follow these steps

1. Remove the flush solvent tubing from port 7 of fraction collection valve to the flush solvent reservoir in the solvent rack:

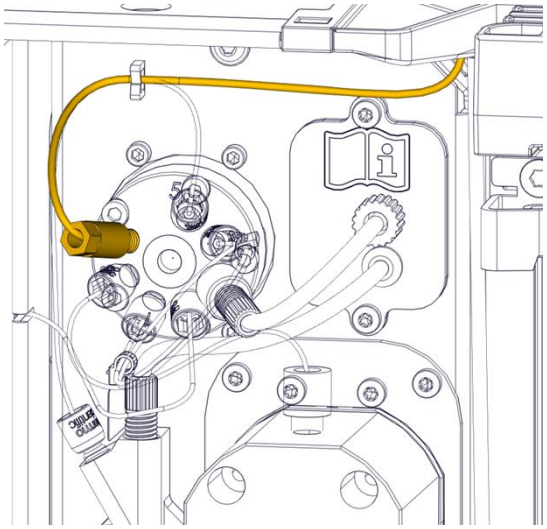

Figure 73: Flush solvent tubing

2. Remove the capillary between flush pump and fraction collection valve port 8:
3. Disconnect from the flush pump by unscrewing the fitting.
4. Disconnect the Viper fitting from port 8 of fraction collection valve with the Viper knurl.

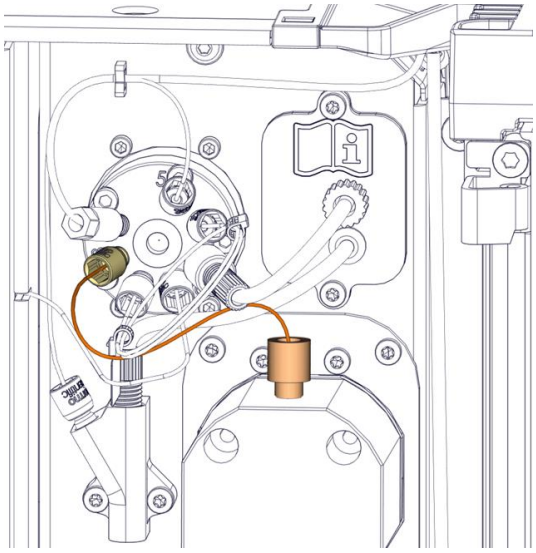

Figure 74: Flush pump to fraction collection valve capillary

5. Remove the flush buffer loop from port 1 to port 4 of fraction collection valve and remove the flush waste tubing from Y-connector and fraction collection valve with the Viper knurl.
6. Disconnect the Viper fitting from port 1 of fraction collection valve.
7. Disconnect the Viper fitting from port 4 of fraction collection valve.
8. Then disconnect the Viper fitting from port 5 of fraction collection valve to remove the flush waste tubing.

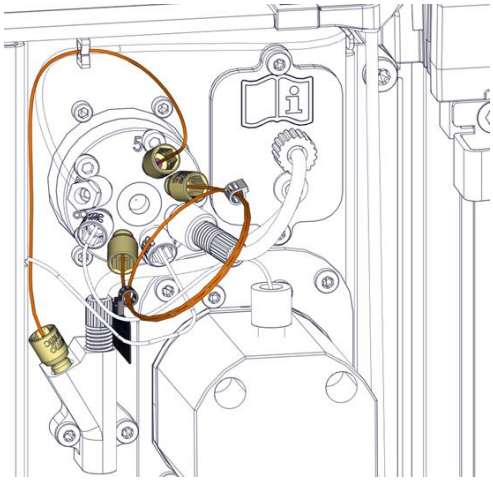

Figure 75: Remove flush buffer loop and flush waste tubing

TIP If capillaries are to be reinstalled, protect the open ends of the capillaries with caps.

9. Connect a new flush buffer loop to port 1 and port 4 of fraction collection valve, and then install a new flush waste tubing to connect Y-connector and fraction collection valve port 5.

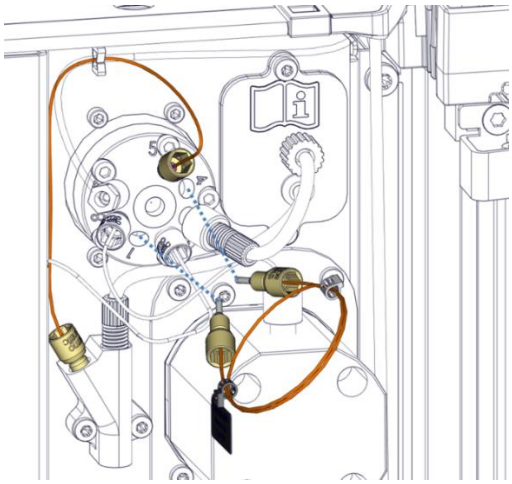

Figure 76: Installation of flush buffer loop and flush waste tubing

a) Unpack a replacement flush buffer loop and a replacement flush waste tubing. Remove the cap from the Viper fittings.

b) Connect the Viper fittings to relevant ports of the fraction collection valve and tighten them with the Viper knurled head.

c) Remove the knurls from the Viper fittings due to limited space at the fraction collection valve.

10. Connect the capillary between flush pump and port 8 of fraction collection valve:

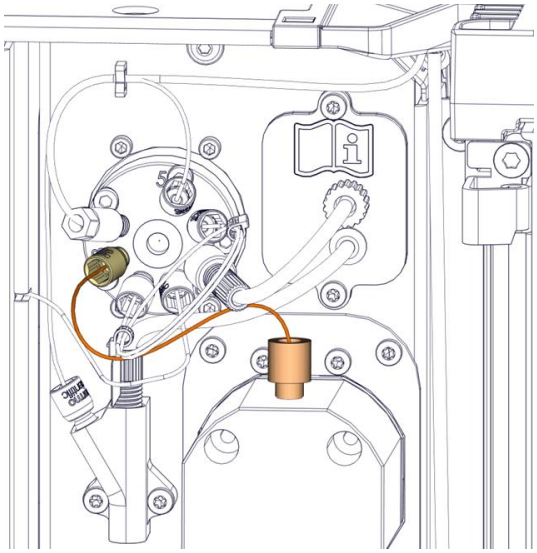

Figure 77: Flush purge line connected to fraction collection valve and flush pump

a) Unpack the replacement capillary. Remove the protection cap from the Viper fitting.

b) Connect the capillary to the flush pump by tightening the fitting.

c) Connect the Viper fitting to port 8 of fraction collection valve.

d) Remove the knurl from the Viper fitting due to the limited space at the fraction collection valve.

NOTICE

A black Viper knurled head is needed to tighten or loosen Viper fitting.

Tighten the capillaries by hand. For details, see Connecting Viper Capillaries (▸ page 77).

Keep the Viper knurls for reuse in the future.

11. Connect a new flush solvent tubing to port 7 of fraction collection valve and route to the flush solvent reservoir in the solvent rack.

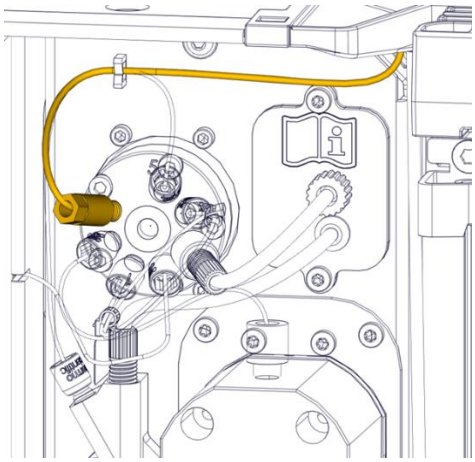

Figure 78: Install the replacement flush solvent tubing

a) Unpack a replacement flush solvent tubing.

b) Connect the flush solvent tubing onto port 7 of fraction collection valve by tightening the fitting.

c) Route the flush solvent tubing to flush solvent reservoir. For details, see Connecting Flush Solvent Reservoir (▸ page 87).

12. Power on the device. The device will run initialization automatically. Make sure no errors or warnings are reported in the *Audit trail*.

13. In *Chromeleon*, make sure to check the installed flush buffer loop compatible with the installed needle capillary. Both the needle capillary and flush buffer loop shall match with the application of flow rate range.

Flow rate [mL/min]	Needle Capillary ID x L [mm]	Flush Buffer Loop ID x L [mm]
0 - 5.0	0.18 × 415	0.5 × 255 (V = 50 µL)
5.0 - 10.0	0.25 × 415	0.5 × 510 (V = 100 µL)

NOTICE The needle capillary must match with installed flush buffer loop as shown in above table in order to achieve good fraction collection performance with low carry over and high recovery when flush function is enabled. The fluidic volume of flush buffer loop shall be around double volume of matched needle capillary.

14. Flush the flush pump solvent lines to ensure they are filled with fresh flush solvent, see Performing A Flush Purge Cycle (▸ Page 179).

7.8.3 Performing A Flush Purge Cycle

When

- Routine and preventive maintenance for the flush purge system
- Replacing the flush solvent
- Replacing flush purge lines

Preparations

- Observe the *Flush Solvent Guidelines*. See Flush Solvent Guidelines (▸ page 171).

Follow the step

In Chromeleon, select **Purge Flush Pump** on the ePanel FC tab to fill the flush pump with the fresh flush solvent. During purging, the flush pump and the flush buffer loop is washed continuously until all flush purge lines filled with fresh flush solvent.

7.9 Replacing the Needle Capillary

When

If the needle capillary is clogged or damaged, or a new needle capillary needs to be installed due to flow rate change.

Parts required

Replacement needle capillary

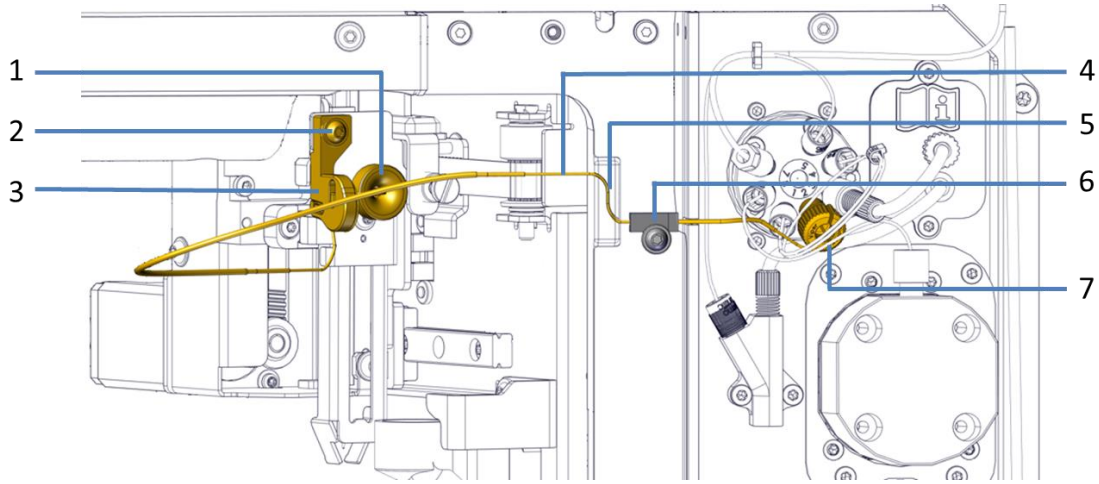

Figure 79: Needle capillary

No.	Description	No.	Description
1	Needle capillary Viper fitting on the needle unit	5	S-shape slot on the foam part
2	Needle capillary screw	6	Needle capillary press plate
3	Needle capillary support block	7	Needle capillary Viper fitting on the fraction collection valve
4	Needle capillary		

Tools required

Screwdriver, Torx T10

Preparations

1. Prepare the device for maintenance, move the needle unit into service position. See Before Maintenance (▸ page 160).
2. Turn off the device with its main power switch.

3. Take one Viper knurl from other Viper capillaries as a tool for following actions, e.g. from the delay capillary connecting detector outlet and fraction collection valve central port. The knurl needs to be fit with Viper fitting first before tightening or loosening it.

NOTICE The device shall be powered off while replacing the needle capillary.

Follow these steps

1. Remove the front plate. See Removing the Front Plate (Page 162).
2. Loosen the attachment screw on needle capillary press plate with the screwdriver till the needle capillary can be released from the needle capillary press plate. The screw shall stay loose but not removed from the device.

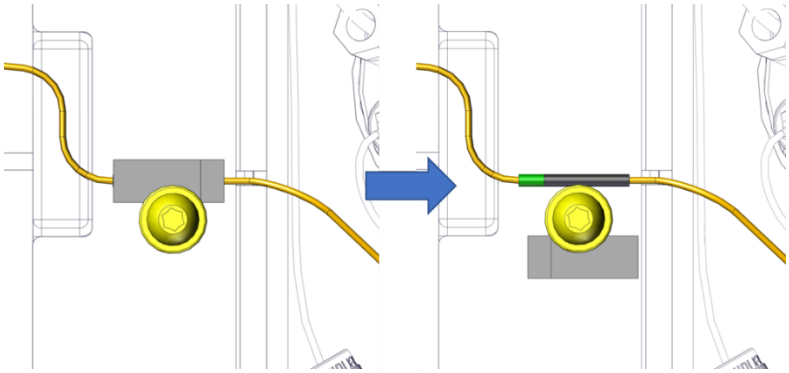

Figure 80: Loosening the attachment screw to release needle capillary

3. Loosen the needle capillary screw and disconnect the needle capillary Viper fitting from the needle unit.

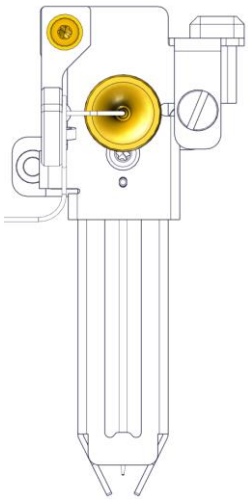

Figure 81: Removing the needle capillary

4. Disconnect the needle capillary Viper fitting from the port 2 of the fraction collection valve with the Viper knurl pre-prepared.

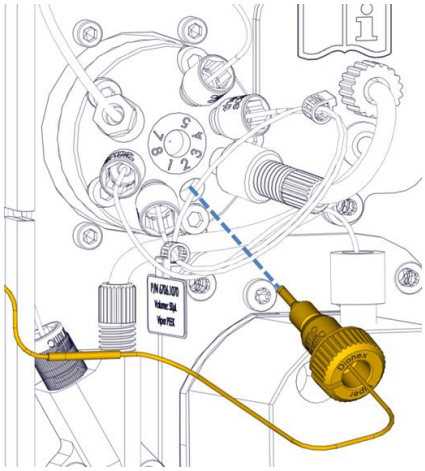

Figure 82: Disconnect Viper Fitting

5. Remove the old needle capillary from the device.
6. Unpack the replacement needle capillary carefully. Remove the protection cap from the Viper fittings.
7. Connect the needle capillary Viper fitting to the port 2 of fraction collection valve. Remove the Viper knurl due to limited space at the fraction collection valve and reserve it for future use.

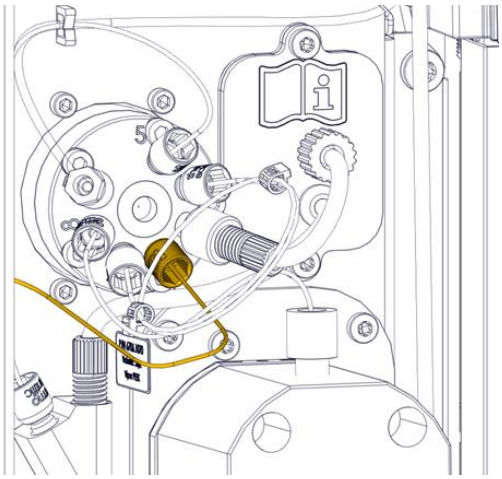

Figure 83: Connect Viper fitting to fraction collection valve port 2

8. Connect the needle capillary Viper fitting to the needle unit and tighten the needle capillary screw. Make sure the needle capillary support block is aligned well with the needle unit.

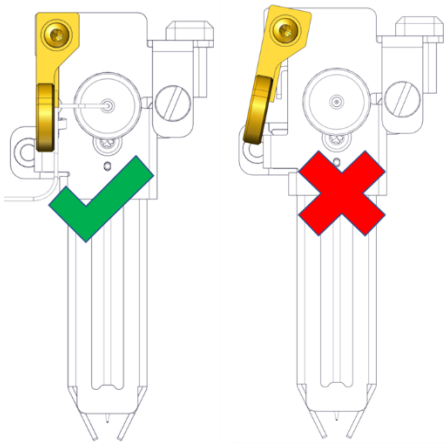

Figure 84: left – correct alignment, right: wrong alignment

9. Insert the needle capillary into the S-shape slot on the foam part and fix the needle capillary with the needle capillary press plate. Tighten the attachment screw on the needle capillary press plate to fix the needle capillary press plate and secure the needle capillary in the place.

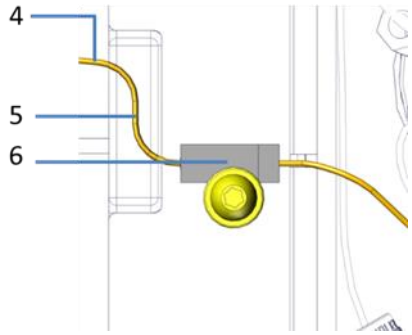

Figure 85: Route and secure the needle capillary on the front surface of the device

NOTICE Do NOT over-tighten the attachment screw because the needle capillary under the press plate may be damaged.

10. Install back the front plate with reverse steps. See Removing the Front Plate (▸ page 162).
11. Power on the device. Close the compartment doors and the device will run initialization automatically. Make sure no errors or warnings are reported in the Audit trail.
12. In Chromeleon, configure the **Needle Capillary**. There are two options of the needle capillary types: 0.18 x 415 mm and 0.25 x 415 mm. Users can check via the marker on the needle capillary and select accordingly. For more details, see Setting Up the Device in the Software (▸ page 95).
13. In Chromeleon, select **Internal Needle Rinse** on ePanel to rinse the internal surface of the needle capillary and needle unit with mobile phase. For more details, see Important Operating Parameters (▸ page 114).

7.10 Replacing the Needle Unit

When

If the needle unit is clogged or damaged

Parts required

Replacement needle unit

Tools required

Screwdriver, Torx T10

Preparations

1. Prepare the device for maintenance, move the needle unit into service position. See Before Maintenance (▷ page 160).
2. Turn off the device with its main power switch.

NOTICE The device shall be powered off while replacing the needle unit.

Follow these steps

1. Remove the front plate. See Removing the Front Plate (▷ page 162).
2. Remove the needle capillary. See Replacing the Needle Capillary (▷ page 180).
3. Push the lock pin upward so that you can access the attachment screws to uninstall the needle unit. Unscrew the attachment screws with the screwdriver. Remove the needle unit.

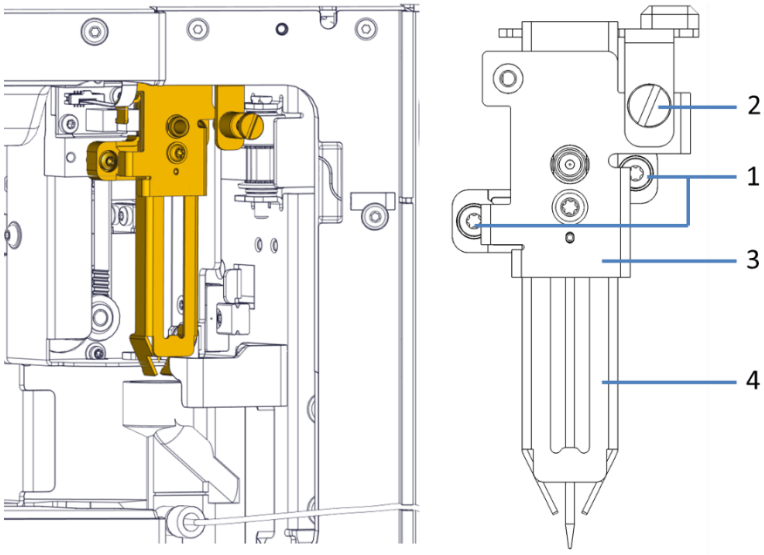

Figure 86: Removing the needle unit

No.	Description	No.	Description
1	Attachment screw for the needle unit	3	Vial pusher cover
2	Lock pin	4	Vial pusher

NOTICE Pay attention to the removing and installation process. Make sure no extra force or damage to the yellow cable nearby the needle unit.

1. Unpack the replacement needle unit and remove the protection parts, including a short tubing on the needle tip and a plug.
2. Position the needle unit on the installation plate. Align the two pins on the rear side of the needle unit into **the holes on the installation plate.**

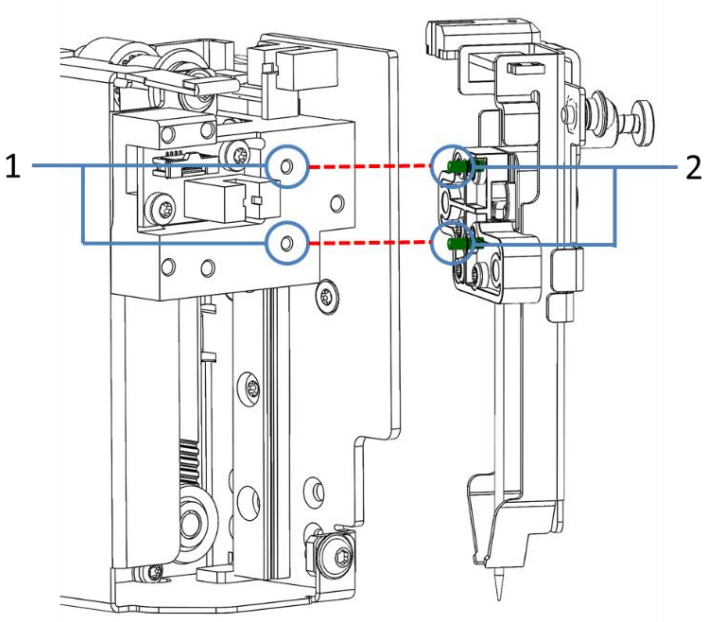

Figure 87: Install the needle unit via two aligning pins

No.	Description	No.	Description
1	Two alignment holes on the front side of the installation plate	2	Two pins on the rear side of the needle unit

3. Tighten the two attachment screws on the needle unit.

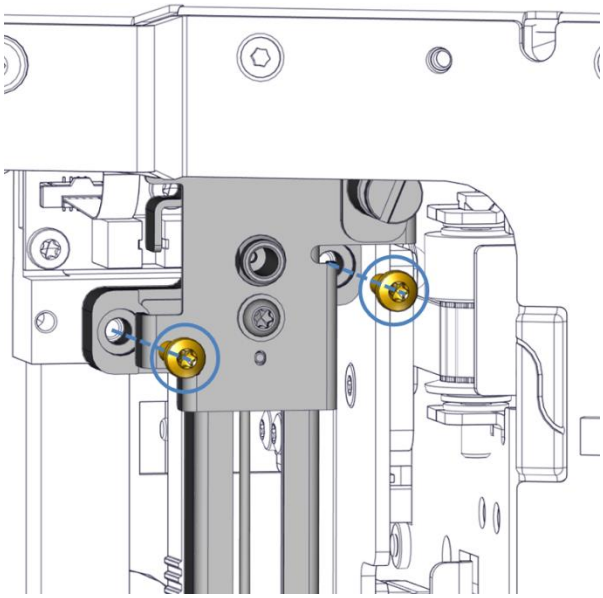

Figure 88: Tighten the needle unit with two attachment screws

4. Check if the needle unit is positioned correctly:

   Move the lock pin slightly upward. If the lock pin and the vial pusher can move up and down easily, the needle unit sits correctly in place.

5. Reinstall the needle capillary. See Replacing the Needle Capillary (▸ page 180).

6. Install the front plate. See Removing the Front Plate (▸ page 162).

7. Power on the device. Close the compartment doors and the device will run initialization automatically. Make sure no errors or warnings are reported in the *Audit trail*.

7.11 Replacing the Drain Pump Head with Tubing

When

- Drain pump tubing is worn or damaged
- Drain pump head is broken

Parts and additional items required

Replacement drain pump head with tubing

Preparations

Make sure that the drain pump is turned off.

Follow these steps

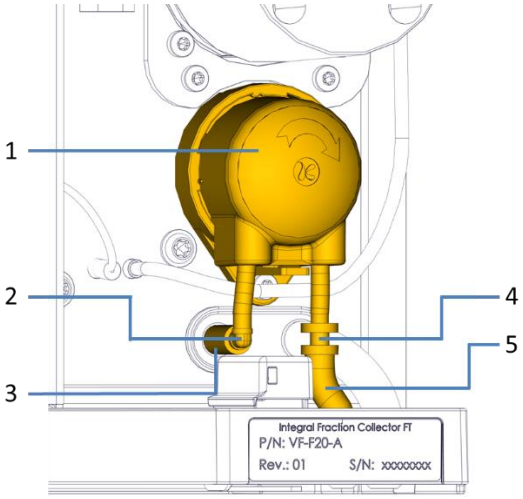

Figure 89: Configuration of drain pump head with tubing (waste tubing)

No.	Description	No.	Description
1	Drain Pump Head	4	Straight Tubing Connector
2	Elbow tubing connector	5	Waste Tubing (pre-installed with the pump head)
3	Condensation Tubing		

1. Rotate the drain pump head counterclockwise slightly with and remove it gently.
2. Disconnect the condensation tubing on the left from the tubing connectors. Leave the tubing connectors connected to the drain pump head.

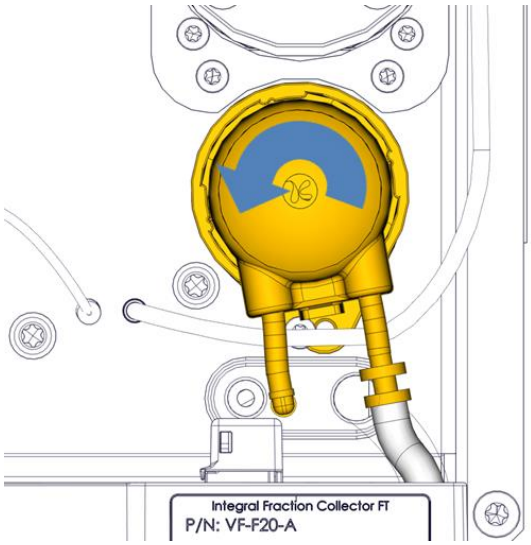

Figure 90: Drain pump rotate counterclockwise to release the pump head from pump motor

3. Unpack a replacement drain pump head with tubing.
4. Connect the condensation tubing in the device to the left tubing connector on the replacement drain pump head with tubing.
5. Mount the replacement drain pump head and rotate it clockwise slightly to the end by hand. When you hear a click, the replacement drain pump head is successfully installed with pump motor together.
6. Insert the right-hand side waste tubing of the replacement drain pump with tubing into the relevant hole and secure onto the front leak tray.
7. In Chromeleon, perform the **DrainPumpHeadChanged** command.
8. Turn on the drain pump to check proper functionality.

NOTICE Make sure to rotate the pump head gently and not damage the pump tubing during the operation.

7.12 Replacing the Fraction Collection Valve Stator and Rotor

When

There is a fraction collection valve leakage issue

One drain hole is provided at the right side of the fraction collection valve. If liquid droplets appear on the drain hole, this may indicate valve leakage.

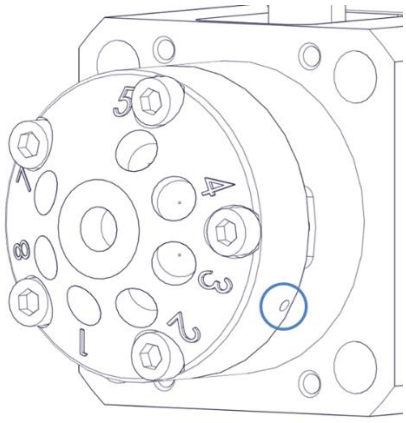

Figure 88: Drain hole on the right side of fraction collection valve

Parts and additional items required

Replacement fraction collection valve stator

Replacement fraction collection valve rotor

Preparations

Prepare the device for maintenance.

See Preparing the Device for Maintenance, page 160. (Make sure to stop pump flow)

Follow these steps

1. Disconnect all liquid lines connected to the fraction collection valve.
2. Remove the five stator screws located in the stator, using a hexagon driver (size 3/32''). Loosen the screws in quarter-turn (90°) increments until all load is removed.

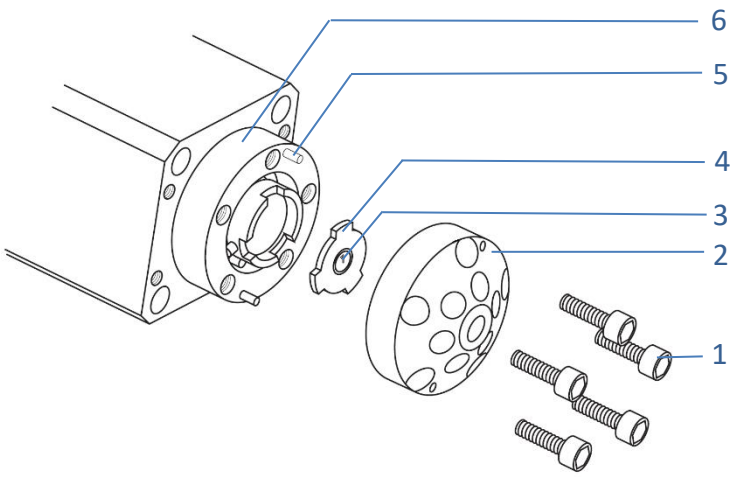

Figure 89: Exploded view of the fraction collection valve

No.	Description	No.	Description
1	Stator screws	4	Fraction collection valve rotor
2	Fraction collection valve stator	5	Pins (two) on valve body
3	Grooves on fraction collection valve rotor	6	Fraction collection valve body

3. Remove the fraction collection valve stator (2). To ensure that the sealing surface of the stator is not damaged, rest it on its outer face.
4. With your fingers or a small tool, gently pry the rotor (4) away from the body.
5. Examine the rotor sealing surface for scratches. If you see any, the rotor should be replaced.
6. Examine the stator sealing surfaces. If scratches are visible between the ports, that stator should be replaced.
7. Clean all the parts thoroughly with an appropriate solvent, taking care that no surfaces get scratched.

TIP The most common problem in the use of the valve with HPLC is the formation of buffer crystals, which are usually water-soluble. After cleaning, it is not necessary to dry the rotor.

To avoid any contamination of the surfaces, clean all parts with isopropanol and use disposable gloves when reassembling the valve.

8. Reinstall the cleaned rotor or replace with a new rotor, making sure that the rotor sealing surface with its engraved grooves is facing out. The tabs on the rotor have an asymmetrical pattern to prevent assembly with improper orientation.

9. Reinstall the cleaned stator or mount the replacement stator onto the valve, by aligning the matching holes in the stator with the two pins on the valve body.

10. Insert the five stator screws and tighten them gently until they start to get snug. Alternate among the five screws in the sequence as indicated in below figure, tightening them in quarter-turn (90°) increments until the stator is flush against the valve body.

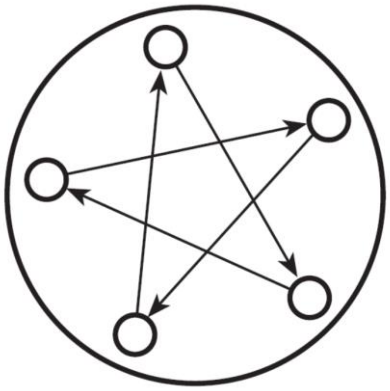

Figure 90: Loosening and tightening order

11. Reinstall all liquid lines as reversed steps.

NOTICE The valve sealing surfaces must be protected during any disassembly or cleaning procedure. Work in a clean environment and always set parts on a soft tissue or clean paper. Cleaning a valve can often be accomplished by flushing all the lines with appropriate solvents.

7.13 After Maintenance

The section describes how to restart the fraction collector after respective maintenance procedures.

When

See the steps in the respective maintenance section to obtain if restarting the fraction collector after maintenance is required for the procedure.

Follow the steps

1. Perform the required parameter updates or adjustments. Follow the instructions in the respective maintenance procedures.
2. Prepare the fraction collector for operation. See Preparing the Device for Operation (▷ page 106).

7.14 Replacing the Main Power Fuses

When

Blown fuses

Parts required

Replacement fuses (2 fuses, 5AT, 230 V AC, slow-blow, 5 x 20 mm) from Fuses Kit

Tools required

Slotted screwdriver, any size between 3.3 mm and 5.5 mm is appropriate

Preparations

WARNING—Electric Shock

High voltages are present inside the device that could cause an electric shock or damage to the device.

Turn off the device with its main power switch. Disconnect the power cord from both the power source and the device.

Use only the fuses of the type and current rating specified for the device by Thermo Fisher Scientific. Do not use repaired fuses and do not short-circuit the fuse holders.

Follow these steps

The fuse holder is located next to the main power switch.

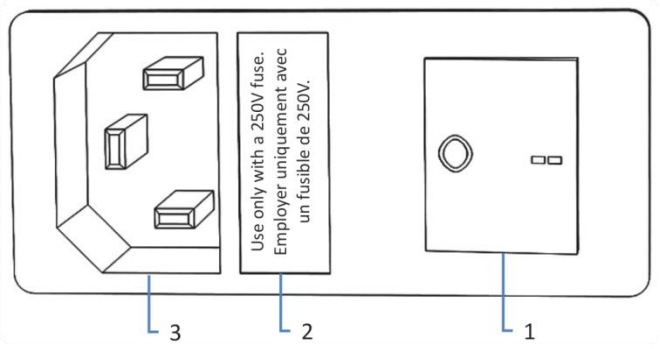

Figure 91: Fuse holder

No.	Description
1	Main power switch (on/off control)
2	Fuse holder
3	Power-inlet connector

1. Use the screwdriver to remove the fuse holder. To do this, insert a small flat screwdriver into the slot next to the fuse holder and remove the cover cap with a lever movement.
2. Replace the two fuses with new fuses of the specified type and current rating. Always replace *both* fuses.
3. Reinstall the fuse holder.
4. Reconnect the power cord to the power source and to the device.
5. Turn on the device with the main power switch.

7.15 Updating the Device Firmware

When

Updating the device firmware might be required, for example, when a new firmware version is released that adds functionality or solves problems of a previous version.

Items required

Firmware version/Chromeleon Service Release as appropriate

TIP When a new firmware version is released, the new version will be included in the next available Chromeleon Service Release. The new firmware will *not* be transferred automatically to the device when you install the Chromeleon Service Release.

Preparations

1. Read the release notes provided with the firmware and/or Chromeleon version.
2. Connect the device in the Chromeleon software.
3. Stop all operations in the Instrument that includes the device.
4. Wait until the instrument is idle.

Follow these steps

1. Start the Chromeleon Instrument Configuration Manager.
2. Perform a firmware update from the **General** tab page in the configuration dialog box for the device. For more information, refer to the *Chromeleon Help*.

NOTICE A firmware downgrade or incomplete firmware update may result in loss of functionality or malfunctioning of the device.

- Do not interrupt communication between the Chromeleon software and the device at any time during the procedure.
- At the beginning of the update process, a message appears showing the firmware version currently installed in the device and the version that will be transferred from the Chromeleon software. If the firmware installed in the device is a later version than the version in Chromeleon, cancel the download.

The firmware update may take several minutes.

3. Monitor the Audit Trail of the Chromeleon Instrument Configuration Manager to see whether the firmware update is successful or fails.
    - If the firmware update fails, turn the device off and on again and repeat the firmware update.
    - If the firmware update fails repeatedly, contact Thermo Fisher Scientific Technical Support for assistance.
4. After a successful firmware update, requalification of the device may be required. See the release notes for a recommendation.

7.16 Replacing the Doors

When

Damage of door

TIP The maintenance procedures do not require that you remove the doors. If this should ever be required for a specific reason or procedure, follow the related steps in this section.

Parts required

Replacement door

Follow these steps

NOTICE
To avoid damage to the door hinges, be careful when performing the following sequence of steps and do not apply force.

1. To remove a door, push the door upward while opening.
   Open the door to a position in which the two hinges on the housing are aligned in the grooves on the door. You can remove the door only when the hinges are in the grooves.

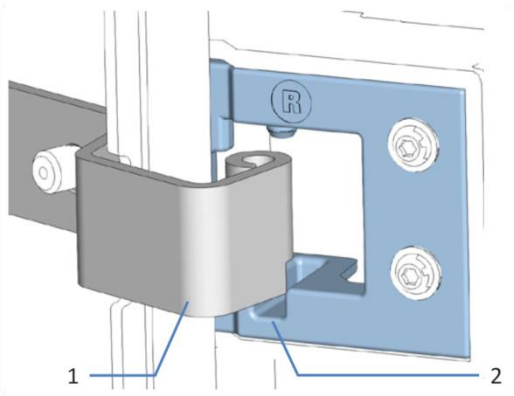

Figure 92: Unhinging a door

No.	Description
1	Hinge on the housing
2	Reception groove on the door

2. Slightly tilt the door to the outside, away from the housing, and remove the door.

3. To install the door, align the door with the hinges on the housing. Be careful not to clamp tubing or capillaries between the door and the enclosure.
4. Insert the hinges in the groove, by pushing up and slightly turning the door.
5. Push the door downward to lock it in place.
   You can close the door only when it is properly installed.

7.17 Transporting or Shipping the Device

If you want to transport the device to a new location or if you need to ship the device, first prepare the device for transport and then move or ship the device as required. Follow the instructions in this section.

Observe the following safety guidelines:

CAUTION—Heavy Load, Bulky device

The device is too heavy or bulky for one person alone to handle safely. To avoid personal injury or damage to the device, observe the following guidelines:

- Physical handling of the device, including lifting or moving, requires a team effort of two persons.
- A team effort is in particular required when lifting the device into the system stack or when removing it.
- Use the carrying handles that were shipped with the device to move or transport the device. Never move or lift the device by the front doors. This will damage the doors or the device.

Preparing the device for Transport

To prepare the device for transport, follow these steps:

1. Perform a long-term shut down of the device. See Long-Term Shutdown (▸ page 146).
2. Remove the needle capillary. See Replacing the Needle Capillary (▸ page 180).
3. Verify that the shipping locks for the needle drive and carousel are installed properly.
4. Turn off the device with its main power switch and disconnect the power cord.
5. Remove all cables and flow connections to other devices.

6. Empty the needle wash system:
   a) Unscrew the cap of the needle wash reservoir.
   b) Together with the cap, remove the needle wash inlet line from the reservoir.
   c) When you remove the needle wash inlet line from the tubing guides, be careful not to pull on other tubing in the fluid.
   d) Place the needle wash inlet line in a waste reservoir to empty it.
7. Empty the flush purge lines:
   a) Unscrew the cap of the flush solvent reservoir.
   b) Together with the cap, remove the flush solvent tubing from the reservoir.
   c) When you remove the flush solvent tubing from the tubing guides, be careful not to pull on other tubing of the fluidics.
   d) Place the flush solvent tubing in a waste reservoir to empty it.
8. Check the leak tray and drain port for liquid. If liquid is present, absorb the liquid with a tissue.
9. On the fraction collection valve, disconnect the delay capillary to the detector outlet, the flush tubing to the flush solvent reservoir, and the needle wash inlet line to the needle wash liquid reservoir.
10. Remove the waste line from the Y-connector.
11. Close open flow connections with appropriate plugs or caps.

NOTICE Flow connections and capillary connectors are highly sensitive to contamination. Dust and debris can contaminate these connections. Always install caps onto capillaries and plugs to open flow connections to protect them from contamination.

12. Install the carrying handles and remove the device from the Vanquish system. Follow the instructions on dismounting the system stack in the *Transporting or Shipping the System* section of the *Vanquish System Operating Manual*.

TIP To remove the slide-in module from the device, follow the steps in Removing the Slide-In Module (▸ page 205).

Transporting the device to a New Location

To transport the device to a new location, follow these steps:

1. Observe the notes for handling and lifting the device safely.
2. Transport the device to the new location.
3. Install and set up the device in the system stack. Follow the instructions on mounting the system stack in the *Vanquish System Operating Manual*.
4. Set up the device:
    a) To connect the device and to set up flow connections, follow the instructions in the *Installation chapter* in this operating manual.
    b) To prepare the device for first-time operation, follow the instructions in the *Preparing the device for Operation section* in this operating manual.
5. Before starting an analysis, let the device equilibrate and be sure that it is ready for operation.

Shipping the device

To ship the device, follow these steps:

1. Follow the unpacking instructions in this manual in the reverse order.
   Use only the original packing material and shipping container. If the original shipping container is not available, appropriate containers and packing material can be ordered from the Thermo Fisher Scientific sales organization.
2. If you need to return the device to Thermo Fisher Scientific for depot repair, contact your local Thermo Fisher Scientific support organization for the appropriate procedure.

CAUTION—Possible Contamination

Hazardous substances may have contaminated the device during operation and may cause personal injury to service personnel.

- Decontaminate all parts of the device that you want to return for repair.
- Fill in and sign the Decontamination Certificate, which is part of the Service Return Form. Sign the certificate to confirm that the device has been properly decontaminated and that it is free of hazardous substances.
- Thermo Fisher Scientific refuses to accept devices for repair if the Decontamination Certificate is missing.

Restarting the device after Shipping

To restart the device after shipping, follow these steps:

1. Follow the unpacking instruction in this operating manual.
2. Install and set up the device in the system stack. Follow the instructions on mounting the system stack in the *Vanquish System Operating Manual*.
3. Set up the device:
   a) To connect the device and to set up flow connections, follow the instructions in the *Installation chapter* in this operating manual.
   b) To prepare the device for first-time operation, follow the instructions in the *Preparing the device for Operation section* in this operating manual.
4. Before starting an analysis, let the device equilibrate and be sure that it is ready for operation.

7.18 Slide-In Module

CAUTION—Heavy Load, Bulky device

The device is too heavy or bulky for one person alone to handle safely. To avoid personal injury or damage to the device, observe the following guidelines:

- Physical handling of the device, including lifting or moving, requires a team effort of two persons.
- A team effort is in particular required when lifting the device into the system stack or when removing it.

7.18.1 Removing the Slide-In Module

Tools required

Screwdriver, Torx T20

Preparations

Prepare the device for transport. See the *Transporting or Shipping the device section* in this operating manual.

Follow these steps

1. Loosen the four captive screws on the front left and front right of the device.

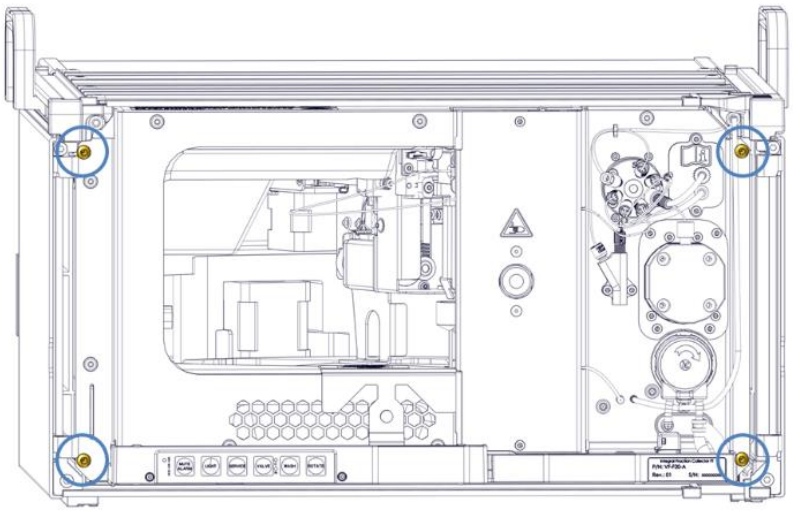

Figure 93: Captive screws on the slide-in module

2. Push all tubing and capillaries, which are present in the tubing chase of the Vanquish system modules, into the tubing chase. Otherwise, you will not be able to remove the slide-in module properly from the enclosure in the next step.

3. Grasp the slide-in module by the middle frame where the door lock is placed and pull the module out of the enclosure by approximately 10 cm.

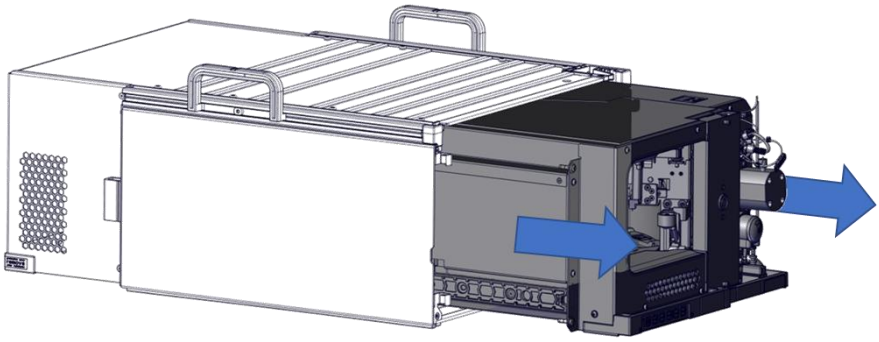

Figure 94: Pulling out the slide-in module

NOTICE
The slide-in module can fall down when pulling it out of the enclosure too far. Pull out the slide-in module just far enough so that you can grasp it on both sides from below.

4. Remove the slide-in module from the enclosure.
   The following steps require a team effort:
   a) Take the slide-in module on both sides from below.
   b) Pull the slide-in module from the rails towards the front.
   c) Place the slide-in module on a clean and stable surface.

5. Return the slide-in module:
   a) To request a dedicated packaging for the slide-in module and for the appropriate procedure for returning the module, contact your local Thermo Fisher Scientific support organization.
   b) Pack the slide-in module in the dedicated packaging.

NOTICE
The packaging for the slide-in module differs from the packaging for the complete module. Shipping the slide-in module or the device incorrectly leads to damage on the device. Always pack and ship the slide-in module and the device in the respective, dedicated packaging.

CAUTION—Possible Contamination

Hazardous substances may have contaminated the device during operation and may cause personal injury to service personnel.

- Decontaminate all parts of the device that you want to return for repair.
- Fill in and sign the Decontamination Certificate, which is part of the Service Return Form. Sign the certificate to confirm that the device has been properly decontaminated and that it is free of hazardous substances.
- Thermo Fisher Scientific refuses to accept devices for repair if the Decontamination Certificate is missing.

7.18.2 Installing the Slide-In Module

Parts required

Replacement slide-in module

Tools required

Screwdriver, Torx T20

Preparations

1. Verify that the device enclosure into which the slide-in module is installed is clean. If required, clean the inner and outer surfaces of the enclosure. See the *Cleaning the device section* in this operating manual.
2. When installing the slide-in module to an enclosure in the system stack, check that the enclosure is placed correctly in the stack.

Follow these steps

1. Unpack the slide-in module. Remove any foam spacers from the module.
2. Push all tubing and capillaries, which are present in the tubing chase of the Vanquish system modules, into the tubing chase. Otherwise, you will not be able to insert the slide-in module properly into the enclosure in the next step.
3. Insert the slide-in module in the enclosure.
   The following steps require a team effort:
   a) Take the slide-in module on both sides from below.
   b) Lift the slide-in module to the height of the enclosure.
   c) Place the slide-in module in the enclosure so that the module sits in the enclosure by approximately 25 cm.
   d) Push the slide-in module onto the rails and into the enclosure until the slide-in module sits completely in the enclosure.

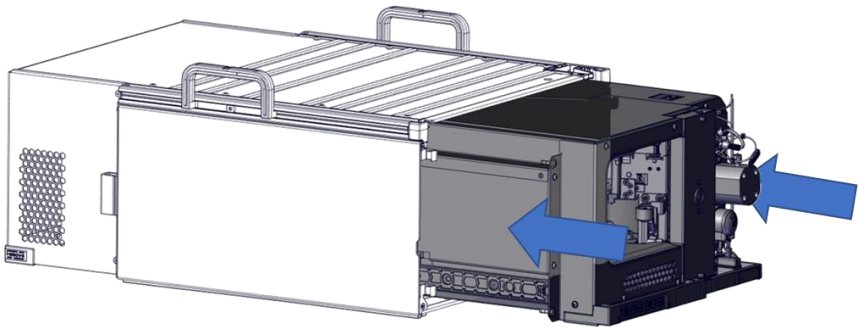

Figure 95: Inserting the slide-in module

4. Gradually and evenly, tighten the four captive screws on the slide-in module hand-tight.

NOTICE Verify that the screws are tightened. Pull the slide-in module by the leak tray towards the front and check whether the screws move. If they do not move, the slide-in module is installed properly. If the screws move, tighten the screws further.

5. Set up the slide-in module:

   a) To connect the slide-in module and to set up flow connections, follow the instructions in the *Installation chapter* in this operating manual.

   b) To prepare the slide-in module for first-time operation, follow the instructions in the *Preparing the device for Operation section* in this operating manual.

6. Prepare *all other* modules of the Vanquish system for operation and restart them. Refer to the *Operating Manuals* for the modules.

7. Before starting an analysis, let the chromatography system equilibrate and be sure that it is ready for operation.

8 Troubleshooting

This chapter is a guide to troubleshooting issues that may arise during operation of the device.

8.1 General Information about Troubleshooting

The following features help you to identify and eliminate the source for problems that may arise during operation of the device.

TIP For information about operating issues that might occur during the operation of a Vanquish system, refer to the *Vanquish System Operating Manual*.

If you are unable to resolve a problem following the instructions given here or if you experience problems that are not covered in this section, contact Thermo Fisher Scientific Technical Support for assistance. See the contact information at the beginning of this manual.

To facilitate device identification, have the serial number and technical name available when communicating with Thermo Fisher Scientific.

Status Indicators

The status indicator LED bar on the front side of the device and the **STATUS** LED on the keypad inside provide quick visual feedback on the operational status of the device. If the device firmware detects a problem, the status indicators are red. The problem is reported to the Chromeleon software and a message appears in the Audit Trail.

Alarms

Leaks are a potential safety issue. Therefore, if a leak sensor detects leakage, beeping starts to alert you in addition to the message in the Chromeleon Audit Trail and the status indicators changing to red. Follow the instructions in this manual to find and eliminate the source for the leakage.

Chromeleon Audit Trail Messages

If the device firmware detects a problem, the problem is reported to the Chromeleon software.

The Chromeleon software logs information about all events related to instrument operation for the current day in an Audit Trail. The Audit Trail is named with the current date, using the format yyyymmdd. For example, the Audit Trail for May 15, 2021, is named 20210515.

Chromeleon: The Instrument Audit Trails can be found on the ePanel Audit tab. In addition, Audit Trails for each instrument are available in the Chromeleon Console Data view in the folder of the instrument.

Messages in the Chromeleon Audit Trail are preceded by an icon. The icon identifies the seriousness of the problem. The table shows the icons and explains the severity level.

Icon	Severity	Description
	Warning	• The queue can be started. • The current run is not interrupted. However, Thermo Fisher Scientific recommends taking appropriate action to remedy the situation.
	Error	The software attempts to correct the problem. An error does not interrupt the current analysis. However, if the error occurs during the Ready Check, the analysis will not be started.
 or 	Abort	• The queue (cannot be started. • A running queue or batch is stopped immediately. • The issue must be resolved first.

For possible causes and recommended remedial actions, see Messages (▷ page 214).

Firmware Failure

If a firmware failure occurred during operation of the device, an exception log was created about the processes during the firmware failure. The firmware sends the exception log to the Audit Trail when the device is connected in Chromeleon software.

In this case, observe the following:

- Send the daily Audit Trail as **.cmbx** file to Technical Support before you clear the log.
- To clear the exception log and continue operation of the device, perform the command **ExceptionLogClear**.

For more information, refer to the *Chromeleon Help*.

8.2 Messages

The table lists the most frequently observed messages for the device and provides troubleshooting assistance.

Each message consists of a code number and a text. The code number is the unique identifier for the problem while the wording may change. Note the following:

- To facilitate finding a message, the table lists the messages sorted by code.
- If you cannot find the code you are looking for, check the message text. Two messages (**Unexpected module behavior** and **Module malfunction detected**) can have different codes and therefore, appear at the beginning of the table.

TIP If you are unable to resolve the problem following the instructions in this manual, or if you encounter a message not listed in the table, write down the code and wording of the message and contact Thermo Fisher Scientific Technical Support for assistance.

Message and Code	Description and Remedial Action
Unexpected module behavior. Code XX	XX = Two-digit to four-digit code number. When the message appears, write down the message code and turn off the module. Wait for 5 seconds and turn on the module again. **TIP** If the message appears again, contact Technical Support.
Module malfunction detected. Code XX	XX = Two-digit to four-digit code number. When the message appears, write down the message code. Turn off the module and contact Technical Support.
Code 15. Command rejected - device is busy.	Device not ready to accept command. Wait for current operation to complete and repeat command.
Code 34. Leak detected.	When this error code is reported, it means leak detected by the front leak sensor located at the front and right-hand bottom side of the device.Find and eliminate the source for the leakage (Operating Issues (▸ page 221).
Code 53. Module software malfunction occurred. Diagnostic information available. Please send daily audit trail to service support.	A firmware failure occurred during operation of the module and an exception log has been created about the processes during the firmware failure. For details, see General Information about Troubleshooting (▸ page 212).

Message and Code	Description and Remedial Action
Code 89. Leak sensor missing or defective. Here it means the front leak sensor.	Contact Technical Support for assistance. To operate the device nevertheless, you can disable the leak sensor functionality in the Chromeleon software by setting **Leak Sensor Mode** to **Disabled.**
Code 9000. Firmware upgrading failed.	Power cycle the device and retry. If the issue persists, contact Technical Support.
Code 9001. Command rejected - module is in error state.	The module cannot execute a command because it is in error state. An internal error has occurred. Perform **Self Test** via FC ePanel: ePanel FC tab → More Options → Service → **SelfTest** button. If the issue persists, contact Technical Support.
Code 9002. Rear leak sensor not recognized or defective.	No rear liquid leak sensor is found or sensor malfunction. Power cycle the device and retry. If the error persists, contact Technical Support.
Code 9004. Liquid detected inside the fraction collector compartment.	If liquid is detected inside the fraction collector compartment, the warning message will be shown in the user-level audit trail, and drain pump is triggered to drain out liquid to waste drain port. The device keeps monitoring the status of the rear leak sensor and if the sensor gets dry, the drain pump will stop working immediately. Possible causes triggering the warning as follows: • 1) Accumulated condensation if the device remains running at cooling mode for a long time under a tough environment (e.g. 35°C with 80% RH). • 2) Drain pump and its pump tubing broken, thereby failing to drain out liquid inside the compartment. • 2) Needle capillary broken. • 3) Needle damaged or deformed. • 4) Vial not present or vial broken. • 5) Liquid spray out of needle wash port. • If the warning persists with drain pump working continuously, contact Technical Support.
Code 9005. Carousel homing time out	Carousel can't return to home position. Check if the carousel is blocked by obstacles. After resolving physical blockage, then perform self-test to recover the issue. If the issue persists, contact Thermo Fisher Scientific Technical Support for assistance.
Code 9006. Needle horizon drive homing time out	Needle drive can't return to home position. Check if the needle drive is physically blocked. After resolving physical blockage, then perform **Self Test** to recover the issue. If the issue persists, contact Technical Support.

Message and Code	Description and Remedial Action
Code 9007. Needle vertical drive homing time out	Needle drive can't return home position. Check if the needle drive is physically blocked. After resolving physical blockage, then perform **Self Test** to recover the issue. If the issue persists, contact Technical Support.
Code 9008. Carousel blocked. Check for obstructions with racks or well plates.	Rotate the carousel and check if it can be moved easily. If obstacles are present in the way of carousel, remove the obstacles. After resolving physical blockage, then run **Self Test** to recover the issue. If the issue persists, contact Technical Support. Check if the carousel is physically blocked. After resolving physical blockage, then run self-test to recover the issue. If error persists, contact Thermo Fisher Technical Support for assistance.
Code 9009. Vertical needle drive blocked.	Check if the needle drive vertical needle drive is physically blocked in vertical direction. After resolving physical blockage, then run self-test to recover the issue. If the issue persists, contact Technical Support.
Code 9010. Vial not found. Check for correct vial position in the rack and sample sequence.	Vial not found with **InVial** collection mode. Check if vials or well plate are present at the specified positions. Check the Frac Start position (start collection position) in FC ePanel tab, and then check the settings in the sequence view where individual collection position is specified. Specify a different tube position, or place vials to specified positions as the setting in the ePanel FC tab or sequence view, if necessary. Check if a sample rack or well plate is present at the specified position. Place a sample container at the specified position. After resolving physical blockage, then run self-test to recover the issue. If the issue persists, contact Technical Support.
Code 9011. Carousel hit an unexpected object.	Carousel hit an expected object due to improper needle height setting or improper well plate height, or other physical blockage in the way of carousel. Carousel stepper motor step loss detected. Check any unexpected object. Check if the correct sample rack or well plate is configured and check if needle height or well plate height is properly set manually. Then run self-test to recover the issue. Check if the correct sample rack or well plate is configured. After resolving physical blockage, then run self-test to recover the issue. If the issue persists, contact Technical Support.

Message and Code	Description and Remedial Action
Code 9012. Needle hit an unexpected object. (Z-axis)	Needle hit an unexpected object due to incorrect sample rack or well plate configuration, or improper needle height or well plate height is set manually. Needle obstruction, maybe due to incorrect sample rack or well plate configuration or any unexpected object. Check if the correct sample rack or well plate is configured. Consider number of positions of the configured sample rack or well plate as well as the respective well plate height. Or check any unexpected object. After resolving physical blockage, then run self-test to recover the issue. Check if the correct sample rack or well plate are configured, and the correct tube position is defined in the ePanel FC tab. Check if the needle height or well plate height is set correctly. If the issue persists, contact Technical Support.
Code 9016. Flush pump stepper motor over current.	Power cycle the device to recheck the status. If the issue persists, contact Technical Support.
Code 9020. TEA driver abnormal: Heating current abnormal , Cooling current abnormal, or IC fault feedback.	First run self-test to recover the issue and check audit trail for more information. If the issue persists, power cycle the device and check again if it is recovered. If the issue still persists, contact Technical Support.
Code 9021. Temperature sensor open - cabin air	Power cycle the device. If the issue persists, contact Technical Support.
Code 9022. Temperature sensor short - cabin air	Power cycle the device. If the issue persists, contact Technical Support.
Code 9023. Temperature sensor open - ambient air	Power cycle the device. If the issue persists, contact Technical Support.
Code 9024. Temperature sensor short - ambient air	Power cycle the device. If the issue persists, contact Technical Support.
Code 9025. Temperature sensor open - outside heat sink	Power cycle the device. If the issue persists, contact Technical Support.
Code 9026. Temperature sensor short - outside heat sink	Power cycle the device. If the issue persists, contact Technical Support.
Code 9027. Cabin air temperature too low	Cabin air temperature < 2 °C Power cycle the device. If the issue persists, contact Technical Support.
Code 9028. Cabin air temperature too high	Cabin air temperature > 45 °C Power cycle the device. If the issue persists, contact Technical Support.
Code 9030. Temperature control is switched off due to left door is open for 20 minutes.	Check the state of the left door. If the left door is forgotten to be closed, close the door.
Code 9031. Internal Fan1 broken	Power cycle the device. If the issue persists, contact Technical Support.
Code 9032. Internal Fan2 broken	Power cycle the device. If the issue persists, contact Technical Support.

Message and Code	Description and Remedial Action
Code 9033. Outer Fan1 broken	Power cycle the device. If the issue persists, contact Technical Support.
Code 9034. Outer Fan2 broken	Power cycle the device. If the issue persists, contact Technical Support.
Code 9036. Delay volume determination timeout. Air bubble not detected by FC.	Air bubble is not detected by air bubble sensor embedded inside the device 3 minutes after Autosampler injection. First, re-perform the DVD function and observe if one air bubble (about length of 2.5 mm) can be seen to flow along the waste line (connecting to fraction collection valve port 3) after the bubble retention time on UV detector (around 0.2-0.3 min) for each time of injection. If the air bubble can be observed, then re-do the DVD. If the issue persists, contact Technical Support.
Code 9037. Delay volume determination failed. Air bubble not detected by detector.	Air bubble is not detected by the UV detector. Check if a correct DVD capillary (P/N: 6040.2330, ID x L. 0.13 x 850 mm) is installed between autosampler and detector inlet and if an empty vial is installed at autosampler position R:A9 in Chromeleon 7.3.2 CDS and later (R:A1 in Chromeleon 7.3.1 CDS and later). Then purge the pump for a while and rinse the system with methanol (not IPA) for 10 min above with flow rate of 1.2 mL/min, then with 10% methanol/water at 1.2 mL/min for another 10 min. Make sure both collect position and waste position are involved. The purpose is to eliminate air bubbles inside the flow. Then re-do the DVD function and check if it can be implemented successfully. If the issue persists, contact Technical Support.
Code 9038. Air bubble sensor abnormal. DVD cannot work.	Air bubble sensor is not detected by system. Turn the device off, wait for 5 seconds and turn it on again. If the issue persists, contact Technical Support.
Code 9039. Fraction Valve is not in the right port.	The fraction collection valve may be worn, as result it cannot be switched to correct position. Or it may be a temporary error, run self-test. If the issue persists, contact Technical Support.
Code 9040. Fraction Valve communication error.	First, run self-test to recover the issue and check audit trail for more information. If the issue cannot be resolved, power cycle the device. If the issue still persists, contact Technical Support.
Code 9041. Barcode reader communication error.	Power cycle the device. If the issue persists, contact Technical Support.
Code 9043. Left door opened during sequence	Make sure the left door is closed during sequence running. Close the door and try again.
Code 9045. Flush pump homing time out.	Flush pump cannot find home possibly due to pump plunger stall issue. Run Self Test to recover the issue. If the issue persists, contact Technical Support.

Message and Code	Description and Remedial Action
Code 9046. MIDB or SMCB timeout.	Internal CAN bus disconnect, or firmware failure. Power cycle the device. If the issue persists, contact Technical Support.
Code 9047. Temperature sensor open - inside heat sink.	Power cycle the device. If the issue persists, contact Technical Support.
Code 9048. Temperature sensor short - inside heat sink.	Power cycle the device. If the issue persists, contact Technical Support.
Code 9049. Delay volume determination failed. Flow cell not supported by this function.	The flow cell of the detector in the system is not supported by the delay volume determination function. See Vanquish Detector Flow Cells (▸ page 131) for supported Vanquish detector flow cells. Check the detector flow cell and make sure it is in the support list.
Code 9052. Fraction Valve homing error.	The fraction collection valve fails to return to home position due to a temporary communication issue or the valve is worn seriously after running for a long time. First, run **Self Test** to recover the issue and check the audit trail for more information. If not resolved, power cycle the device. If the issue persists, contact Technical Support.
Code 9053. Wrong vial position.	Invalid **tube position** is provided when setting in ePanel FC tab: Invalid **tube position** is provided when manually moving needle to one specific position by selecting **Move Needle Position** button on ePanel FC tab. Check the racks and make sure the **Tube Position** and **Move Needle Position** are in correct format and in range.
Code 9054. Air bubble sensor abnormal during power up check.	Power cycle the device. If the issue persists, contact Technical Support.
Code 9055. Internal needle rinse failed. Pump speed is 0.	Flow rate of upstream Vanquish pump is 0. This may occur when performing **Internal Needle Rinse** via ePanel FC tab or the flush function during a sequence running. Turn the Vanquish pump on and set proper flow rate, then redo the manual internal needle rinse or injection.
Code 9056. Flush number of times limit reached. System does not flush any more.	Be aware that the flush pump internal volume is 1000uL and limited flush times are allowed. When installing needle capillary (P/N: 6706.1010, ID x L: 0.18 x 415 mm) with flush buffer loop (50 µL), the flush number is 20 times in one injection. When installing needle capillary (P/N: 6706.1020, ID x L: 0.25 x 415 mm) with flush buffer loop (100 µL), the flush number is 10 times in one injection.
Code 9057. Needle drive pusher status has conflict with current method setting.	Current physical pusher status does not align with the configured Needle movement mode (InVial, AboveVial). Need to manually adjust the pusher status to be align with the needle movement mode. Otherwise the sequence cannot be started.

Message and Code	Description and Remedial Action
Code 9058. Door open interrupted BCR scan	The opening of left door will stop BCR scanning. After the door is closed, the scanning will restart automatically.
Code 9060. Invalid vial position.	Invalid position at the end of a collection (injection with Fraction Collection not off) with **Tube Wrapping** disabled in the instrument method. This indicates that the current collection has finished successfully, but the last available tube has been used. Enable **Tube Wrapping** or replace the racks and reset the **Tube Position** on ePanel FC tab, otherwise, users will not be able to start another collection. An error “Maximum number of installed tubes used up” will be popped up during the injection ready check. In another case, this warning indicates users try to manually adjust needle height vial ePanel when the needle is not located over a vial but at parking, wash, or service positions.

8.3 Operating Issues

This section gives an overview of possible operating issues and remedial actions.

8.3.1 Resolving Front Leakage

When

The leak sensor is wet. The leak sensor reports leakage.

Parts required

Replacement part as required

Additional items required

Cloth or tissue

Preparations

When resolving leakage, observe the safety guidelines and general rules for maintenance and service as presented in Maintenance and Service (▷ page 149).

Follow these steps

1. Locate the source of the leak.
   As leakage usually occurs at a connection, visually inspect all components and connections in the flow path.
2. Tighten or replace the connection or component as required.
3. With a cloth or tissue, thoroughly absorb all liquid that has collected in the leak tray and under the leak sensor. Be careful not to bend the sensor.
4. Allow the sensor to adjust to the ambient temperature for a few minutes.
5. If leakage is no longer reported, you can resume operation.

8.3.2 Resolving Clogging in the Device

When

Components in the device flow path are clogged

Preparations

Turn off the pump flow to the device. Wait until the system pressure is down to zero. Be sure that no backpressure from other modules in the system is present.

Follow these steps

Turn off pump flow and wait for the system pressure drop down. Bypass the detector with DVD capillary (P/N: 6040.2330, ID x L: 0.13 × 850 mm). The fluidics connection is shown as below:

1. Press the **Service** button on the keypad. The device moves the needle unit into service position.
2. Disconnect the needle capillary fitting from the needle unit.
3. Place the open connector of the needle capillary into the central hole of needle wash port.
4. Check that the fraction collection valve is set to collection position.
5. In Chromeleon, set the pump flow rate to the maximum pump flow rate.
6. Turn on the pump flow and flush the needle capillary to wash port at the maximum pump flow rate for approximately 1 minute. Afterward, **turn off the pump flow**.
7. Connect the needle capillary to the needle unit. Before tightening the needle capillary, position it correctly (refer to Replacing the Needle Capillary (▷ Page 180)).
8. Press **Wash** button to move the needle unit into the needle wash port position.
9. Turn on the pump flow and rinse the internal surface of needle capillary and needle into the needle wash port at the maximum pump flow rate for approximately 1 minute. (Make sure the fraction collection valve remains at the collection position).

10. Then switch the fraction collection valve to flush position, flush the internal surface of flush buffer loop, needle capillary and needle into the needle wash port at the maximum pump flow rate for approximately 1 minute.
11. Then switch the fraction collection valve to waste position, flush the waste line at the maximum pump flow rate for approximately 1 minute. Afterward, turn off the pump flow.
12. Restart the device with its main power switch. The device performs a self-test. The needle initializes and adjusts its position.
13. Afterward, turn off the pump flow.

8.3.3 Temperature Setpoint Cannot Be Achieved

Causes

- The ambient temperatures may be out of specified range.
- The **Fraction collector compartment** may not be insulated sufficiently.

Remedial Action

Check if the door is closed properly.

9 Modifying the Fraction Collector for Specific Applications

9.1 Normal-Phase Compatible Solvents and Additives

Normal-phase (NP) compatible solvents and additives may be used with the fraction collector installed in a Vanquish Core system if the fraction collector and all other system modules have been modified for NP applications. For the Vanquish Core system modules refer to the *Vanquish System Operating Manual*.

9.2 Modifying the Fraction Collector

When

To use very non-polar and harsh organic solvents, such as n-hexane, tetrahydrofuran, and similar solvents.

Parts required

- Vanquish Fraction Collector Normal-phase (NP) kit, consisting of
  - 1.8 m Needle wash line NP long, pre-widened, for connection from solvent reservoir to wash pump, Flexelene™ PE, ID 1.6 mm x OD 3.2 mm
  - 1x Needle wash port tubing NP, pre-widened, for connection from wash pump to needle wash port, PEEK, ID x L 1.0 x 130 mm, OD 1/16”
  - 2x Sealing plug Ø 3.0 mm, for fixing the new needle wash lines at the solvent reservoirs
- Tubing cutter

Preparations

1. Turn off the pump flow and wait until the system pressure is down to zero.
2. Unscrew the cap of the fraction collector needle wash reservoir.
3. Together with the cap, remove the needle wash line from the reservoir.
4. To empty the needle wash line, start a needle wash purge.

Follow these steps

The normal-phase (NP) compatible wash lines are stiffer than the standard wash lines. The ends of the tubes are pre-widened to fit on the connectors of the needle wash pump. Do not cut off the pre widened ends of the lines.

1. Replace the needle wash outlet line from wash pump outlet to the needle wash port inlet by *needle wash port tubing NP, pre-widened* (Figure 96 and Figure 97) from the kit. See Replacing Needle Wash Lines (▸ Page 167).

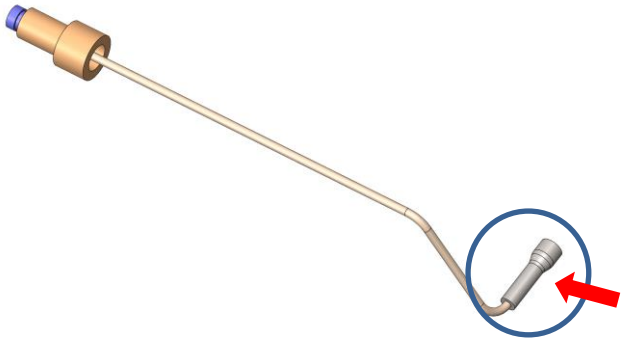

Figure 96: Needle wash port tubing NP, the arrow shows the pre-widened end to be applied to the wash pump outlet

Figure 97: Needle wash outlet line from wash pump to wash port

2. Replace the needle wash inlet line from wash pump inlet to the needle wash reservoir in the solvent rack by *needle wash line NP long, pre widened* from the kit (Figure 98). The pre-widened end (red arrow) is to be used at the side of the wash pump inlet.

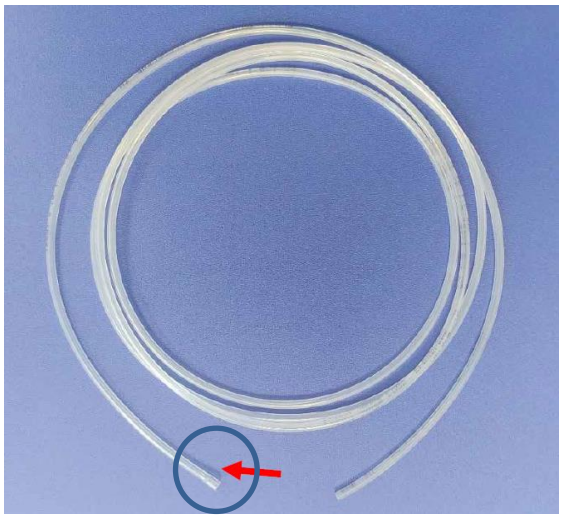

Figure 98: Needle wash inlet line from reservoir to wash pump, the arrow shows the pre-widened end to be applied to the wash pump inlet

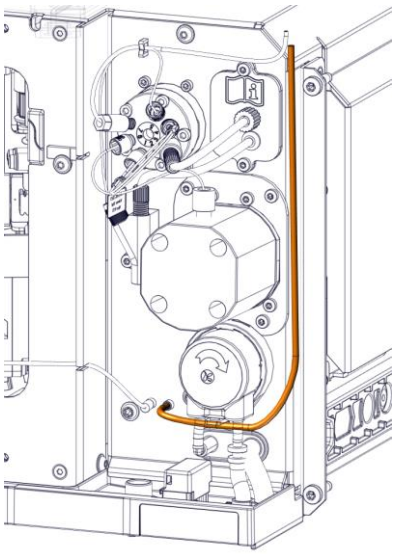

Figure 99: Routing the needle wash inlet line

3. Replace the retention guide at the needle wash reservoir with the retention guide from the NP kit (Figure 100).

Figure 100: Needle wash inlet line and retention guide at the reservoir

4. The normal-phase (NP) compatible waste line and the PEEK finger-tight fitting on the PEEK capillary are contained in the Normal-Phase Kit for Vanquish Core. When the fraction collector is installed in the HPLC system, the detector waste line will be used to connect with the Y-connector outlet of the fraction collector and routed to the waste reservoir.

    a) For the normal-phase (NP) compatible waste line, slide the PEEK finger-tight fitting on the PEEK capillary. The capillary must stick out about 1 cm.

    b) Insert this assembly into the outlet of Y-connector (Figure 101). Make sure the PEEK capillary is completely inserted and touches opposing face inside the Y-connector. While keeping the capillary gently pressed towards the Y-connector, start screwing the PEEK fitting hand tight. Check if the capillary cannot be easily pulled out of the fitting.

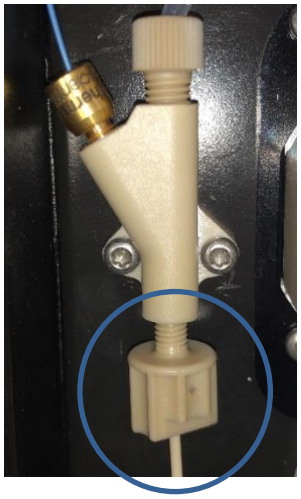

Figure 101: Assembled waste line at the outlet of Y-connector

c) Guide the PEEK capillary to the waste reservoir. Take care to avoid any sharp bends or locations where the capillary might be squeezed by parts of the HPLC (e.g. doors) or other lab equipment.

9.3 Considerations with Normal-Phase Compatible Solvents and Additives

After the installation of the NP kit, the fraction collector remains compatible with reversed-phase applications. The pH range of the system is not affected by application of the NP kit, see Allowed pH Ranges (▷ page 27).

When running applications with normal-phase compatible solvents and additives, observe the information in *Vanquish System Operating Manual* on:

- Needle wash liquid
- Long-term shutdown
- Routine and preventive maintenance

10 Specifications

This chapter provides the physical and performance specifications, including information about the materials used in the flow path of the device.

10.1 Performance Specifications

The fraction collector performance is specified as follows:

Type	Specification
Operating Specifications	
Sample capacity	• Any four of the following sample racks or well plates with SBS footprint format • 54 x 12 mm O.D. vials (≤ 1.5 mL) • 96 x 6, 7 and 8 mm O.D. vials (≤ 1.2 mL) • 16 x 15 mm O.D. vials (≤ 4 mL) • 9 x 22.5 mm O.D. vials (≤ 10 mL) • 24-position deep well plate, 48- position deep well plate, 96- and 384-position well plates (deep and shallow)
Collection Modes	• Triggered by peak signals or time frames • (Saw)vertical, (saw)horizontal • Interrupt and continuous • Above or in sample container • Manual collection, pooling, wrapping and concatenating
Needle Wash	• Rinse of inner needle surface and needle capillary with mobile phase into needle wash port (before or after each injection) • Dip wash and continuous wash of outer needle surface • Flush function between fractions to flush inner needle surface and needle capillary with flush liquid into sample container
Operating Flow Range	0.05 mL/min – 10 mL/min
Delay Volume	~ 19 µL with • Fraction collector inlet to fraction collection valve port: ~ 2.7 µL (default, time-based fractionation, one stack configuration) • Fraction collection valve: < 0.5 µL • Fraction collection valve to needle: ~ 10.7 µL (default) • Needle: ~ 5 µL
Min. Collection Volume	One droplet collection volume: ≥ 6µL water
Carry over	Carry over < 0.15% with flush enabled
Automation Features	• Barcode reading: ♦ Empty segment detection ♦ Rack/well plate verification ♦ Inventory management • Fraction simulation to model and optimize peak detection options in Chromeleon CDS using chromatogram data.

Type	Specification
Temperature Range	4 – 40 °C, cooling ≥ 23 K below ambient at < 80% relative humidity
Temperature Accuracy	- 2 °C / + 4 °C
Temperature Stability	± 1 °C
Cooling performance	Cooling duration < 20 min when reducing cabin temperature by 10 °C from ambient temperature 25 °C
Needle Move Time	≤ 0.75 s vial to vial with needle above sample container (with 54 position rack) ≤ 1.25 s vial to vial with needle in sample container (with 54 position rack)
HPLC Stack Configuration	In one stack or separated in two stacks
Detectors Supporting Automated Delay Volume Determination	One of the following: • Thermo Scientific™ Vanquish™ Variable Wavelength detectors (VC-D40-A, VF-D40-A) • Thermo Scientific™ Vanquish™ Diode Array detectors (VH-D10-A, VF-D11-A, VC-D11-A) • Thermo Scientific™ Vanquish™ Multiple Wavelength detector (VC-D12-A)
Flow Cells Supporting Automated Delay Volume Determination	Flow cell, Standard, 11 µL, 10mm (P/N: 6077.0250) Flow cell, Semi-micro, 2.5 µL, 7mm (P/N:6077.0360) Flow cell, Standard, 13 µL, 10mm (P/N: 6083.0510) Flow cell, Semi-Analyt., 5 µL, 7mm (P/N:6083.0520) Flow cell, Semi-micro, 2.5 µL, 7mm (P/N: 6083.0530) Flow cell, Semi-micro Bio, 2.5 µL, 7mm (P/N: 6083.0550) LightPipe flow cell, Standard, 2 µL, 10 mm (P/N: 6083.0100B) LightPipe flow cell, High Sensitivity, 13 µL, 60 mm (P/N: 6083.0200B)
Primary Wetted Material	Sample flow path: MP35N, PAEK, PAEK/PTFE composite, PEEK Flush flow path: FEP, PEEK, ceramics, FFKM Wash liquid flow path: Silicone (Flexelene™ PE for Normal-Phase (NP)), PP, FFPM, PEEK, PA Waste flow: PP, PEEK, FEP, TPE
Biocompatibility	Yes pH range: 2 - 12 Chloride concentration: ≤ 1 mol/L
Normal-Phase (NP) compatibility	Yes, with hardware modification by 6706.0400 Normal-Phase (NP) kit Vanquish Fraction Collector
USB Communication	1 USB port (USB 2.0, "B" type connector) 1 USB hub with 3 ports (USB 2.0, "A" type connectors)
System Interlink	2 system interlink ports (RJ45-8 connectors)

Type	Specification
Control	• Available for Chromeleon 7.2 SR5, Chromeleon 7.2.10, Chromeleon 7.3.1 and Chromeleon 7.3.2 CDS • Details on the minimum required Chromeleon CDS version can be found in the List of Supported Instruments (LOSI) distributed with each Chromeleon release • Details on the supported instrument features can be found in the release notes of the Chromeleon CDS and instrument driver package versions • Keypad: Mute Alarm, Light, Service, Valve, Wash, Rotate • Status Indicators: LED bar, Status LED
Safety features	Leak detection and safe leak handling
Good Laboratory Practice (GLP) features	Predictive Performance functions for scheduling maintenance procedures based on the actual operating and usage conditions of the device. All system parameters are logged in the Chromeleon CDS Audit Trail.

10.2 Physical Specifications

The physical conditions of the device are specified as follows:

Type	Specification
Range of use	Indoor use only
IP level	IP20
Ambient Operating Temperature	5 °C – 35 °C
Ambient Storage Temperature	-20 °C – 45 °C
Ambient Operating Humidity	20% - 80% RH (non-condensing)
Ambient Storage Humidity	Maximum 60% RH (non-condensing)
Operating Altitude	Maximum 2000 m above sea level
Pollution degree	2
Overvoltage category	II
Power requirements	100 – 240 VAC, ± 10%, 50/60 Hz, max. 525 W / 550 VA
Emission sound pressure level	< 70 dB(A), typically < 50 dB(A)
Dimensions (height x width x depth)	23 x 42 x 62 cm (9.1 x 16.5 x 24.4 in.)
Weight	Max. 30 kg (66.14 lbs), including package Max. 23 kg (53.7lbs), excluding package

11 Accessories, Consumables and Replacement Parts

This chapter describes the standard accessories that are shipped with the device and the accessories that are available as an option. This chapter also provides information for reordering consumables and replacement parts.

11.1 General Information

The device must be operated only with the replacement parts and additional components, options, and peripherals specifically authorized and qualified by Thermo Fisher Scientific.

Accessories, consumables, and replacement parts are always maintained at the latest technical standard. Therefore, part numbers are subject to change. If not otherwise stated, updated parts will be compatible with the parts they replace.

11.2 Ship Kit

The ship kit includes the items listed in the table. The kit content is subject to change and may vary from the information in this manual. See the content list included in the kit for the most recent information about the kit content at the time when the device is shipped.

Item	Quantity in shipment
Bottlecap Retaining Guide, 1/16” for flush solvent line	2
Capillary for delay volume determination connecting autosampler to detector, Viper, ID x L 0.13 x 850 mm, SST	1
Delay capillary connecting detector and fraction collection valve for time-based fraction collection for flow rates up to 2 mL/min in one stack, Viper, ID x L 0.10 x 350 mm, MP35N	1
Delay capillary connecting detector and fraction collection valve for time-based fraction collection from 2 - 10 mL/min in one stack, Viper, ID x L 0.18 x 350 mm, MP35N	1
Capillary connecting column out and detector flow cell in for flow rates up to 2 mL/min in two stacks, Viper, ID x L 0.10 x 550 mm, MP35N	1
Capillary connecting column out and detector flow cell in from 2 - 10 mL/min in two stacks, Viper, ID x L 0.18 x 550 mm, MP35N	1
Flush Solvent Tubing, ID x L 8 mm x 1.5 m, OD 1/16", FEP	1
Needle Capillary, ID 0.18, MP35N with partial PEEK shielding	1
Plugs and retaining guides for reservoir caps, kit including • Cap plug to close open holes in the reservoir cap (pack of 5) • Retaining guide (1/8”) to keep the liquid line in place in the reservoir cap (pack of 2) for needle wash line	1
Reservoir, 0.25 L, with reservoir cap *Note:* The reservoir may be included in the shipment outside the ship kit packing.	1
Sample rack, for 54 x 12 mm O.D. vials *Note:* The sample racks provide a 2D barcode for Vanquish rack type identification.	4
Silicone tubing	3 m
Solvent line adapter (1/8-1/16) flush solvent line	2
Solvent line filter, filter frit, biocompatible, 10 µm	2
Solvent line filter, filter holder (no filter frit included)	2
System Interlink Cable RJ45, 91cm	1

Item	Quantity in shipment
Tubing bracket	1
USB 2.0 cable, type A to type B, High speed USB 2.0, 1m	1
Vial septum kit, including vials and caps with pre-assembled septa	1

For reordering information, see Consumables and Replacement Parts (▸ page 245).

11.3 Optional Accessories

Delay capillaries (Install between detector and fraction collector):

Fraction Collection by	Flow Rate	Item	Part No.
Time	0.05 – 2 mL/min	Viper, ID x L 0.10 x 350 mm, MP35N	6042.2340
	2 – 10 mL/min	Viper, ID x L 0.18 x 350 mm, MP35N	6042.2337
Peak	0.05 – 0.5 mL/min	Delay capillary, peak-based FC up to 0.5 mL/min, Viper, ID x L 0.18 x 1200 mm, MP35N	6706.1100
	0.5 – 1 mL/min	Delay capillary, peak-based FC, 0.5 - 1 mL/min, Viper, ID x L 0.25 x 1500 mm, MP35N	6706.1110
	1 – 2 mL/min	Delay capillary, peak-based FC, 1 - 2 mL/min, Viper, ID x L 0.5 x 800 mm, PEEK	6706.1120
	2 – 10 mL/min	Delay capillary, peak-based FC, 2 - 10 mL/min, ID x L 1 x 1000 mm, OD 1/16”, PEEK	6706.1130

Flush buffer loops (Install between Fraction collection valve port 1 and port 4):

Item	Part No.	Remarks
Flush Buffer Loop, 50 µL up to 5 mL/min, Viper, PEEK	6706.1070	Use with needle capillary 6706.1010 (ID 0.18 mm)
Flush Buffer Loop, 100 µL, 5 – 10 mL/min, Viper, PEEK	6706.1080	Use with needle capillary 6706.1020 (ID 0.25 mm)

Needle capillaries:

Item	Part No.	Remarks
Needle Capillary, ID 0.18 mm, MP35N with partial PEEK shielding	6706.1010	For flow rates up to 5 mL/min
Needle Capillary, ID 0.25 mm, MP35N with partial PEEK shielding	6706.1020	For flow rates between 5 - 10 mL/min

Application kits:

Item	Part No.	Remarks
Normal-phase (NP) kit for Vanquish Fraction Collector	6706.0400	Kit to replace fraction collector needle wash lines
Normal-Phase (NP) kit for Vanquish Core HPLC System	6036.3972	Kit to modify the pump and autosampler and for replacing the detector waste line

11.4 Consumables and Replacement Parts

Capillaries

Description	Part No.	Connection
Capillary for delay volume determination connecting autosampler to detector, Viper, ID x L 0.13 x 850 mm, SST	6040.2330	sampler to detector
Capillary connecting column out and detector flow cell in for flow rates up to 2 mL/min in two stacks, Viper, ID x L 0.10 x 550 mm, MP35N	6042.2360	Column to detector in two stacks setup
Capillary connecting column out and detector flow cell in for flow rates up to 2 mL/min in two stacks, Viper, ID x L 0.10 x 550 mm, MP35N	6042.2355	Column to detector in two stacks setup
Fitting plug, Viper, titanium	6040.2303	
Flush pump to fraction collection valve capillary, Viper, PEEK	6706.1050	fraction collection valve port 8 to flush pump port
Flush Solvent Tubing, ID x L 8 mm x 1.5 m, OD 1/16", FEP	6706.1700	
Needle Wash Port Tubing, ID x L 1.0 x 130 mm, OD 1/16", PEEK	6706.1140	
Waste tubing to Y-connector, Viper, PEEK	6706.1060	fraction collection valve port 5 to Y-connector
For other system capillaries, refer to the *Vanquish System Operating Manual.*		

Flow components

Description	Part No.
Needle unit, ID 0.3mm, MP35N	6706.1000
Rotor, fraction collection valve	6706.1517
Stator, fraction collection valve	6706.1511

Interface cables

Description	Part No.
System interlink cable, 91 cm	6706.0004
USB 2.0 cable, type A to type B, High speed USB 2.0, cable length: 1 m	6035.9035

USB cable, type A to type B, high-speed, USB 2.0 Cable length: 5 m	6911.0002

Miscellaneous

Description	Part No.
Front doors	6706.0100
Front plate with electronics	6706.1680
Fuses kit, Vanquish system The kit includes the appropriate fuses for the Vanquish system modules. For the fraction collector, use only 5AT, 230V AC, slow-blow fuses	6036.0002
Packaging material	6706.7000

Power cords

Description	Part No.
Power cord, Australia	6000.1060
Power cord, China	6000.1080
Power cord, Denmark	6000.1070
Power cord, EU	6000.1000
Power cord, India, SA	6000.1090
Power cord, Italy	6000.1040
Power cord, Japan	6000.1050
Power cord, UK	6000.1020
Power cord, USA	6000.1001
Power cord, Switzerland	6000.1030

Reservoirs for solvents and wash liquids

Description	Part No.
Bottlecap Retaining Guide, 1/16''	6261.0216
Cap for reservoirs, screw-cap (pack of 4)	6270.0013
Cap plug to close open holes in the reservoir cap (pack of 20)	6000.0047
Reservoir, 1 L, including cap	2270.0012
Reservoir, 0.25 L, including cap	2270.0026
Solvent line adapter (1/8-1/16) (pack of 6)	6850.1056
Solvent line filter, filter frit, biocompatible, 10 µm	6268.0111
Solvent line filter, filter holder (no filter frit included)	6268.0115

Sample racks and well plates

Description	Part No.
Sample rack, for 9 x 22.5 mm O.D. vials With 2D barcode for Vanquish rack type identification	6851.1020
Sample rack, for 16 x 15 mm O.D. vials With 2D barcode for Vanquish rack type identification	6851.1030
Sample rack, for 54 x 12 mm O.D. vials With 2D barcode for Vanquish rack type identification	6850.1023
Sample rack, for 96 x 6 mm O.D. vials With 2D barcode for Vanquish rack type identification	6850.1026
Sample rack, for 96 x 7 mm O.D. vials With 2D barcode for Vanquish rack type identification	6850.1030
Sample rack, for 96 x 8 mm O.D. vials With 2D barcode for Vanquish rack type identification	6850.1034
For well plates, refer to the ordering information that is included in the ship kit of the Vanquish Split Sampler.	

Tubing and wash components

Description	Part No.
Drain pump head with tubing	6706.1650
Silicone tubing, 3 m	6007.9100

Overpressure relief valve

Description	Part No.
Overpressure Relief Valve (60 bar) for installations with Vanquish Diode Array Detector HL	6083.9260
Overpressure Relief Valve (40 bar) for installation with Vanquish Fluorescence Detector C or F	6079.9240

12 Appendix

This chapter provides additional information about compliance.

12.1 Compliance Information

12.1.1 Declarations of Conformity

CE Declaration of Conformity

The device has satisfied the requirements for the CE mark and is compliant with the applicable requirements.

WARNING

Class A equipment is intended for use in an industrial environment. There may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances.

cTUVus Compliance

The cTUVus label on the device indicates that the device has satisfied the requirements for the cTUVus mark. Compliance with the applicable standards has been evaluated by TÜV Rheinland (Shanghai) Co., Ltd.

RoHS Compliance

This product complies with the RoHS (Restrictions of Hazardous Substances) directives:

- *European RoHS Directive*

  Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment

  The CE mark on the device indicates that the product is compliant with the directive.

- *China RoHS regulations*

  Measures for Administration of the Pollution Control of Electronic Information Products

  One of the following logos may be present on the device if applicable:

Logo	Description
	The green logo marks items that do not contain the hazardous substances identified by the regulations.
	The orange logo including a one-digit or two-digit number marks items that contain hazardous substances identified by the regulations. The number indicates the environment-friendly use period (EFUP) of the item. During this period, the item (when used as intended) will not cause serious damage to human health or environment. For more information, go to http://www.thermofisher.com/us/en/ home/technical-resources/rohs-certificates.html

12.1.2 WEEE Compliance

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive. It is marked with the following symbol:

Figure 102: WEEE symbol

Thermo Fisher Scientific has contracted with one or more recycling or disposal companies in each European Union (EU) Member State, and these companies should dispose of or recycle this product. For further information, contact Thermo Fisher Scientific.

12.1.3 FCC Compliance

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the U.S. FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his expense.

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