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Vanquish

Neo System

VN-A10, VN-C10, VN-P10,  
VN-S10

Operating Manual

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**ThermoFisher**  
SCIENTIFIC

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Original Operating Manual

The hardware descriptions in this manual refer to devices VN-A10-A-02, VN-C10-A-01, VN-P10-A-01, VN-S10-A-01.

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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 provides instructions for installation, set up, start up, shut down, operation, maintenance and troubleshooting of your system.

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

### *Notes on Illustrations*

The descriptions in this manual refer to a standard Vanquish Neo system configuration.

- Illustrations in this manual are provided for basic understanding. They may vary from the actual model of the system or component.
- No claims can be derived from the illustrations in this manual.

## 1.2 Conventions for 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.

## 1.3 Special Notices

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 system 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 system.

---

## 1.4 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

### *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 refer to the viewpoint of a person that is facing the system 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

## 1.5 Reference Documentation

In addition to this manual, other documentation is available.

**TIP** Electronic versions of these manuals are available as PDF (Portable Document Format) files. To open and read the PDF files, Adobe™ Reader™ or Adobe™ Acrobat™ is required.

### *Hardware Documentation*

*Vanquish Neo Standard Application Manual*

### *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 system.

## 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 system.

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 system, read this manual carefully to be familiar with the system and this manual. The manual contains important information with regard to user safety as well as use and care of the system.
- Always keep the manual near the system 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 System

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

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.
— O	Power supply is on Power supply is off
	Indicates a power button that switches the system between on and off states.
	Indicates alternating current.
	Indicates that the surface becomes hot during operation. Do not touch these surfaces while they are heated up.
	Indicates a potential pinch point hazard. Keep your hands clear to avoid harming your hands.

### 2.1.4 Rating Plates

The rating plates are present on each system module 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.

#### *System serial number label*

In addition, a system serial number label is present at the inner side (bottom left) of the system base drawer. The system serial number label indicates the system serial number, part number, system name, revision number and the manufacturer's address.

#### *Type label*

An additional type label on the leak tray of each system module indicates the module name, serial number, part number, 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 intended use of the Vanquish system is to analyze mixtures of compounds in sample solutions.

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

The Vanquish system and its modules 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 system.



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

- Operate the system only within its technical specifications.
- Use only the replacement parts and additional components, options, and peripherals specifically authorized and qualified for the system by Thermo Fisher Scientific.
- Perform only the procedures that are described in this operating manual and in supporting documents for the system. Follow all instructions step by step and use the tools recommended for the procedure.
- Open the enclosure of the system 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 system. 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 system.

### *Installation*



Only skilled personnel are permitted to install the system 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 system, the installer is responsible for ensuring the safety of the system.

### *Operation*



#### **General Operation**

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

All users must know the hazards presented by the system 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.
- 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.

### 2.3.5 General Residual Hazards

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



#### **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.
- Avoid handling of solvent reservoirs above head height.
- Do not operate the system 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 system 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 autosampler. This can pose health and safety risks and lead to wrong results.

- 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**

Some capillaries in the system are made of PEEK. Swelling or attack by acids can cause PEEK capillaries to start leaking or to burst. Certain chemicals, for example, trichloromethane (CHCl<sub>3</sub>), 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 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 system modules from the power line.



## 2.4 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 system is delivered to you, the system modules meet all pertinent electromagnetic compatibility (EMC) and safety standards as described in this manual.

Changes that you make to the system modules may void compliance with one or more of these EMC and safety standards. Changes to the system modules 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 system has been shipped from the manufacturing site in a safe condition.



# 3 System Overview

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

## 3.1 System Features

The system comprises the following features:

### *Main Features*

- Pre-installed system offering high workflow versatility
- Operating pressure of up to 150 MPa
- Flow range from 50 nL/min to 100 µL/min
- Integrated automated startup and purging functions
- Continuous background system monitoring for minimized unplanned downtime
- Diagnostic features for fast troubleshooting and increased uptime
- Touch-based user interface, offering instrument monitoring and control and maintenance assistance

### *Specific Pump Features*

- Binary pump with each channel based on a serial dual-piston design
- Floating piston design for compensation of small mechanical tolerances within the specification and thus enhanced robustness of the pump
- One flowmeter supporting flow rates of 50 nL/min to 100 µL/min; no hardware change required except for system capillaries
- Active seal wash system for high lifetime of pistons and piston seals
- Automated purge valves for easy startup and diagnostics
- Integrated automated startup and purging functions
- Built-in vacuum degasser for autosampler needle wash liquids
- Vacuum degasser for solvent degassing with micro LC applications available as an option
- Built-in automatic shut-off valves preventing solvent spillage and ensuring robust solvent aspiration

### *Specific Autosampler Features*

- Low carry-over split-loop injection principle featuring two needle wash liquids (weak and strong)
- Washing inner needle, needle seat, and sample loop with weak and strong wash liquid
- Washing outer needle surface with weak and strong wash liquid for minimum LCMS carry-over
- Injection volumes up to 100 µL with one single stroke
- Injection volumes higher than 100 µL through multi-draw feature for preconcentration of large volumes
- Integrated automated startup and purging functions
- Bottom sensing to allow aspiration of small volumes with minimal sample loss
- Temperature control for thermostating the sample compartment
- Barcode reader inside the autosampler for identification of sample racks and well plates with barcodes for Vanquish rack type identification
- Support of sample racks and well plates with a footprint as specified by the Society for Biomolecular Screening (SBS footprint)
- Seal wash for metering device head for high lifetime of the seals
- Integrated loading functionality and automated purging function
- Pre-compression of sample loop and trap column

### *Specific Column Compartment Features*

- Column chamber (34 x 8 x 4 cm, w x h x d) providing room for columns, trap columns, and capillaries in various workflow setups
- Space for up to two switching valves inside the column chamber for advanced applications
- Temperature range from +5 °C to 80 °C without valves or +5 °C to 50 °C with VICI valves or +5 °C to 60 °C with Vanquish Neo low-dispersion (LD) valves, to thermostat the column chamber and the components inside the chamber
- Optimized design enabling an even air flow and heat distribution
- Fast heat-up time (35 °C to 65 °C ±1 °C in less than 12 minutes)
- Advanced temperature control providing temperature stability of ±0.05 °C

## 3.2 System Description

The Vanquish system is designed for use in low-flow liquid chromatography (LC) applications and for connecting a mass spectrometer.

The Vanquish system may comprise the following modules.

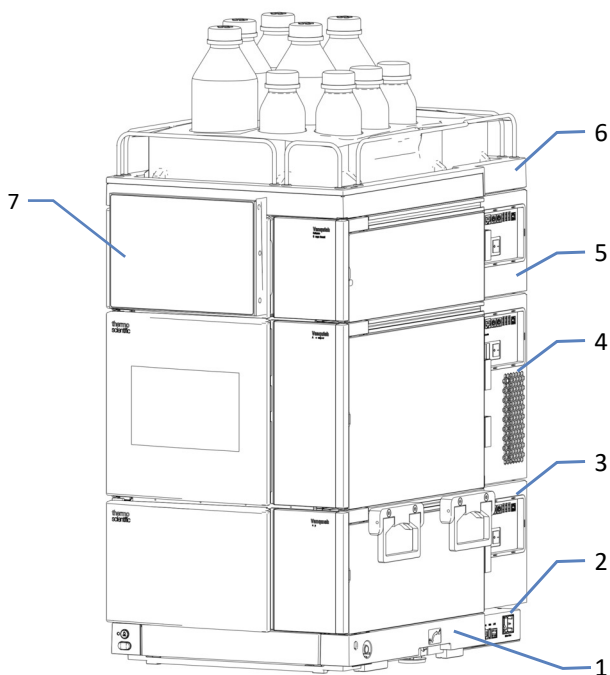


Figure 1: System stack

No.	Description
1	System base
2	System controller
3	Pump
4	Autosampler
5	Column compartment (optional)
6	Solvent rack
7	Display

## 3.3 System Base

The system base carries the pump, autosampler, system controller, and, optionally, the column compartment.

### 3.3.1 System Base Parts

The system base provides:

- Power buttons for power on/off control of all modules and the system controller
- Drawer to store tools and small system parts
- Drain port for connecting a system waste line
- Locks to toggle between moveable and stationary mode

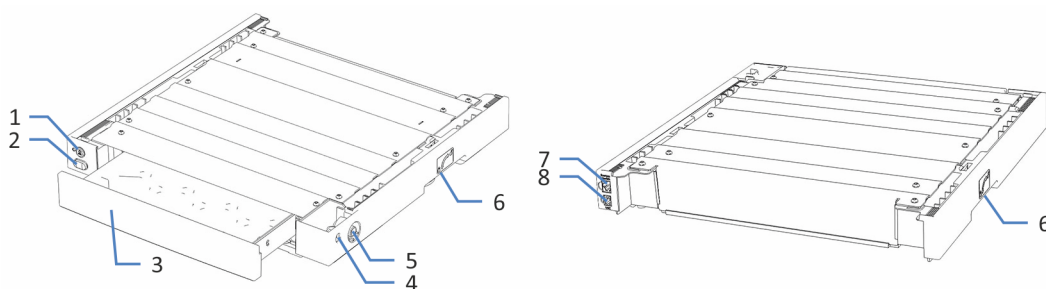


Figure 2: System base (front and rear view)

No.	Description
1	Vanquish System Controller power button Allows power on/off control of the system controller.
2	System power button Allows power on/off control for all modules of the system that are connected to the system base via the System Interlink port.
3	Drawer for tools Allows storing any tools that are necessary to install or maintain the Vanquish system. Push the drawer front to open or close the drawer.
4	Reserved for future use
5	System drain port For connecting the system waste line.
6	Locks - on the left and right side of the system base Allows toggling between movable and stationary mode.
7	System Interlink port Allows connecting the other modules for power on/off control from the Vanquish system base.
8	VSC port Allows connecting the system controller.

### 3.3.2 System Base Lock

The system base has a locking mechanism. Before you move the system base, for example, for installation and maintenance, you need to unlock the system base. To prevent it from being moved during operation on the workbench, lock it.

You can switch between the moveable and stationary mode using the system base locking tools shipped with the system base.



Figure 3: System base locking tool



## 3.4 System Controller

The system controller parts are shown below.

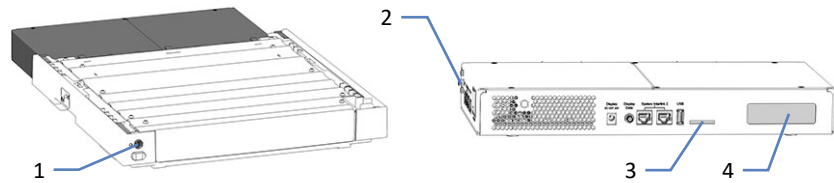


Figure 4: System base with VSC button and system controller

No.	Description
1	VSC power button
2	Spring clips
3	Storage Device (SD) card slot
4	Reserved for future use

## 3.5 Pump

### 3.5.1 Pump Interior Components

The user-accessible components of the pump are located directly behind the front doors.

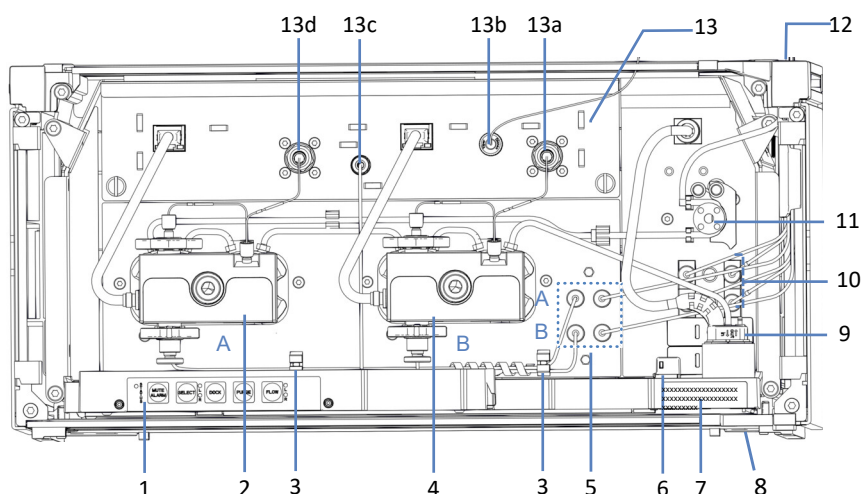


Figure 5: Pump interior components

No.	Description
1	Keypad with buttons for pump control
2	Pump head A (left pump head)
3	Tubing clips for routing solvent lines to the pump heads
4	Pump head B (right pump head)
5	Shut-off valves
6	Leak sensor
7	Type label, indicating the module name, serial number, part number, and revision number
8	Drain port
9	Seal wash detector (drop detector)
10	Degasser for autosampler needle wash liquids
11	Seal wash pump
12	Tubing chase with tubing guides
13	Flowmeter, with:
13a	Flowmeter inlet B
13b	Pump outlet to autosampler (flowmeter outlet)
13c	Flowmeter waste line (Purge Out)
13d	Flowmeter inlet A

### 3.5.2 Pump Operating Principle

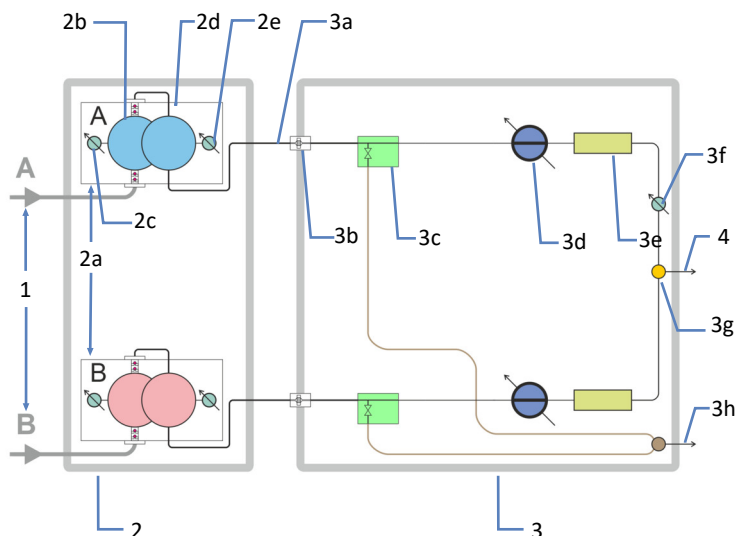


Figure 6: Operating principle

No.	Description
1	Solvent lines: A and B
2	Flow-controlled pump with two identical pump blocks (solvent channels), A and B
2a	Pump blocks A and B, each pump block with:
2b	Working cylinder
2c	Working pressure sensor
2d	Equilibration cylinder
2e	Primary pressure sensor The primary pressure is the pressure in the pump head.
3	Flowmeter, with:
3a	Flowmeter inlet line (capillary from pump head)
3b	Flowmeter filter
3c	Automatic purge valve with waste outlet
3d	Flow sensor
3e	Restrictor capillary
3f	System pressure sensor
3g	Flowmeter outlet with fluidic Tee piece
3h	Waste outlet
4	System capillary (to autosampler injection valve)

The pump is a binary pump with a flowmeter for flow control:

- Each pump block has a working cylinder and an equilibration cylinder. The cylinders are connected in series. The solvent passes the cylinders successively.
- Each pump block delivers flow continuously. The working cylinder delivers while the equilibration cylinder is filled simultaneously. The equilibration cylinder serves as the reservoir and delivers while the working cylinder performs the intake stroke.
- The sensors in the flowmeter measure and control the partial flows of the pump blocks.
- The partial flows are combined in the fluidic Tee piece at the flowmeter outlet. The combined flow leaves the flowmeter with the selected target flow rate and solvent composition.

## 3.6 Autosampler

### 3.6.1 Autosampler Interior Components

The user-accessible components are located directly behind the front doors.

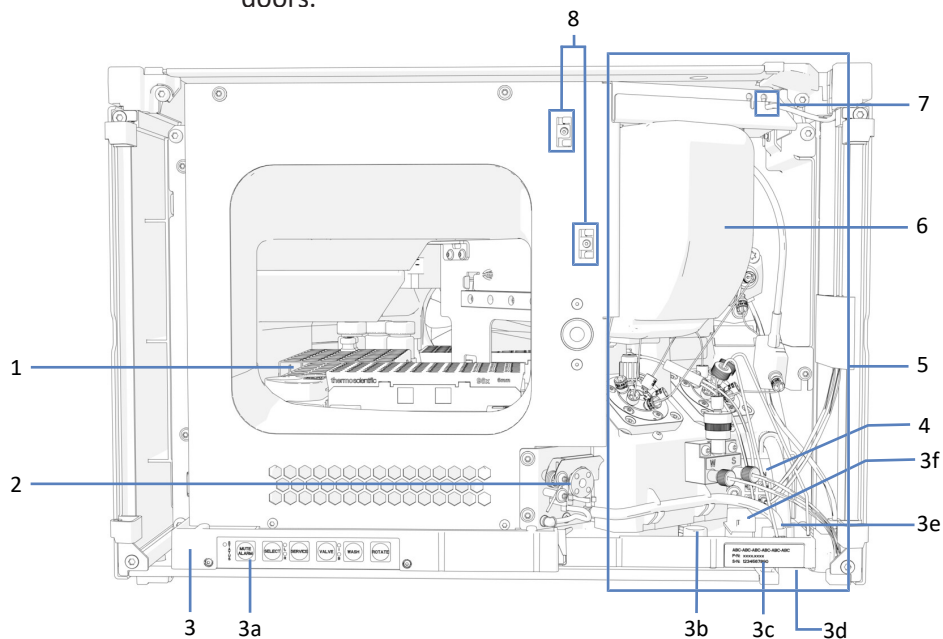


Figure 7: VN-A10 Autosampler interior view

No.	Description
1	Sample compartment with carousel
2	Drain pump
3	Leak tray with:
3a	Keypad with status indicators
3b	Pump capillary guide hole
3c	Type label, indicating the module name, serial number, part number and revision number
3d	Drain funnel
3e	Drain ports
3f	Leak sensor
4	Needle wash pump
5	Injection unit (refer to next page for detailed view)
6	Insulation Cover
7	Seal wash inlet port
8	Guides for capillary to column compartment

## Injection Unit of the Autosampler

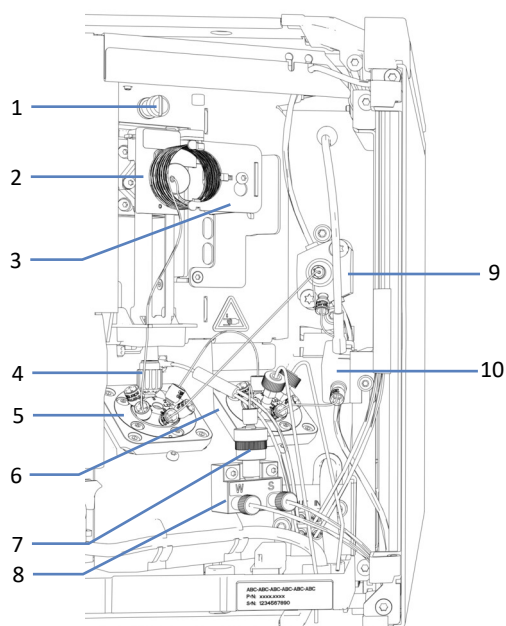


Figure 8: VN-A10 Detailed view of the injection unit without insulation cover

No.	Description
1	Shipping lock screw for needle unit
2	Needle unit with vial pusher
3	Sample loop unit
4	Needle seat
5	Injection valve
6	Solvent valve
7	Check valve
8	Selector valve
9	Metering device head
10	Pressure sensor

### 3.6.2 Autosampler Operating Principle

The operating principle of the autosampler is based on the split-loop injection principle. In this injection principle, the needle is part of the sample loop. Described here is the direct injection setup.

#### *Sample draw and pre-compression, valves in bypass position*

- At the beginning of a sample injection process the needle moves from the needle seat to the pre-defined sample in the carousel. There the needle descends into the sample container.
- The metering device draws the sample from the sample container through the needle into the sample loop. After that the needle withdraws from the sample container.
- To remove residual sample from the needle between injections, the outside of the needle can be washed. In this case the needle moves to the wash port and descends into it. The needle wash pumps supply needle wash liquid to the wash port to rinse the outer surface of the needle to the wash waste.
- The needle moves back to the needle seat, which seals the needle tip against the system pressure, while the metering device provides a pre-compression of the sample.

#### *Injection of the sample, valves in inject position (see figure)*

- The injection valve switches to inject position to establish the required flow path so that the solvent from the pump flows through sample loop, needle seat and needle and flushes the sample through the injection valve onto the column.

#### *Start of Gradient, valves in bypass position*

- When the sample has been pushed out of the autosampler completely, the injection valve switches back to bypass position. The gradient can start to provide the smallest gradient delay volume possible.  
NOTE: If applicable the autosampler can be configured to keep the inject valve in inject position to start the gradient immediately. Thus the complete sample loop is involved the gradient delay volume will be higher.

### Washing process, valves in wash position

- With the injection valve in bypass position, the solvent valve switches to wash position and the needle moves from the needle seat to the wash port and descends into it. In this position the outside and the inside of the needle will be washed with strong needle wash liquid from the wash port (7) and weak wash solvent from the degasser of the pump (13).

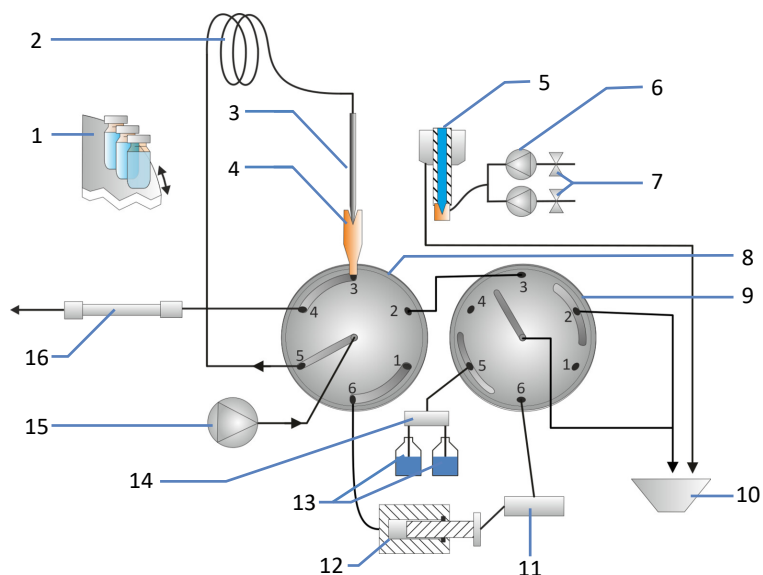


Figure 9: Operating Principle VN-Autosampler, Inject Position

No.	Description
1	Carousel
2	Sample loop
3	Needle
4	Needle seat
5	Wash port
6	Needle wash pump
7	Needle wash liquids (weak and strong)
8	Injection valve
9	Solvent valve
10	Wash waste
11	Pressure sensor
12	Metering device
13	Wash solvents from degasser of the pump (weak and strong)
14	Selector Valve
15	Pump
16	Column



### 3.6.3 Port Assignments of the Autosampler Valves

In the direct injection setup the injection valve ports are assigned as follows:

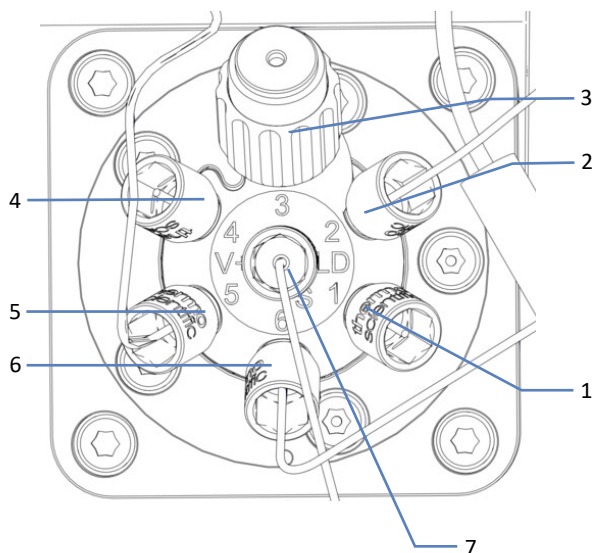


Figure 10: Injection valve with connected capillaries

Port	Connected Component
1	Viper plug
2	Solvent valve
3	Needle seat
4	Column (if installed: Column Compartment)
5	Sample loop
6	Metering device
7	Pump

For direct injection, the solvent valve ports are assigned as follows:

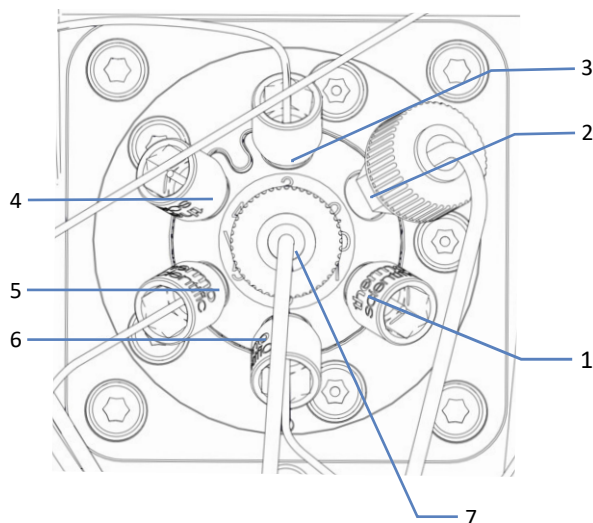


Figure 11: Solvent valve with connected capillaries

Port	Connected Component
1	Viper plug
2	Waste
3	Injection valve
4	Viper plug
5	Check valve
6	Pressure sensor
7	Waste

### 3.6.4 Sample Compartment

The sample compartment of the autosampler accommodates a carousel with four color-coded segments, each with an additional three-position vial holder for 10 mL vials.

The autosampler supports sample racks and well plates with a footprint as specified by the Society for Biomolecular Screening (SBS footprint).

The sample compartment provides the following features:

- Sample compartment thermostating, see [Sample Compartment Thermostating](#) (▶ page 47).
- Rack type identification and verification, empty segment detection and inventory management, see [Rack Type Identification](#) (▶ page 49).

### 3.6.4.1 Sample Compartment Thermostatting

Temperature control can be enabled for sample compartment thermostatting. Circulating air is used to cool or heat the sample compartment to the selected temperature, thus allowing precise equalization of the sample temperature.

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

Sample compartment thermostatting provides a temperature range of +4 °C to +40 °C. Sample cooling is possible to max. 23 K below ambient temperature.

Depending on the ambient humidity, condensation liquid may occur during sample cooling. A drain pump (peristaltic pump) in the autosampler actively removes any occurring condensation liquid from the sample compartment.

The autosampler is equipped with an insulation cover covering the sample loop. This cover protects the interior components from high humidity and extensive condensation when thermostatting the sample compartment. If the cover is not installed properly, thermostatting cannot be enabled or will be turned off automatically.

### 3.6.4.2 Carousel

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

Each segment separates into the following areas:

- Positioning area that accommodates space for one sample rack or well plate
- Support vial holder that comprises three vial positions for vials with a volume of up to 10 mL, such as reagent vials  
The support vial holder is positioned left of the area for the sample rack or well plate in each segment.

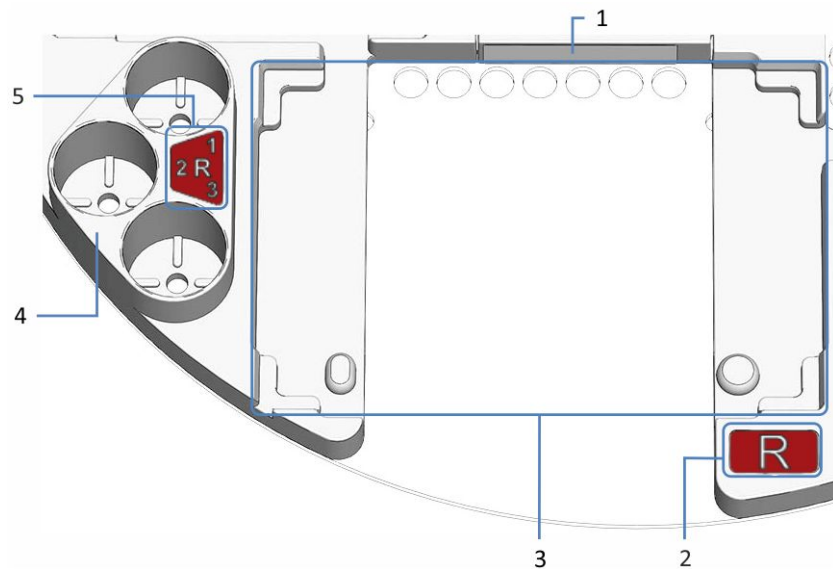


Figure 12: Detailed view on segment in the carousel

No.	Description
1	Barcode label 'empty' Label that identifies that the segment is empty for the barcode reader
2	Color code for the segment ( <i>here: R</i> for the red segment)
3	Positioning area of the segment Space to position a sample rack or well plate With alignment angles and alignment points to align the sample rack or well plate
4	Support vial holder For three vials with a volume of up to 10 mL
5	Color code for the support vial holder ( <i>here: R1</i> for example for the first vial holder in the red segment)

### 3.6.4.3 Rack Type Identification

A barcode reader inside the sample 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 identifies the rack type and orientation. This information is sent to the chromatography data system.

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.



Figure 13: Sample rack with barcodes for rack type identification

No.	Description
1	Sample position A1
2	Vanquish rack type barcode

## 3.7 Column Compartment

### 3.7.1 Column Compartment Interior Components

The user-accessible components of the column compartment are located directly behind the front doors.

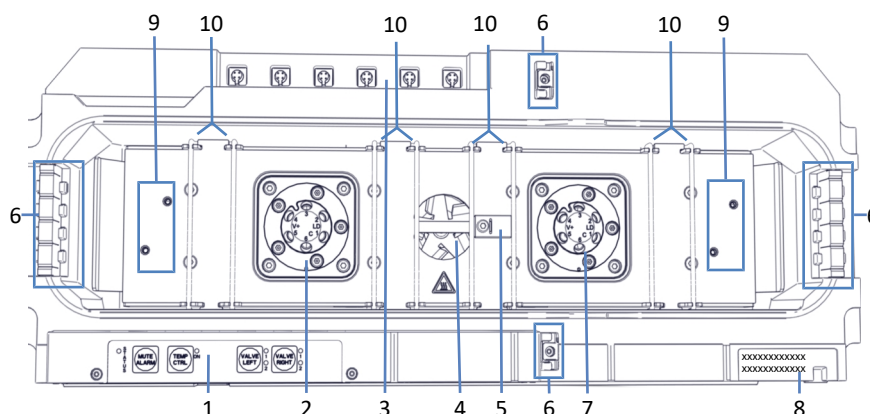


Figure 14: Column compartment interior components

No.	Description
1	Keypad
2	Left column switching valve (if installed; here: Vanquish valve)
3	Column ID ports
4	Fan
5	Temperature sensor
6	Capillary guides
7	Right column switching valve (if installed; here: Vanquish valve)
8	Type label, indicating the module name, serial number, part number, and revision number
9	Mounting positions for the passive pre-heater
10	Column brackets

### 3.7.2 Column Compartment Operating Principle

The fundamental requirement for a column compartment for liquid chromatography applications is the ability to maintain the set temperature as precisely as possible. The advanced design of the column compartment enables the column chamber to maintain the temperature with a precision of  $\pm 0.1$  °C.

To obtain good measurement results, temperature stability is more important than the temperature accuracy. The column compartment provides a temperature stability of  $\pm 0.05$  °C.

Heating elements heat up the column chamber and the internal components to the set temperature. The optimized design enables an even air flow.

This ensures the following:

- The temperature of the stationary phase remains constant over the total column length.
- The column and the eluent have the same temperature during analysis.
- The analytical separation is performed at the set temperature.

### 3.7.3 Column Switching Valve Overview

The column compartment can hold one or two switching valves for advanced applications, including column switching. You can install the switching valves at the positions shown in [Column Compartment Interior Components](#) (► page 50).

The following switching valve types are available:

- Vanquish switching valves
- VICI™ switching valves

A mixed configuration of Vanquish switching valves and VICI switching valves is possible. You can install a Vanquish switching valve at any position where no VICI valve drive is installed.

When no valve is installed, a cover plate closes the opening.

### Vanquish Switching Valves

The Vanquish switching valves consist of one part. The valve drive is integrated into the valve assembly.

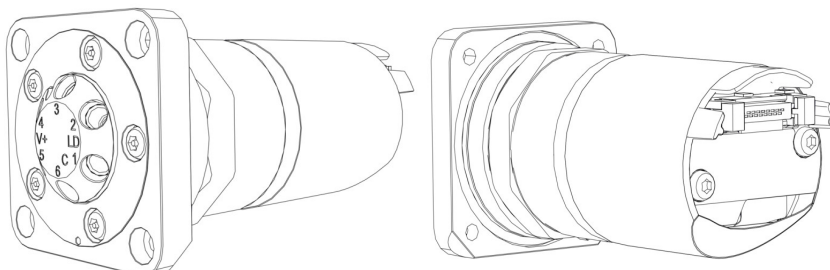


Figure 15: Vanquish switching valve: front view (left), rear view (right)

To install a Vanquish valve, see [Installing the Vanquish Switching Valve](#) (▶ page 83).

To replace a Vanquish valve, see [Replacing the Vanquish Switching Valve](#) (▶ page 287).

### VICI Switching Valves

The VICI valve consists of two parts, the valve pod (no. 1) and the valve lock ring (no. 2). The valve lock ring connects the valve pod to the valve flange (no. 3) of the valve drive. The valve drive is not integrated into the valve assembly. The valve drive is located inside the housing and cannot be accessed by the customer.

You can only install or replace the VICI valve. To install the VICI valve drive, contact your local Thermo Fisher Scientific Technical Support.

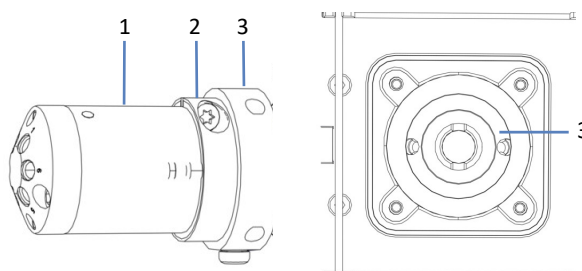


Figure 16: VICI valve overview (left); valve opening with flange (right)

No.	Description
1	Pod
2	Lock ring
3	Flange (inside the housing)

To install a VICI valve, see [Installing the VICI Switching Valve](#) (▶ page 85).

To replace a VICI valve, see [Replacing the VICI Switching Valve](#) (▶ page 290).



## 3.8 Solvent Rack

The image shows the parts of the solvent rack.

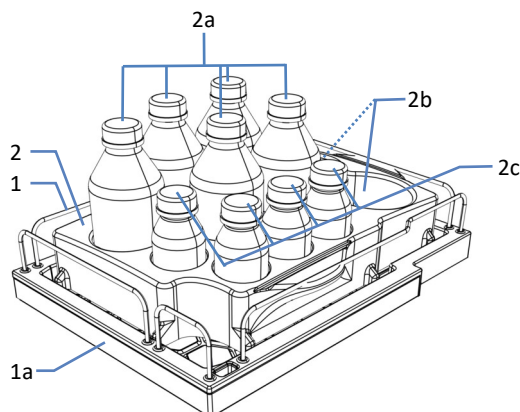


Figure 17: Solvent rack parts

No.	Description
1	Solvent rack
1a	Magnetic front Allows attaching a magnetic label holder to the front side of the solvent rack, for example, to show a specific system name. Labels are included in the system ship kit.
2	Foam piece <sup>1</sup> Provides slots for the following reservoirs:
2a	5 slots for 1 L reservoirs
2b	2 slots for 2 L reservoirs
2c	4 slots for 0.25 L reservoirs
<sup>1</sup> : The foam piece can be removed easily. Without foam piece, the solvent rack can store, for example: <ul style="list-style-type: none"> <li>• 6 x 1 L solvent reservoirs</li> <li>• 2 x 0.25 L solvent reservoirs</li> </ul> The maximum volume for an individual reservoir should not exceed 5 L.	

## 3.9 Leak Detection

As leaks are a potential safety issue, the pump and autosampler modules are equipped with a leak sensor.

The leak sensors monitor the system for liquid leaks from the flow connections. The liquid is collected in the leak trays and guided to the drain port. From the drain port, the liquid is discharged to waste through the drain system.

When a leak sensor detects leakage, the status indicators of the related module change to red and beeping starts to alert you.

If leakage in the pump is not resolved after 3 minutes, the pump stops the flow.

### See also

 [Testing the System for Liquid Leaks](#) (▶ page 355)

## 3.10 Needle Wash System (Overview)

The autosamplers needle wash system enables to wash the inside and the outside of the needle to remove residual sample from the needle. The wash cycles can be part of the sampling sequence or can be performed manually.

The needle wash components are pre-installed within the autosampler upon shipment.

### *Outer needle wash*

The needle wash system for the outside of the needle is supported by two needle wash pumps, which can deliver a strong or a weak needle wash liquid.

The outside of the needle can be washed automatically after drawing a sample or manually.

### *Inner needle wash*

When performing the inner needle wash, the outside of the needle will be washed together with the inside of the needle. To ensure a low carry-over, also the needle seat and sample loop will be washed when performing the inner needle wash. Additional to the two needle wash pumps for the outer needle wash, the inner needle wash uses a weak needle wash liquid that flows through the degasser of the pump.

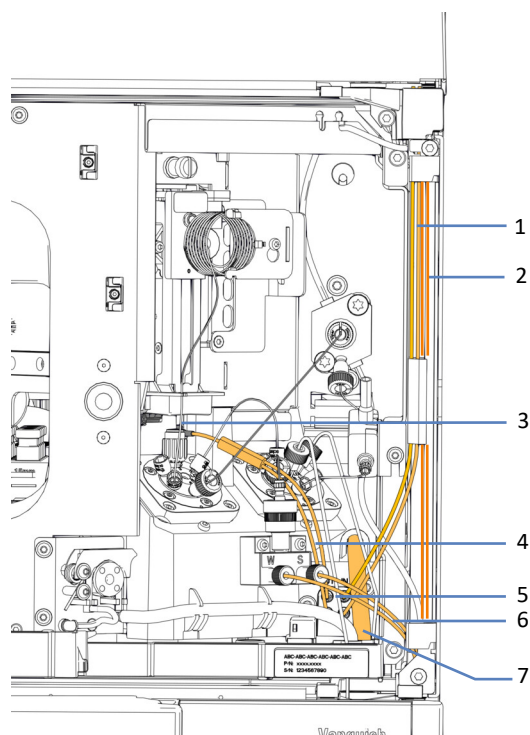


Figure 18: Needle Wash Components

No.	Description
1	Wash line labeled with <b>SWP (red)</b> from strong wash reservoir to needle wash pump inlet, used for strong outer and inner needle wash. Wash line labeled with <b>WWP (green)</b> from weak wash reservoir to needle wash pump inlet, used for weak outer needle wash.
2	Wash line labeled <b>S (red)</b> from strong wash reservoir to degasser inlet port in the pump, used for purging and short-term shutdown procedures. Wash line labeled <b>W (green)</b> from weak wash reservoir to degasser inlet port at the pump, used for inner needle wash and purging.
3	Wash port
4	Wash lines from needle wash pump outlet to wash port
5	Needle wash pump
6	Wash lines from degasser outlet port at the pump to the autosampler.
7	Needle wash waste line

## 3.11 Seal Wash System (Overview)

Seal washing prolongs the lifetime of the pistons and seals by preventing crystallization and particle deposits on the piston surfaces and seals. The flow path of the seal wash system passes through the metering device head in the autosampler and the pump heads in the pump. The seal wash system comprises the following parts:

- In the pump: Seal wash pump (peristaltic pump), seal wash lines, and seal wash detector (drop detector)
- In the autosampler: Seal wash lines
- Reservoir for the seal wash liquid

The system is shipped with the seal wash components and lines installed.

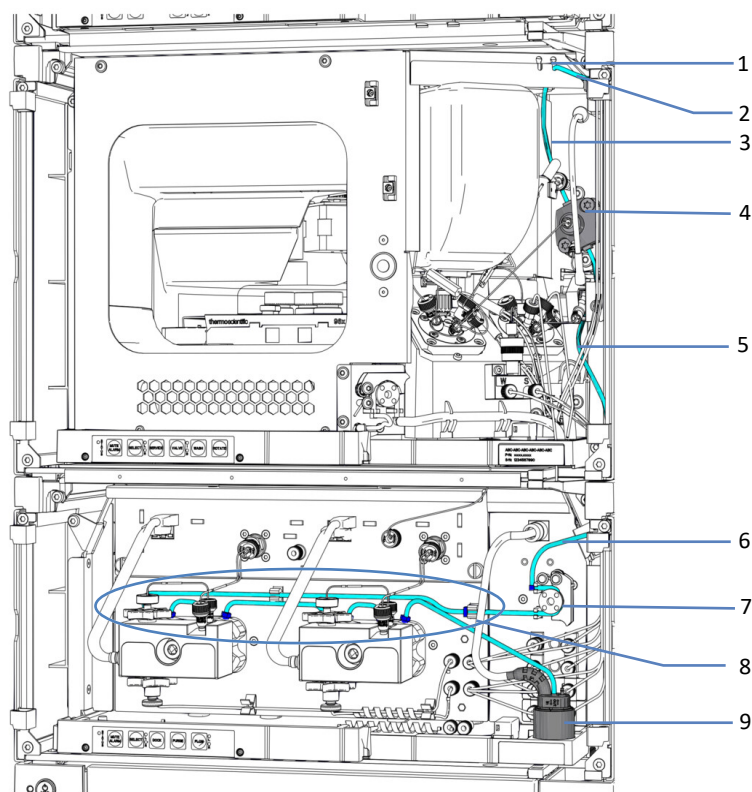


Figure 19: Seal wash system overview

No.	Description
1	Seal wash inlet port (right port)
2	Seal wash reservoir line from reservoir to inlet port
3	Seal wash inlet line from inlet port to metering device head
4	Metering device head

No.	Description
5 + 6	Seal wash pump inlet line
7	Seal wash pump (peristaltic pump)
8	Seal wash lines in the pump (thin tubing), with: <ul style="list-style-type: none"><li>• Seal wash line from seal wash pump to left pump head</li><li>• Seal wash line on left pump head</li><li>• Seal wash line between pump heads</li><li>• Seal wash line on right pump head</li><li>• Seal wash outlet line from right pump head to seal wash detector</li></ul>
9	Seal wash detector (drop detector)

**See also**

 [Filling the Seal Wash Reservoir](#) (▶ page 130)

## 3.12 Power On/Off Control

### Available Power Buttons and Main Power Switches

The image shows the powering devices of the system.

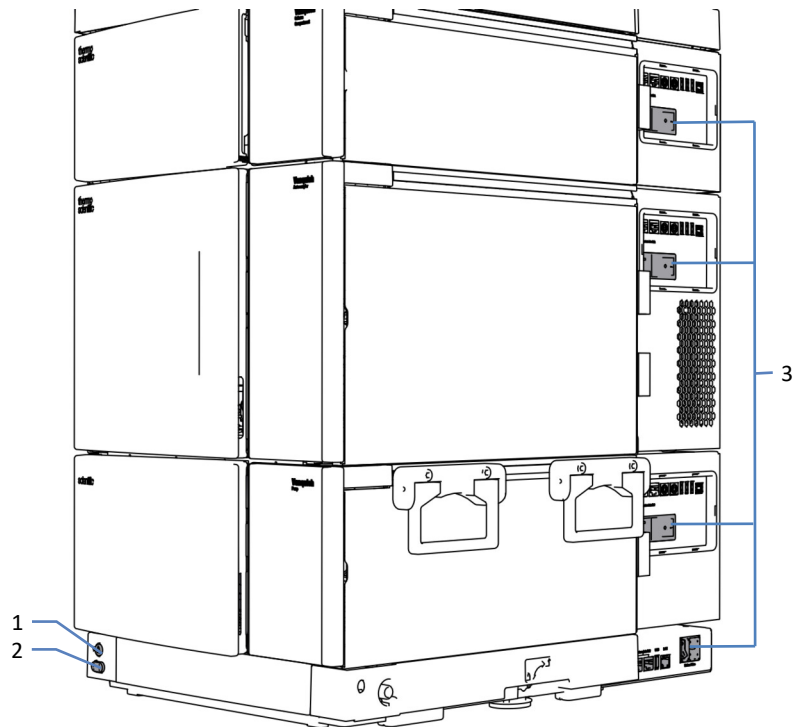


Figure 20: Power buttons and main power switches

No.	Description
1	Power push button of the system controller
2	Power button of the system
3	Main power switches

### System Power Button

If the main power switches of the system modules are on, you can use the system power button for turning on/off all system modules (except the system controller) simultaneously to facilitate the turn on/off control. Observe the following:

Status	Description
On	<ul style="list-style-type: none"> <li>• All system modules in the system that are connected to the system base via system interlink cables are turned on simultaneously.</li> <li>• You cannot turn on a system module with the system power button if the main power switch on a system module is off.</li> </ul>
Off	<ul style="list-style-type: none"> <li>• All system modules in the system that are connected to the system base via system interlink cables are turned off simultaneously.</li> <li>• Pressing the system power button will not be sufficient to turn off the power to the system modules completely. To turn off a system module completely, you have to turn it off with its main power switch. Turn off a system module with its main power switch, when instructed to do so, for example, before maintenance.</li> </ul>

### System Controller Power Button

The system controller power button is a push button and is completely independent of the system power button. If the system controller is turned on, the display is automatically turned on. After a power outage, the system controller restarts automatically.

To turn off the system controller and the display (if available), use the system controller power button.



## 3.13 Operation of the System

### *Maintenance and System Monitoring from the Thermo Scientific Vanquish User Interface*

You can set up the system and monitor system health from the Thermo Scientific Vanquish User Interface. This interface enables you to quickly understand system status, perform maintenance procedures, and solve problems. All this can be done with or without a connection to a chromatography data system.

All descriptions in this manual that relate to software refer to the Vanquish User Interface, if not stated otherwise.

For an overview of the Vanquish User Interface, see [Vanquish User Interface Overview](#) (► page 150).

### *Operation from a Chromatography Data System*

For information about how to connect and control the system with your chromatography data system, contact your local Thermo Fisher Scientific support organization.

## 3.14 Purging (Overview)

Purging means rinsing the system or system components for a certain time at a higher flow rate. Purging is required in various situations and for different reasons. The situation and reason determine which script is the best to use. The tables provide information for the most common situations. You start the scripts from the Vanquish User Interface.

### *During Installation, Before Operation*

Reason	Script	Additional Parameter
When preparing the system for initial operation	Auto Start Up	None
To restart the system after long-term shut-down	Auto Start Up	None

### *During Operation*

Reason	Script	Additional Parameter
To replace a solvent reservoir or autosampler wash liquid reservoir when the liquid level in the reservoir is too low for the next analysis (same type of liquid)	Change Liquids / Solvents	Select the affected solvent or wash liquid and <b>Refresh Only = On</b> .
One or more solvent lines or autosampler wash liquid lines have been empty	Change Liquids / Solvents	Select the affected solvent or wash liquid.
To change to a different set of liquid (solvent or autosampler wash liquid), for example, when changing to a different analytical method	Change Liquids / Solvents	Select the affected solvent or wash liquid.

*During Maintenance*

Reason	Script	Additional Parameter
Pump maintenance: At the beginning of a maintenance procedure: To flush out harmful substances At the end of a maintenance procedure: To remove air that might be trapped in the system due to the procedure	Purge Pump	Select = Pump Purge Time = Standard
Autosampler maintenance: To remove air that might be trapped in the system due to the procedure	Purge Sampler	Select = Sampler Purge Time = Intense

*During Troubleshooting*

Why	Script
To remove air that might be trapped in the system, for example leading to pulsation issues during operation, high noise level, or non-reproducible analysis	Depends on the potential cause. See <a href="#">System Troubleshooting</a> (▶ page 342).



## 4 Unpacking

This chapter describes how to unpack the big shipping container with the pre-installed basic system stack. For information on how to unpack the optional column compartment, see [Unpacking the Column Compartment](#) (▶ [page 69](#)). This chapter also informs you about the scope of delivery.

## 4.1 Damaged Packaging, Defective on Arrival

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

If you suspect that the content 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.

## 4.2 Scope of Delivery

The following items are included in the delivery:

- Pre-mounted system
- Display
- Power cords
- Ship Kit

For details about the kit content, see [Ship Kit](#) (► page 367).

## 4.3 Unpacking the System



### CAUTION—Heavy Load, Bulky System

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

- Physical handling of the system, including lifting or moving, requires a team effort of two persons.
- Use the carrying handles that are fixed to the system to move or transport the system. Never move or lift the system by the front doors. This will damage the doors or the system modules. Verify that the handles are fixed properly and cannot slide off the system.

### NOTICE

Moving the Vanquish system stack even over short distances on the workbench can damage and impair the functionality of the system base.

Before moving the system stack, unlock the system base using the locking tools.

#### *Tools required*

Screwdriver, Torx™ T30

#### *Follow these steps*

1. Transport the system to the installation site.
2. Remove all straps from the shipping container.
3. Lift the cardboard cover and remove it.
4. Remove the ship kit.
5. Lift the upper foam piece and remove it.
6. Remove the system from the shipping container:
  - a) Grasp the system by the carrying handles.
  - b) Slowly and carefully, lift the system out of the shipping container.
7. Place the system on a stable surface and leave protective films attached to the surfaces.

8. To be able to shift the system base slightly on the workbench for better access to system parts, unlock the system base using the system base locking tools (see [Unlocking the System Base](#) (▶ page 70)).
9. Remove any additional packing material.
10. *Optional:* Remove the carrying handles:
  - a) On each carrying handle, loosen the attachment screws until the carrying handles are moveable in the rail. Do not remove the screws from the carrying handles completely.
  - b) Slide off the carrying handles from the rails toward the rear of the system.

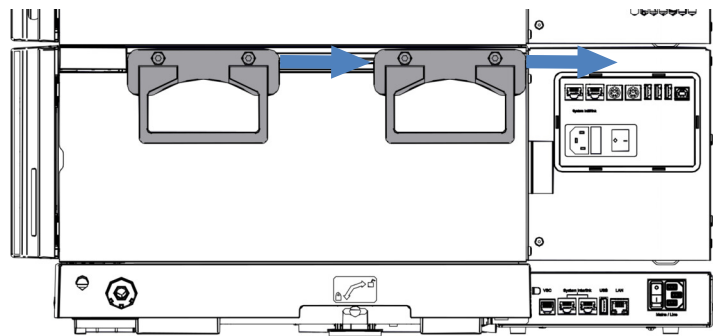


Figure 21: Sliding off the carrying handles from the left rail

11. Fasten the screws of the carrying handles.

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

12. Remove the protective film from all surfaces as applicable.



## 4.4 Unpacking the Column Compartment

### *Damaged Packaging, Defective on Arrival*

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

If you suspect that the content 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.

### *Unpacking*

#### **NOTICE**

To lift or move the device, grasp the device by the carrying handles. Do not move or lift the device by the front doors. This will damage the doors or the device.

### *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.
4. Place the device on a stable surface.
5. 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 [Placing the Column Compartment in the System Stack](#) (► page 81)).
7. 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.

## 4.5 Unlocking the System Base

1. Insert a locking tool into the lock port on one side of the system base.
2. Insert one locking tool into the lock port on the other side of the system base.
3. Unlock the system base by turning the locking tools as shown below. In the unlocked position, the locking tools cannot be removed from the system base.

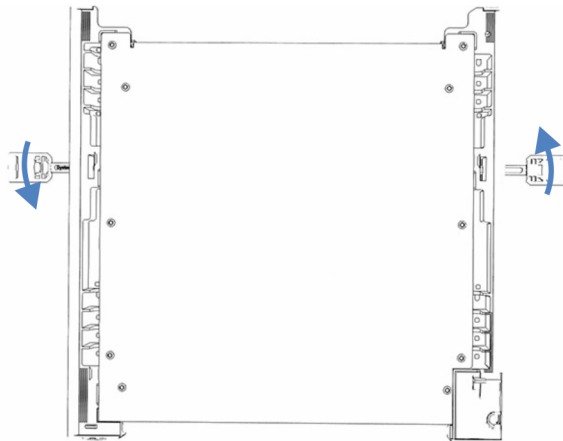


Figure 22: Unlocking the system base

4. Move the system.
5. Lock the system base (see [Locking the System Base](#) (► page 116)).

# 5 Installation

This chapter specifies the requirements for the installation site and describes how to set up, install, and configure the system.

## 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 Injection Needle**

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

To avoid personal injury, never touch the needle tip.



### **CAUTION—Heavy Load, Bulky Device**

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

- Physical handling of the modules, including lifting or moving, requires a team effort of two persons.
- A team effort is in particular required when lifting the modules into the system stack or when removing them.
- Use the carrying handles that were shipped with the modules to move or transport the modules. Never move or lift the modules by the front doors. This will damage the doors or the modules. Verify that the handles are fixed properly and cannot slide off the module.



### **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.

**NOTICE**

Moving the Vanquish system stack even over short distances on the workbench can damage and impair the functionality of the system base.

Before moving the system stack, unlock the system base using the locking tools.

## 5.2 Site Requirements

The operating environment is important to ensure optimal performance of the system.

This section provides important requirements for the installation site. Note the following:

- Make sure that the installation site has enough power outlets for all devices in the system.
- Operate the system only under appropriate laboratory conditions
- For specifications, see [Specifications](#) (▶ page 357).

### 5.2.1 Workbench

The Vanquish system is designed to be placed on a workbench. If the workbench shall carry a complete Vanquish system and possibly other instruments, the bench must be capable to bear the weight of all devices and instruments, including solvents.

For dimensions and weight, see [Specifications](#) (▶ page 357).

#### *Workbench Requirements*

Part	Requirements
Workbench	<ul style="list-style-type: none"> <li>• Sturdy</li> <li>• A height that ensures convenient access to the interior of each device in the system.</li> <li>• The bench top must be dry, clean, and resistant to chemicals.</li> </ul>
Site for the workbench	The workbench must stand in a secure and level position that is free of vibrations.

### System Clearance Requirements

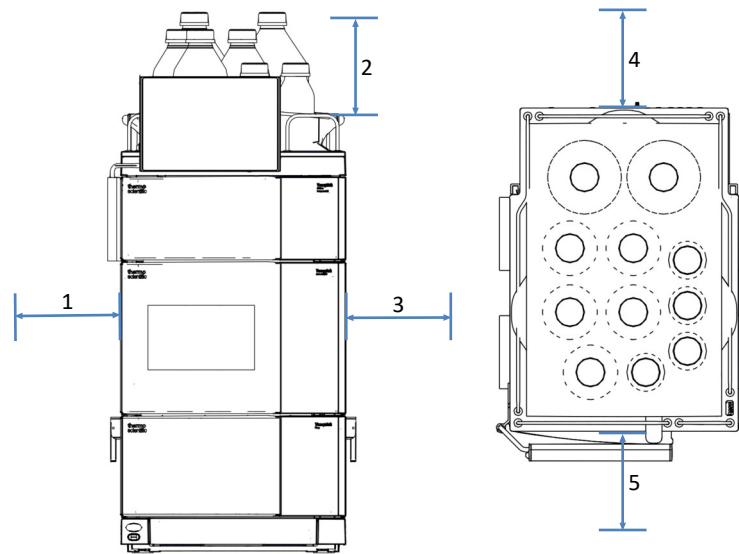


Figure 23: System stack clearances (left: stack front view, right: stack top view)

No.	Description
1	Minimum 10 cm
2	Minimum 30 cm
3	Minimum 5 cm
4	Minimum 15 cm
5	Minimum 35 cm

### 5.2.2 Power Considerations

The power supplies of the modules have wide-ranging capability, accepting any line voltage in the range specified for the modules.



#### **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.

### 5.2.3 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 extension 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.

### 5.2.4 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.



## 5.2.5 Operating Conditions

When operating the system, make sure that the installation site meets these general environmental and operating conditions. For specified ambient temperature and humidity, see [Specifications](#) (▶ [page 357](#)).

### *Temperature*

Temperature fluctuations can affect the performance of the system. Avoid locations with significant changes in temperature and strong air drafts. For example, do not place the system in the direct sunlight, near heating or cooling sources, or under an air duct.

### *Humidity*

The relative humidity of the operating environment is important for the performance of the system. Operate the system in the specified humidity range, with no condensation.

When the humidity is too high, condensation may occur, causing damage to the electronic components in the system. When the humidity is too low, static electricity may accumulate and discharge, shortening the life of the electronic components.

### *Ventilation*

Make sure that the installation site is well ventilated at any time to avoid potential health hazards and safety risks, which may be caused by handling hazardous substances, volatiles or gases.

### *Vibration*

Vibrations may affect the performance of the system. Therefore, the installation site should be free of vibrations. Avoid placing the system in locations where vibrations are caused by other instruments.

## 5.3 Installing the System

A Thermo Fisher Scientific service engineer installs and sets up the Vanquish system, 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 system, follow the steps below.

The steps in the diagram are basic installation steps. Follow the in-depth instructions of each step in the diagram in the given sequence.

Observe the safety guidelines See <a href="#">Safety Guidelines for Installation</a> (▶ page 72)
↓
Observe all site requirements See <a href="#">Site Requirements</a> (▶ page 74)
↓
Optional: Install the column compartment and accessories See <a href="#">Installing the Column Compartment</a> (▶ page 81)
↓
Remove the transport protections from the autosampler See <a href="#">Removing Transport Protections from the Autosampler</a> (▶ page 92)
↓
Mount the display See <a href="#">Mounting the Display</a> (▶ page 96)
↓
Connect cables See <a href="#">Connecting Cables</a> (▶ page 103)
↓
Optional: Connect a mass spectrometer See <a href="#">Connecting a Mass Spectrometer</a> (▶ page 115)
↓
Set up the flow connections See <a href="#">Setting Up the Flow Connections</a> (▶ page 117)
↓
Fill the liquid reservoirs See <a href="#">Filling the Solvent Reservoirs</a> (▶ page 125), <a href="#">Filling the Seal Wash Reservoir</a> (▶ page 130) and <a href="#">Filling the Needle Wash Reservoirs</a> (▶ page 127)
↓

Turn on the system See <a href="#">Turning On the System for the First Time</a> (▶ page 132)
↓
Integrate the system into an instrument LAN See <a href="#">Integrating the System into an Instrument LAN</a> (▶ page 134)
↓
Prepare the system for initial operation See <a href="#">Preparing the System for Initial Operation</a> (▶ page 135)

## 5.4 Opening and Closing the Front Doors

You can find the user-accessible components and flow connections in the devices directly behind the doors.

### *Opening the Front Doors*

1. Open the left door.
2. Open the right door.

**Opening Mechanism of the Autosampler** The left front door of the autosampler is equipped with a mechanism that opens the door automatically to ensure proper ventilation of the sample compartment when the autosampler is turned off. The door also opens automatically if a power failure occurs or if you disconnect the power cord while the autosampler has been turned on.

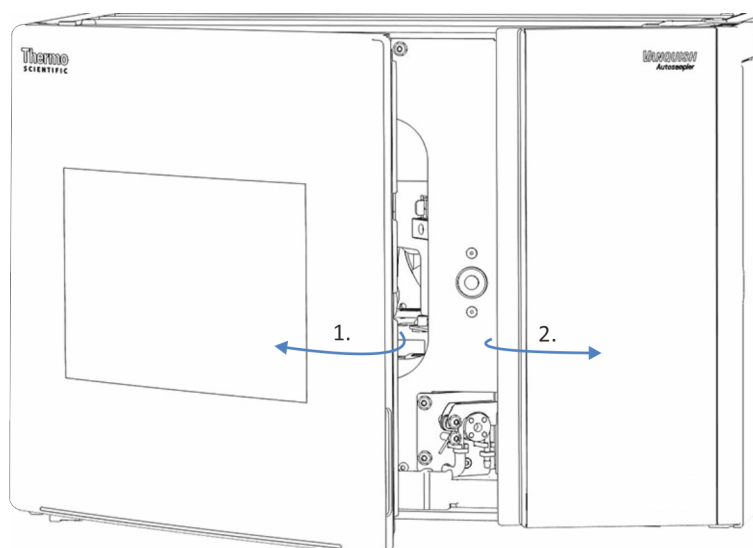


Figure 24: Opening the front doors (here: autosampler)

### *Closing the Front Doors*

1. Close the right door.
2. Close the left door.

**Closing Mechanism of the Autosampler** When the autosampler is turned on, the left front door can be closed completely.

## 5.5 Installing the Column Compartment

### 5.5.1 Placing the Column Compartment in the System Stack

The column compartment is an optional part of the Vanquish system. The system modules are arranged in a system stack, with the arrangement depending on the system configuration.

#### *Tools required*

- Screwdriver, Torx T10
- Screwdriver, Torx T20

#### *Preparations*

When the system is already in operation:

1. Turn off the pump flow.
2. Turn off the system power.
3. Disconnect the liquid lines from the reservoirs.
4. Remove the reservoirs from the solvent rack.

#### *Follow these steps*

1. Loosen the screws that fix the sheet metal bracket on the autosampler, using the screwdriver (Torx T10).
2. Remove the sheet metal bracket.

**TIP** Keep the bracket and the screws. You may need them for future transport.

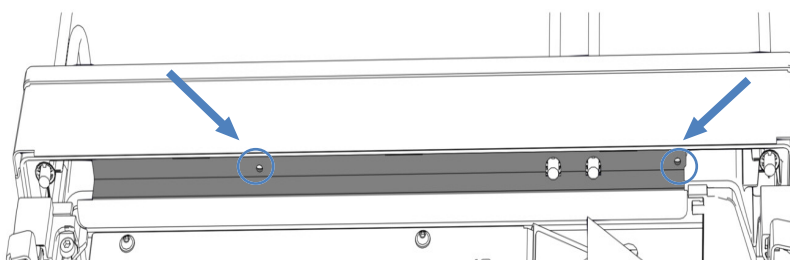


Figure 25: Removing the sheet metal bracket (here: autosampler)

3. Lift the front part of the solvent rack and remove the solvent rack by pulling it towards the front.

4. Lift the column compartment by the carrying handles. Place the column compartment on the autosampler approximately 5 cm before the end of the rails. Push the column compartment towards the rear until the column compartment clicks into place.
5. Loosen the screws on the carrying handles until you can move the carrying handles in the rail, using the screwdriver (Torx T20). Do not remove the screws from the carrying handles completely.

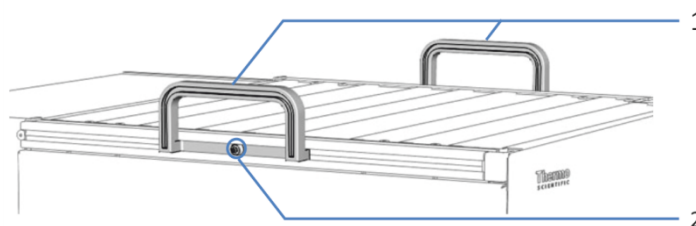


Figure 26: Carrying handles

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

6. Slide off the carrying handles from the rails towards the rear of the column compartment.

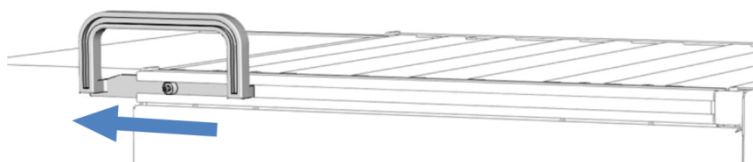





Figure 27: Sliding off the carrying handle from the left rail

7. Place the solvent rack on the column compartment approximately 5 cm before the end of the rails. Push the solvent rack towards the rear until it clicks into place.
8. Connect the liquid lines to the reservoirs.
9. Connect the drain port on the column compartment to the drain system.
10. Connect power cord, USB and system interlink cables to the column compartment.

#### See also

-  [Connecting Power Cables](#) (▶ page 112)
-  [Connecting USB Cables](#) (▶ page 105)
-  [Connecting System Interlink Cables](#) (▶ page 110)

## 5.5.2 Installing the Vanquish Switching Valve

You can install the Vanquish switching valve in the right or left position if no VICI valve drive is installed.

### Parts required

Vanquish switching valve

### Tools required

Screwdriver, Torx T10

### Preparations

1. Turn off the power to the column compartment. If the power is on, the switching valve can be damaged during installation.
2. Do not yet remove the fitting plugs that cover the valve ports.

### Follow these steps

1. To remove the cover plate, screw a fitting plug from the valve ports into the opening in the center of the cover plate.
2. With the screwdriver, loosen the 4 screws on the cover plate.
3. Pull out the cover plate by the fitting plug.

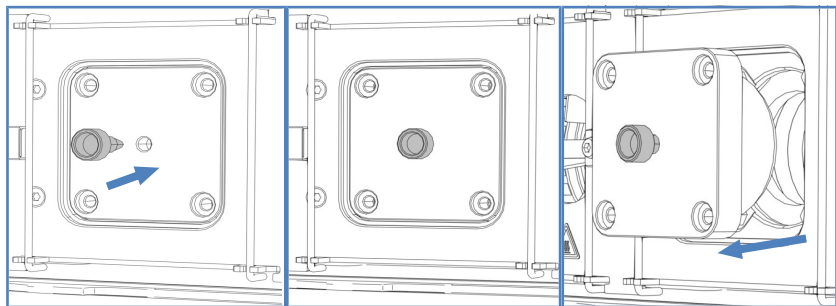


Figure 28: Removing the cover plate

4. Pull the cable out of the housing and connect the cable to the connector on the rear of the switching valve.

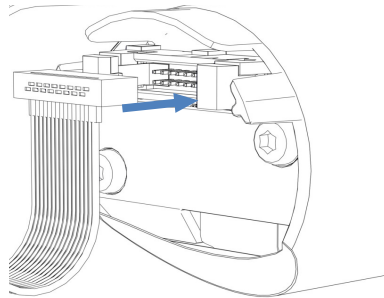


Figure 29: Connecting the cable to the connector

5. Push the cable into the housing.
6. Carefully push the switching valve into the housing.

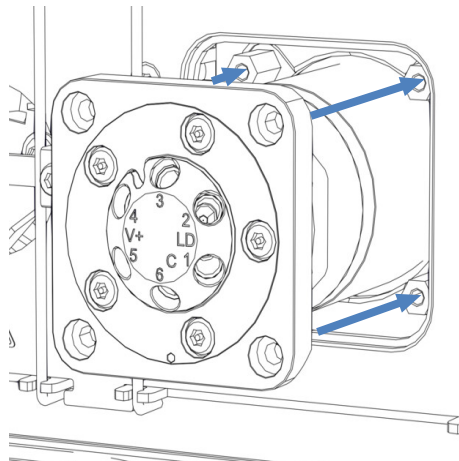


Figure 30: Installing the Vanquish switching valve

7. Check the correct orientation of the switching valve: Port 3 must point upwards.



8. Tighten the 4 screws of the switching valve.

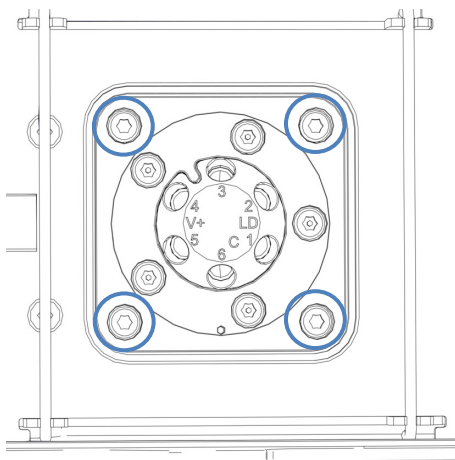


Figure 31: 4 screws on the switching valve

9. Remove the fitting plugs that cover the valve ports.
10. Connect the liquid lines as required by the application.
11. Turn on the power to the column compartment.
12. Inspect the valves visually for leakage.
13. For valves on the left valve position, run the script: **Test System Tightness (Subject To Test = Sampler)**. This script also tests the column switching valves for leakage.

### 5.5.3 Installing the VICI Switching Valve

You can only install the VICI valve where a VICI valve drive is installed. To install the VICI valve drive, contact your local Thermo Fisher Scientific Technical Support. For an overview of the VICI switching valve, see [Column Switching Valve Overview](#) (▶ page 51).

#### Prerequisite

The VICI valve drive and the adapter frame are installed (performed by service engineer).

#### Parts required

- VICI switching valve

#### Tools required

- Screwdriver, Torx T10

Follow these steps

1. To remove the cover plate, screw a fitting plug from the valve ports into the opening in the center of the cover plate.
2. With the screwdriver, loosen the 4 screws on the cover plate.
3. Pull out the cover plate by the fitting plug.

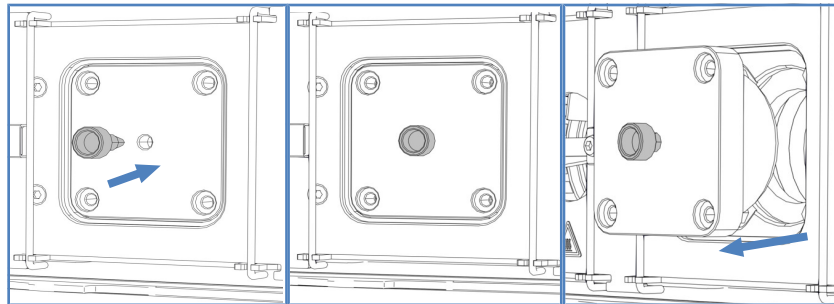


Figure 32: Removing the cover plate

4. Do not yet remove the fitting plugs that cover the valve ports.
5. Align the two pins on the back of the valve lock ring with the matching openings on the valve flange.

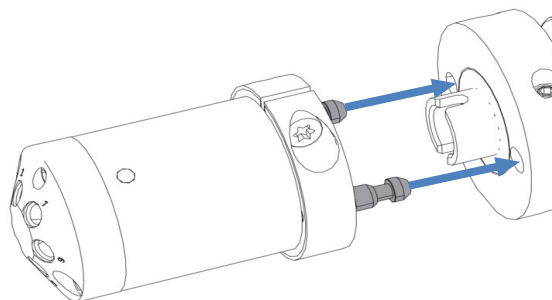


Figure 33: Aligning the lock ring with the flange

6. Press the valve pod to the valve flange.
7. To align the axis with the valve pod, press and hold the **VALVE LEFT** button or the **VALVE RIGHT** button on the keypad depending on the valve position. The catch valve function is activated and you can release the button.
8. When the axis is aligned, the valve pod snaps into the valve flange.
9. Remove the fitting plugs that cover the valve ports.
10. Connect the liquid lines as required by the application.

11. Configure the VICI switching valve in the chromatography data system.
12. Inspect the valves visually for leakage.
13. For valves on the left valve position, run the script: **Test System Tightness (Subject To Test = Sampler)**. This script also tests the column switching valves for leakage.

#### 5.5.4 Installing the Passive Pre-Heater

The passive pre-heater is an optional part. It can be used to adapt the eluent to the column temperature, before the eluent enters the column.

The passive pre-heater is for use with flow rates > 50 µL/min, in particular with 1 mm ID columns used in the flow range of 50-100 µL/min.

##### *Parts required*

- Passive pre-heater
- 2 screws

##### *Tools required*

Screwdriver, Torx T10

Follow these steps

1. Place the passive pre-heater in the desired position.  
Inside the column chamber, two different positions are available.

**TIP**

The passive pre-heater can be mounted in any of the two positions that are shown below. It can be orientated as required, with the outlet capillary pointing downwards or upwards, depending on the column inlet position.

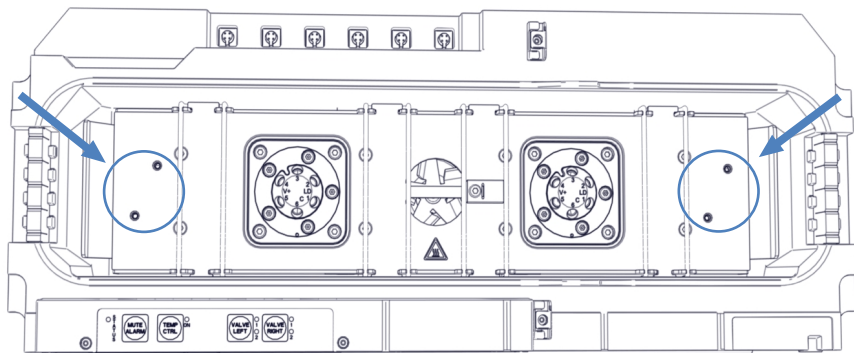


Figure 34: Mounting positions for the passive pre-heater

2. Align the screw holes of the passive pre-heater with the screw holes on the pre-heater mounting position.
3. With the screwdriver, tighten the two screws and washers to mount the passive pre-heater inside the column chamber.
4. Connect the outlet capillary of the passive pre-heater to the column inlet.

5. Connect the inlet capillary of the passive pre-heater to the autosampler or a column switching valve. When connecting the passive pre-heater to the autosampler, route the capillary through the lower capillary guide.

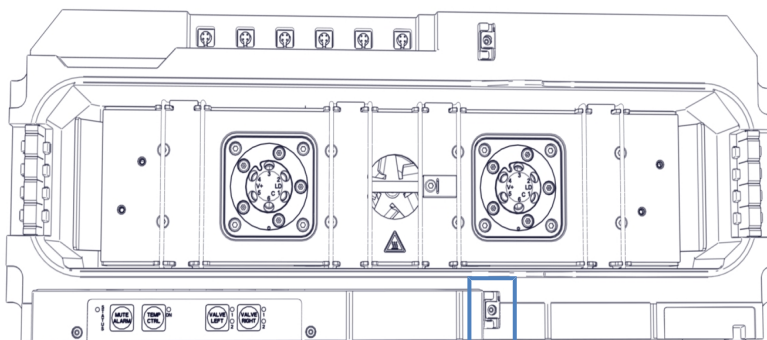


Figure 35: Capillary guide for routing the capillary to the autosampler

#### TIP

The temperature of the passive pre-heater is not controlled. Therefore, it is not required to set up the passive pre-heater in the chromatography data system.

### 5.5.5 Installing Columns in the Column Compartment

Inside the column chamber, eight column brackets are installed. Attach the columns to the column brackets using the column clips from the ship kit. You can install the column clips on the column brackets in any position.

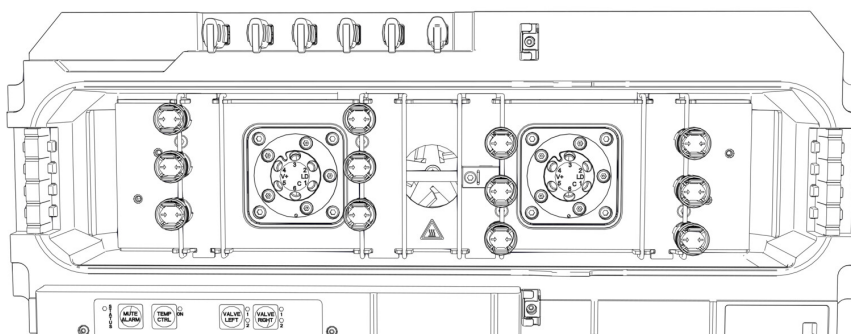


Figure 36: Possible column clip positions

*Parts required*

- Column as required by the application
- Column clips
- Self-adhesive foam pads

*Follow these steps*

1. To remove the ring from the bottom part of the column clip, slightly press the ring in the direction of the arrows.

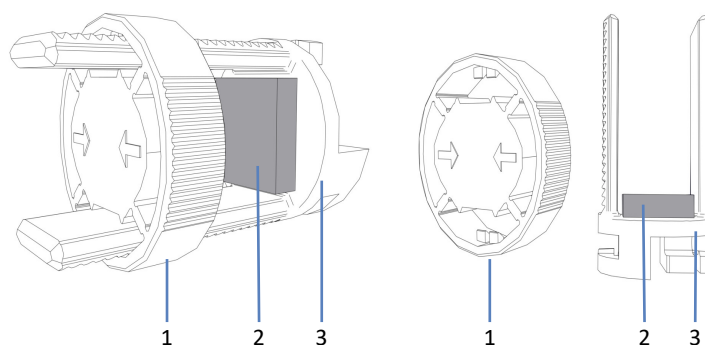


Figure 37: Column clips

No.	Description
1	Ring
2	Foam pad
3	Bottom part

2. Self-adhesive foam pads are shipped together with the column clips. To protect the column, attach one pad to the inside of each bottom part.
3. Attach the bottom part of the column clip to the column bracket in the desired position and turn it 90° clockwise.
4. Connect the capillaries to the column inlet and column outlet.

5. Press the column into the bottom part of the column clip and reinstall the ring.

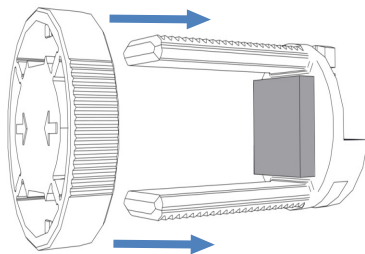


Figure 38: Reinstalling the ring

6. Route the capillaries through one of the capillary guides shown in the figure.

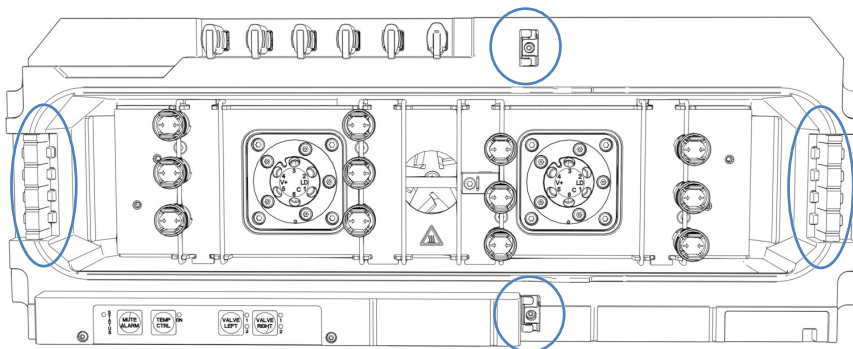


Figure 39: Capillary guides

7. To set the column properties, run the script: **Set Column Specifications**.
8. Turn on the pump flow.

## 5.6 Removing Transport Protections from the Autosampler

### Tools required

Slotted screwdriver

### Follow these steps

1. Remove any remaining shipping locks or protective covers from the autosampler as required. Shipping locks are marked for removal.
2. Open the doors of the autosampler.

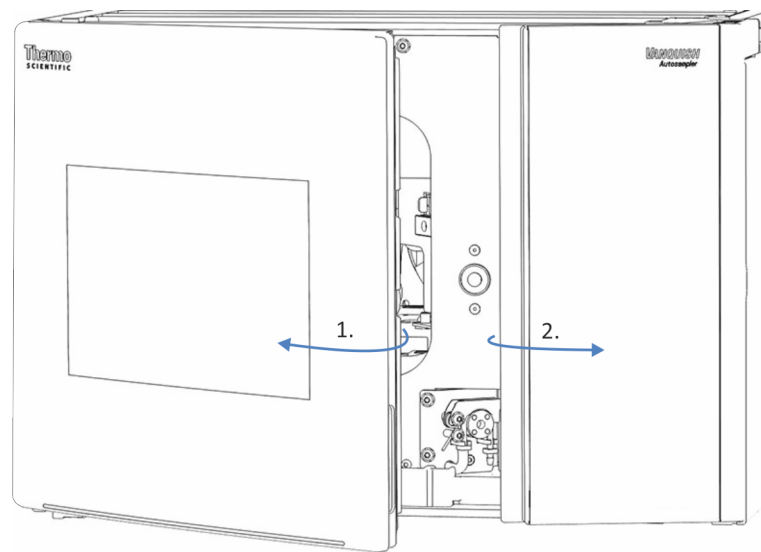


Figure 40: Opening the front doors of the autosampler

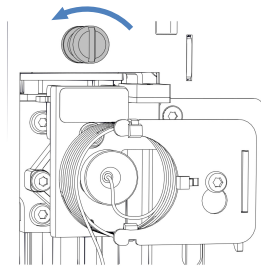
3. Remove the insulation cover (see [Removing the Insulation Cover](#) (▶ page 94)).  
Keep the cover for operation.



**NOTICE**

If the shipping lock screw is not properly loosened, the autosampler may be damaged. Ensure that the shipping lock screw is completely loosened before turning on the autosampler.

4. Loosen the shipping lock screw above the needle unit: Turn the captive screw counterclockwise with your fingers until it hangs loosely in its spring. The use of a slotted screwdriver may facilitate turning the screw.



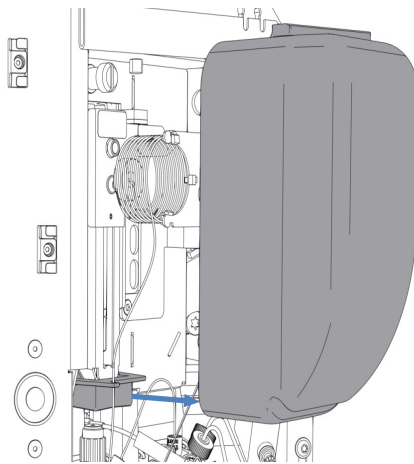
*Figure 41: Loosening the shipping lock screw*

5. Install the insulation cover (see [Installing the Insulation Cover](#) (▶ page 95)).
6. Remove the snap rivet of the carousel shipping lock and remove the carousel shipping lock.

### 5.6.1 Removing the Insulation Cover

*Follow these steps*

1. Take the cover by the bottom end and slightly pull the cover to release the cover groove from the insulation cover mounting bracket.
2. Carefully pull the cover to release it from the top enclosure frame.
3. Pull the cover away from the insulation cover mounting bracket.



*Figure 42: Removing the insulation cover*

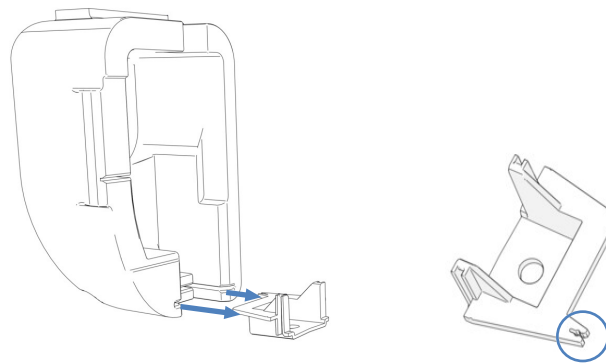
## 5.6.2 Installing the Insulation Cover

### Parts required

Insulation cover

### Follow these steps

1. Properly route the sample loop capillary through the designated guide in the insulation cover mounting bracket.



*Figure 43: Insulation cover with mounting bracket (left); mounting bracket with sample loop capillary guide (right)*

2. Align the cover with the needle unit and the sample loop on the interior front panel.
3. Carefully push the cover groove on the insulation cover mounting bracket to insert the insulation cover. Do not pinch the sample loop capillary with the cover.

## 5.7 Mounting the Display

You can fix the display to the left side of any system stack module (if the module meets the requirement mentioned under *Prerequisite*).

### *Prerequisite*

You can fix the display only to modules that have housings with an angular notch. The display is not suitable for housings with a U-type notch.

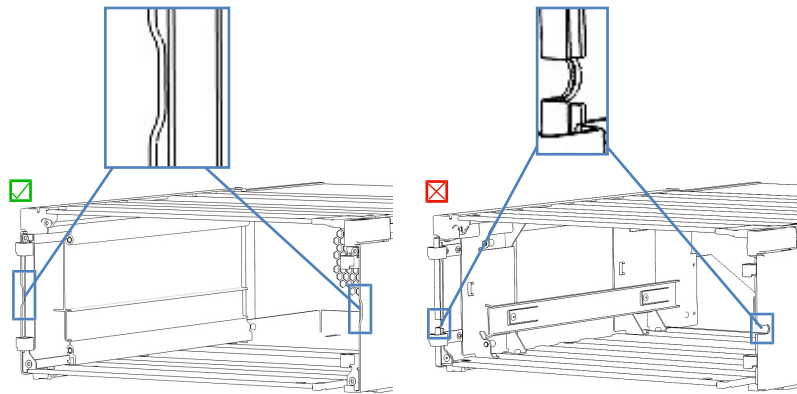


Figure 44: Housings with notches (left: angular, right: U-type)

### *Preparations*

Unpack the display.

**TIP** Keep the shipping container and all packing material. These items will be needed if the display is transported to a new location.

### *Parts required*

- Display assembly including:
  - ◆ 3 Torx™ screws
  - ◆ Fastening block
  - ◆ Sliding block

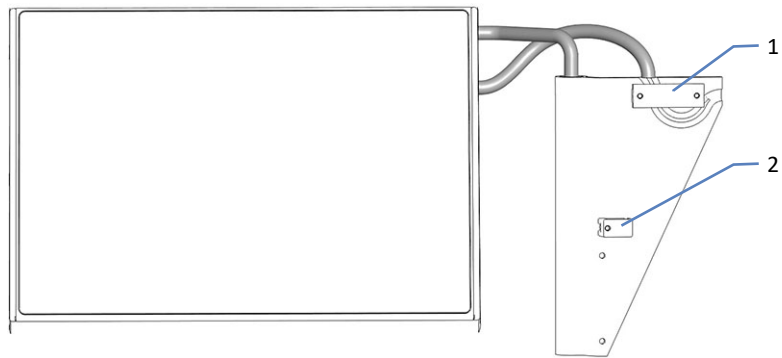


Figure 45: Sliding and fastening blocks

No.	Description
1	Sliding block
2	Fastening block

- Display stop
- Cable cover

#### Tools required

Screwdriver, Torx T10

#### Follow these steps

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

1. Check whether the display cable is as shown below.

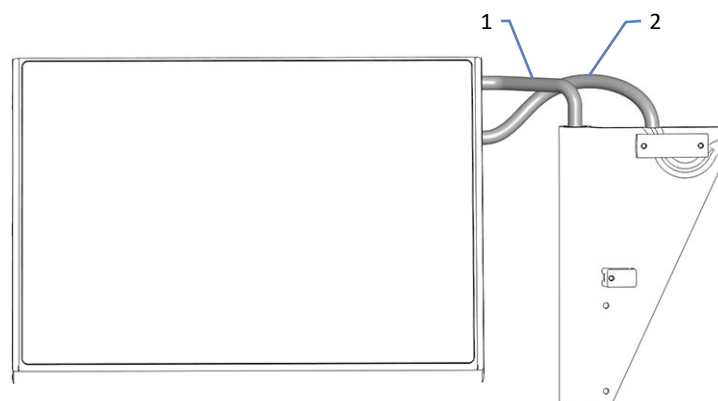
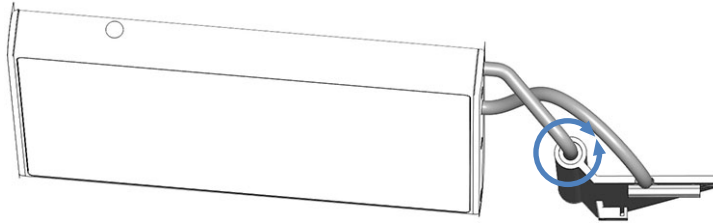


Figure 46: Correct orientation of the display cable

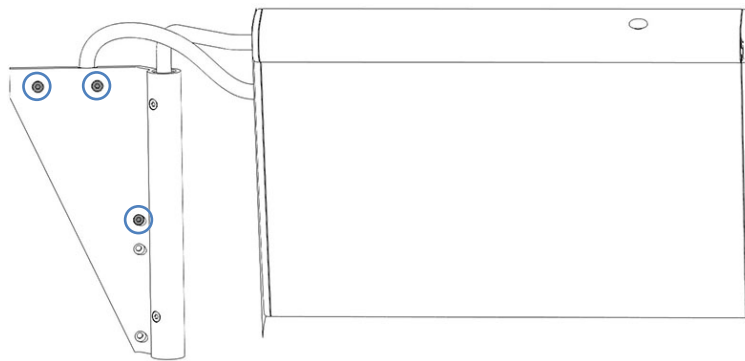
No.	Description
1	Swivel arm
2	Display cable

2. If the display cable is not as shown, turn the display clockwise or counterclockwise at the swivel arm until the display cable is guided as shown above.



*Figure 47: Turning the display at the swivel arm*

3. Loosen the upper 2 screws and unscrew the lower screw on the display assembly to remove the fastening block.



*Figure 48: Screws to be loosened on the display assembly*

4. From the rear side of the module rail, insert the sliding block of the display into the rail on the left side of the module and pull the assembly toward the system front until it reaches the stop.

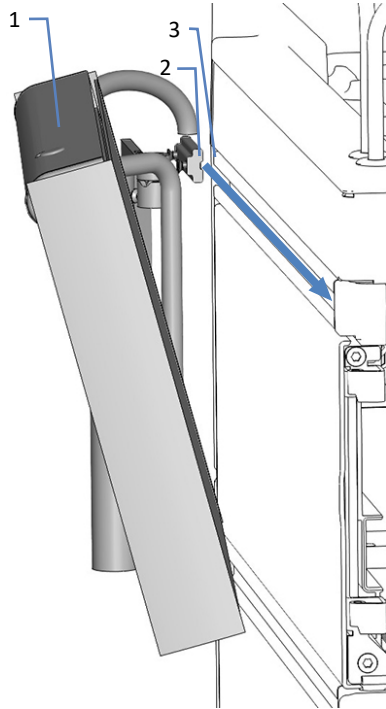
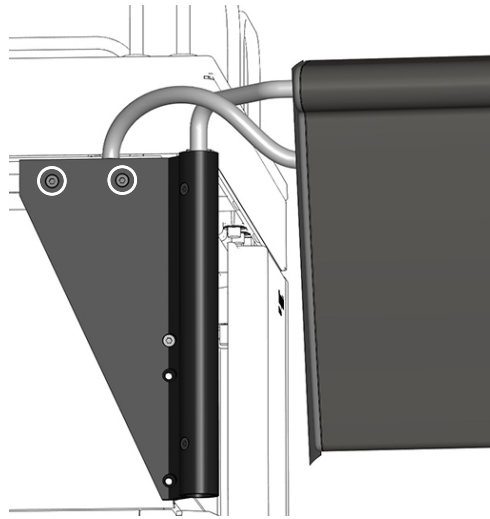


Figure 49: Sliding in the display

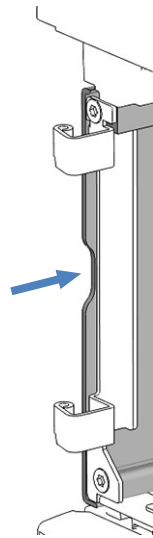
No.	Description
1	Display assembly
2	Sliding block
3	Rail

5. Slightly fasten the display assembly with 2 screws in the two upper holes.



*Figure 50: Fastening the display*

6. On the inside of the left housing panel, locate the notch.



*Figure 51: Notch*



7. Place the fastening block at the height of the notch as shown. Make sure that the hole in the fastening block matches that of the housing.

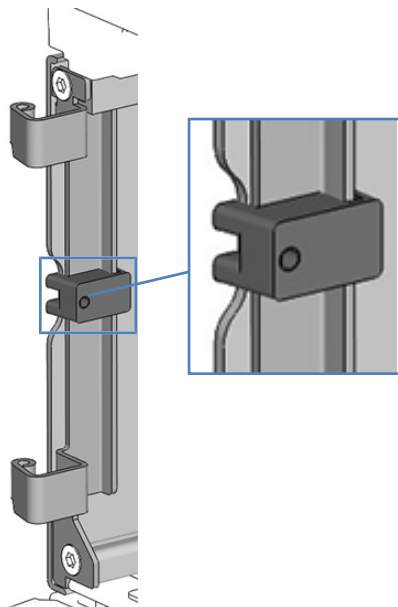


Figure 52: Placing the fastening block

8. Holding the fastening block with the right hand, slightly fix it with a screw with the left hand on the outside. Use one of the holes marked with a circle in the image below.

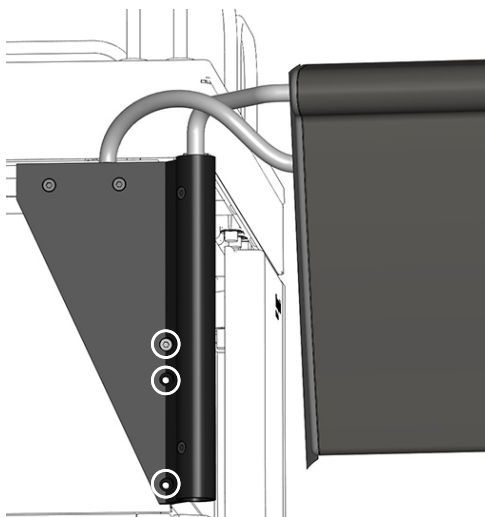


Figure 53: Fixing the fastening block

9. Check whether the display is in a horizontal position. If not, align it as follows:
  - a) Move the display slightly until it is in a horizontal position.
  - b) Firmly fasten the 3 screws.
10. If the display is attached to the top module, place the display stop to the solvent rack as shown.

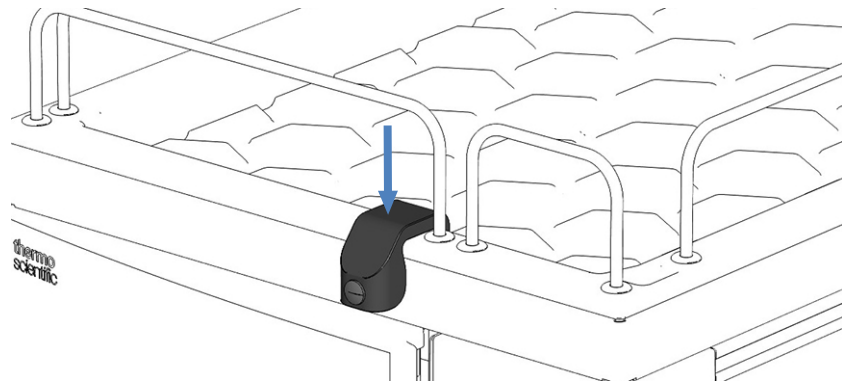


Figure 54: Display stop

## 5.8 Connecting Cables

### 5.8.1 System Module Connector Overview

The following connectors are provided on the system modules for power line connection and for signal connections:

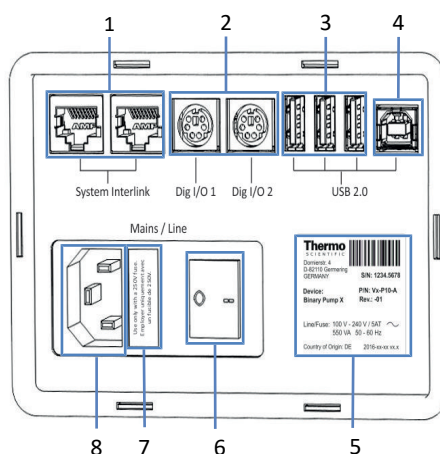


Figure 55: Connectors

No.	Description
1	System Interlink port Allows power on/off control for the system from the Vanquish system base and device communication See <a href="#">Connecting System Interlink Cables</a> (▶ page 110).
2	Digital I/O ports (Dig I/O) Allow exchange of digital signals with external instruments. To connect a mass spectrometer, use Dig I/O 2 on the autosampler. See <a href="#">Connecting a Mass Spectrometer</a> (▶ page 115).
3	USB (Universal Serial Bus) hub ("A" type connector) Allows connection to other modules in the Vanquish system
4	USB port ("B" type connector) Allows connection to other modules in the Vanquish system or the computer on which the chromatography data system is installed See <a href="#">Connecting USB Cables</a> (▶ page 105).
5	Rating plate (example), indicating the serial number, part number, module name, revision number, line and fuse rating, and the manufacturer's address
6	Main power switch (on/off control)
7	Fuse holder
8	Power-inlet connector

**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.

### 5.8.2 System Controller Connector Overview

The following connectors are provided on the short panel of the system controller:

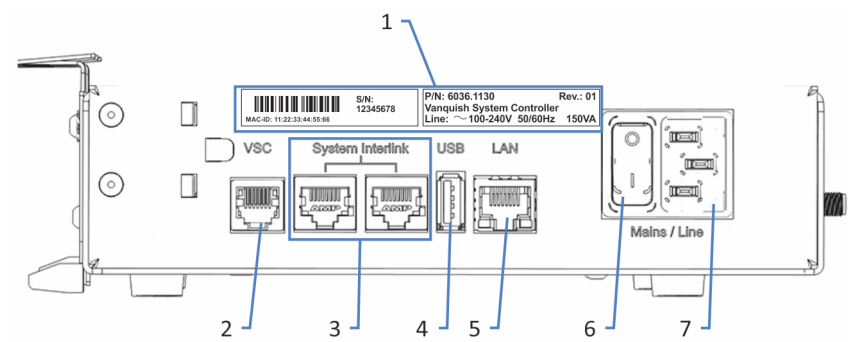


Figure 56: Connectors on the short panel

No.	Description
1	Rating plate Indicates the serial number, part number, module name, revision number, and the line rating.
2	Vanquish System Controller (VSC) connector Allows connection to the system base.
3	System Interlink port Allows connection to the system base and to a module in the HPLC system
4	Universal Serial Bus (USB) port ("A" type connector) Deactivated – Do not use
5	Local Area Network (LAN) port Allows connection to the site network.
6	Main power switch (on/off control)
7	Power inlet port

The following connectors and slots are provided on the long panel of the system controller:

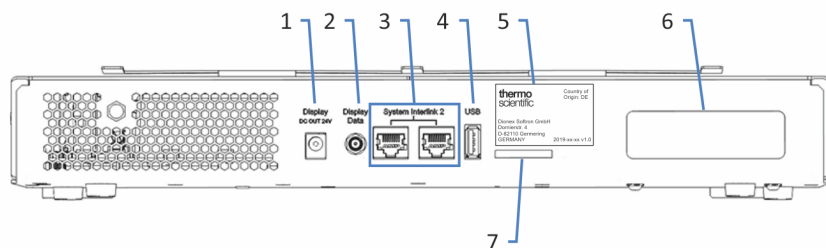


Figure 57: Connectors on the long panel

No.	Description
1	Display power outlet port
2	Display data port
3	System Interlink ports Deactivated
4	USB port ("A" type connector) Deactivated - Do not use
5	Label indicating the manufacturer's address
6	Reserved for future use.
7	Storage Device (SD) card slot

### 5.8.3 Connecting USB Cables

All USB connections require standard USB A-to-B type cable.



Figure 58: USB cable

The flat, rectangular end of the cable is the "A" connector. The smaller, hexagonal end is the "B" connector.

#### TIP

- The USB standard limits the USB cable length to 5 meters. Each USB device can be separated from the computer or next USB hub by no more than 5 meters.
- After connecting the USB cables and before turning on the power to a device for the first time, verify that the chromatography software is installed on the computer. When the power is turned on, the required USB drivers are automatically found and the Windows™ operating system can detect the device.

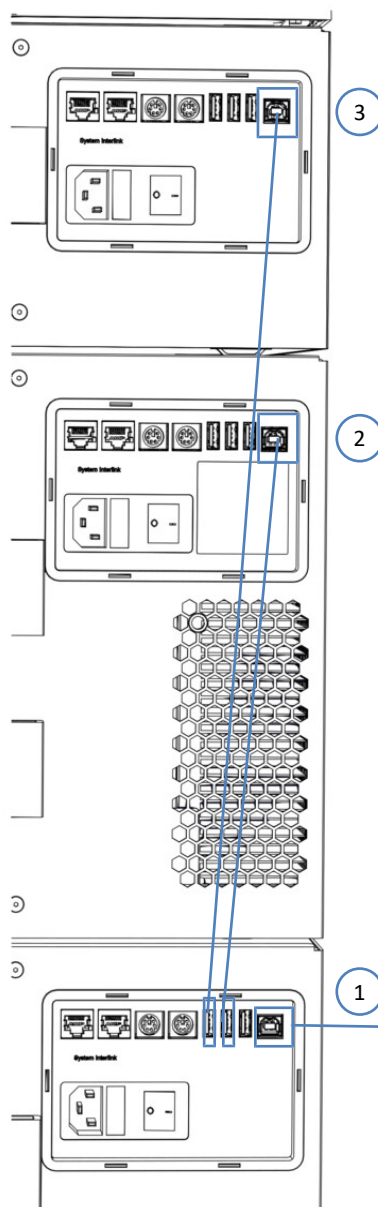


Figure 59: USB cable connections (here: with column compartment installed)

No.	Description
-	USB connection:
1	From pump to computer
2	From autosampler to pump
3	From column compartment (if installed) to pump

*Follow these steps*

1. On the autosampler, pump, and column compartment (if installed), connect the "B" connector of a USB cable to the **USB** port.
2. Connect the "A" connector of the USB cable from the pump to the **USB** hub (2.0 or higher) on the computer.
3. Connect the "A" connector of the USB cable from the other modules to the **USB** hub on the pump.

To control the modules that use a **USB** hub on another module, the module that provides the hub must be turned on.

**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 system.

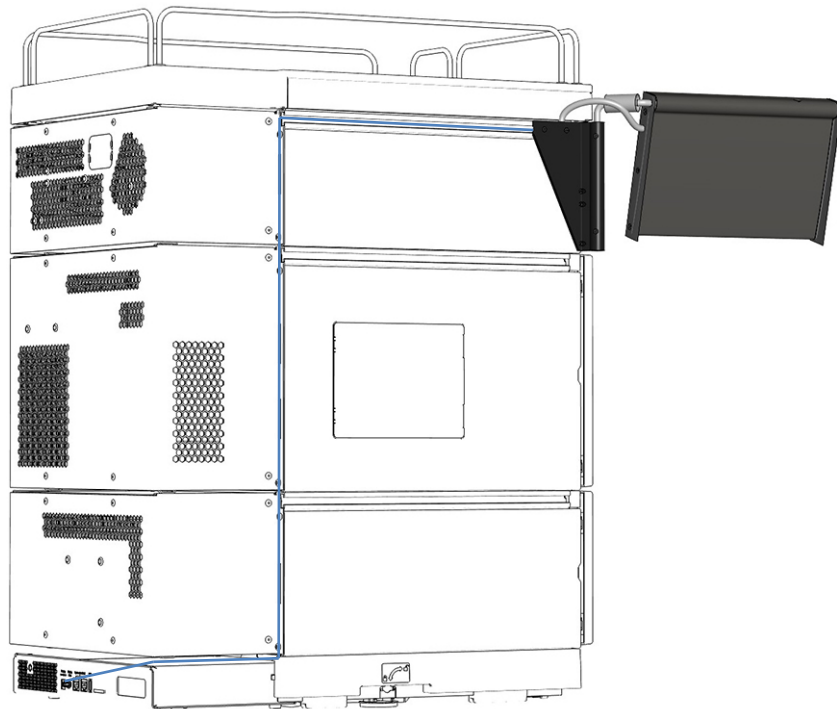
## 5.8.4 Connecting the Display Cables

### *Tools required*

Scissors for cutting the cable cover

### *Follow these steps*

1. Plug the display power cable into the **Display DC OUT 24V** port of the system controller.
2. Fasten in the display data cable to the **Display Data** port of the system controller finger-tight.
3. Route the display power and data cables in the rail.



*Figure 60: Routing the display cables*

4. Cut the cable cover to a length of 34 cm with the scissors.



5. Firmly push the cable cover into the rail.

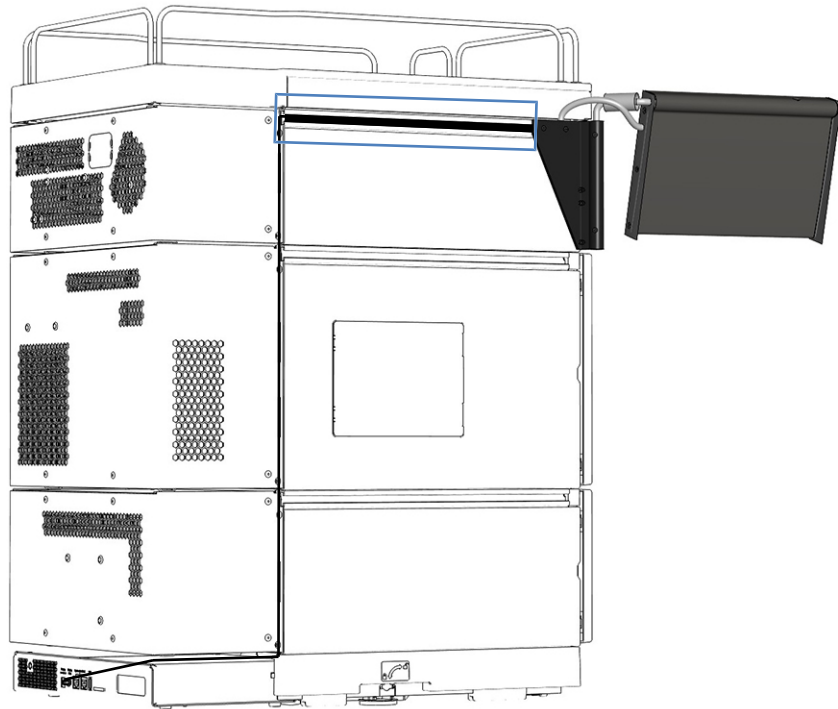


Figure 61: Mounting the cable cover

6. Fix the vertical part of the cable route with the housing cable clips.

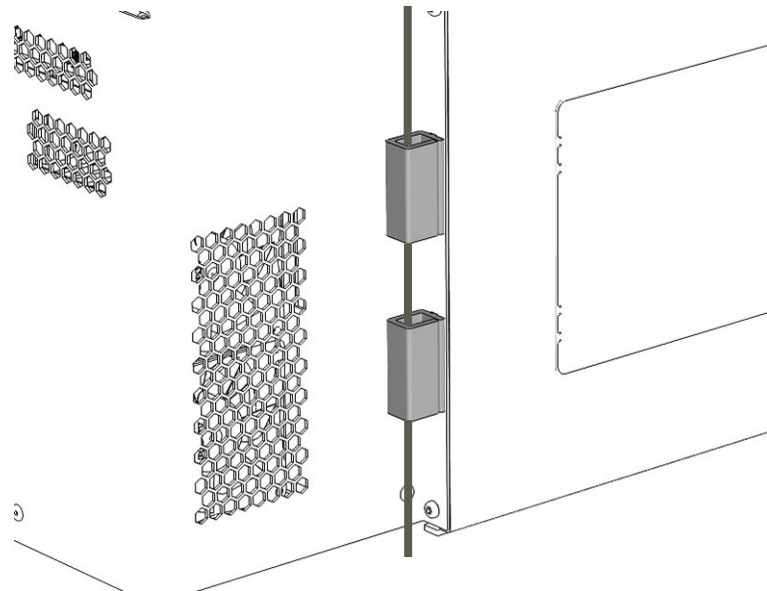
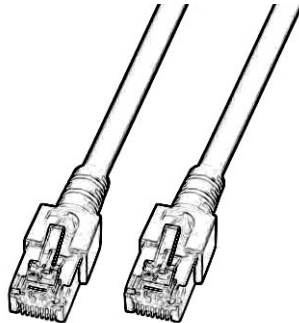


Figure 62: Fixing the cables with cable clips

7. Move the system stack back into the operating position.
8. Lock the system base using the system base locking tools (see [Locking the System Base](#) (► page 116)).

### 5.8.5 Connecting System Interlink Cables

The system interlink connections require a special system interlink cable (Cat. 6 cable).



*Figure 63: System interlink cable*

The system interlink connections from one system module to the other are pre-installed except for the optional column compartment.

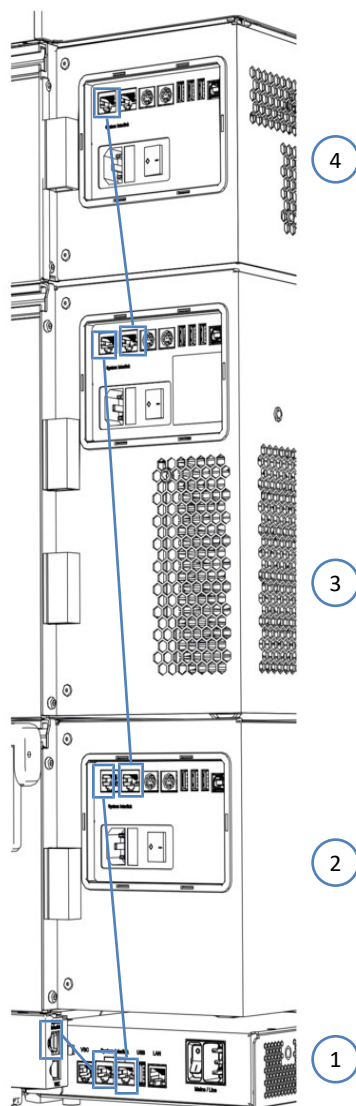


Figure 64: System interlink cable connections

No.	Description
-	System interlink connection:
1	From system base to system controller
2	From system controller to pump
3	From pump to autosampler
4	From autosampler to column compartment (if installed)

*If a Column Compartment is Installed (optional)*

1. Remove the cap which covers the right **System Interlink** port on the autosampler.
2. Connect one end of the system interlink cable to the **System Interlink** port on the column compartment, and the other end to the right **System Interlink** port on the autosampler (as shown in the figure).

## 5.8.6 Connecting a LAN Cable

*Parts required*

- LAN cable
- Network card

*Follow these steps*

### **NOTICE—Vanquish module damage**

The **System Interlink**, the **VSC** and the **LAN** ports use the same connector type. Connecting a LAN cable, for example, to a **System Interlink** port of a Vanquish module, may damage the Vanquish module and the system controller.

Only connect matching ports.

1. Connect a LAN cable to the LAN port of the system controller.
2. Connect the other connector of the LAN cable to the network card LAN port of the computer with the chromatography data system.

## 5.8.7 Connecting Power Cables

This section provides details on how to connect the modules to the power source. Do not turn on the system or modules yet.

### **NOTICE**

Condensation in a device can damage the electronics.

- Before connecting the devices to the power line, be sure that no condensation is present in the devices.
- If you suspect that condensation is present, allow the device to warm up to room temperature slowly. Wait until the condensation is completely gone before proceeding.

*Follow these steps*

1. Verify that the power switch on each device is set to OFF.
2. Connect the power cord to the power-inlet connector on each device.
3. Connect the free end of the power cords to an appropriate power source.
4. Insert the signal and power cables into the cable clips (see [Guiding Signal Cables in the Cable Clips](#) (▶ page 114)).
5. If necessary, move the system to its final position.
6. Lock the system base against moving (see [Locking the System Base](#) (▶ page 116)).

### 5.8.8 Guiding Signal Cables in the Cable Clips

The cable clips on the system's rear can be used to guide the signal cables in an orderly fashion. The pump and the optional column compartment each have one cable clip on each side and the autosampler has two cable clips on each side.

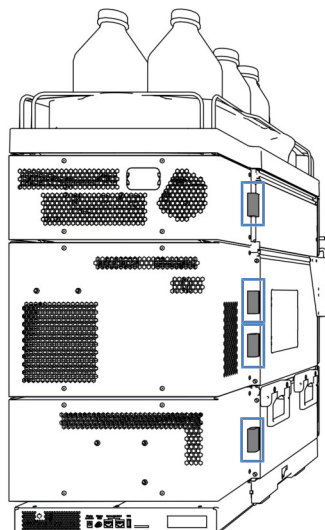


Figure 65: Cable clips in the system

To insert the cables into the clip, open the flap.

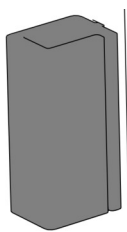


Figure 66: Cable clip

## 5.9 Connecting a Mass Spectrometer

### Parts required

Digital I/O signaling cable

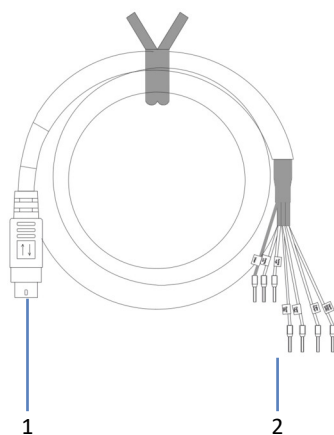


Figure 67: Digital I/O signaling cable

Pin	Description
1	6-pin connector, for connection to the Dig I/O port on the system
2	6 wires, for connection to an external instrument, for example, a mass spectrometer

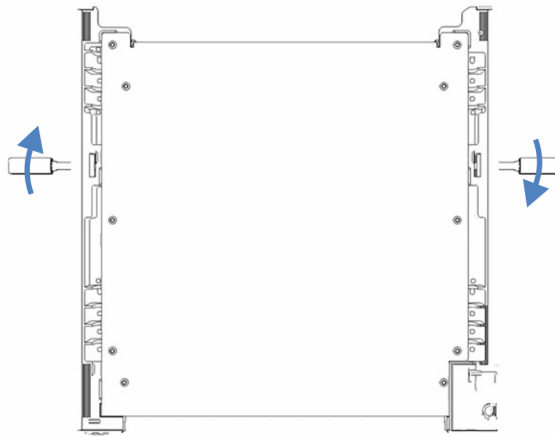
### Follow these steps

1. On the autosampler, plug the 6-pin connector of the cable into the port labeled **Dig I/O 2**.
2. Connect the wires for the output signals (white wire and brown wire) to the appropriate connectors on the mass spectrometer. With this, the inject response signal is delivered automatically.

## 5.10 Locking the System Base

The system base has been set to movable mode after unpacking the system. Therefore, the locking tools are already inserted into the system base.

1. Move the system to the operating position.
2. Lock the system base by turning the locking tools as shown below.



*Figure 68: Locking the system base (system base top view)*

3. Remove the locking tools and store them in a safe place, for example, in the system base drawer.



## 5.11 Setting Up the Flow Connections

The system is shipped with most flow connections installed for a direct injection workflow. Follow the instructions in this section to complete the setup of all flow connections.

**TIP** To change to a different workflow, complete the installation as described in this manual, and then run the script: **Change Fluidics / Workflow**. For details about other workflows, refer to the *Vanquish Neo Standard Application Manual*.

### 5.11.1 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 system or through guide holes or capillary clips.

#### *Tubing Chase with Tubing Guides*

To guide certain tubes and lines 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.

Push the tubing or lines into the tubing guides.

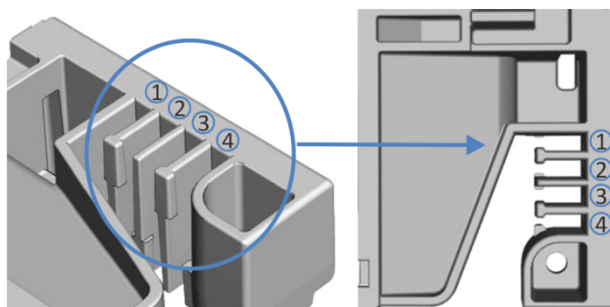


Figure 69: Tubing chase with tubing guides (left: view from inside, right: view from top)

### Tubing Brackets

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

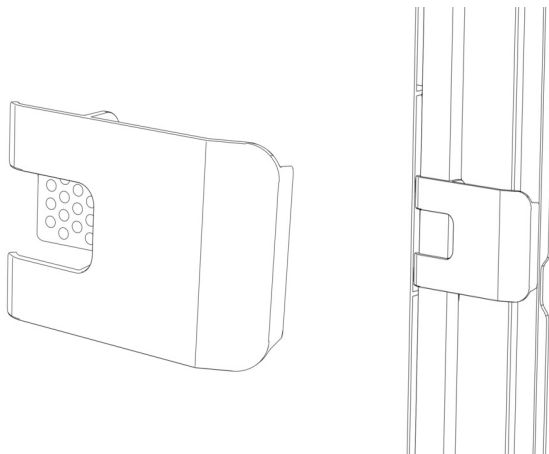


Figure 70: Tubing bracket (left), tubing bracket installed (right)

### 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.

## 5.11.2 Connecting Fittings, Capillaries, and Tubing

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

### 5.11.2.1 General Guidelines

When connecting capillaries and tubing, follow these general recommendations:

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

### 5.11.2.2 Connecting NanoViper Capillaries

This section describes how to connect nanoViper™ capillaries (hereinafter referred to as Viper capillaries).



Figure 71: Viper fitting

The Viper fittings are installed without knurls. If required, you can use the knurls that are included in the ship kit.

#### NOTICE

- Tighten or loosen Viper capillaries *only* with your fingers and the special torque tool. Do not use tools others than those provided by Thermo Fisher Scientific for this purpose. Use the tool only for the connections for which it is intended.
- To avoid damage to the capillary or connection, tighten and loosen the Viper capillaries *only* when the system pressure is down to zero.

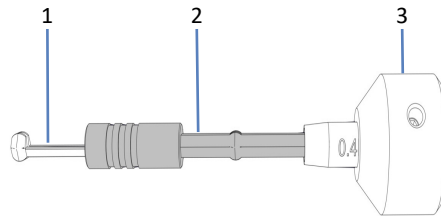
#### Tools required

Torque screwdriver including:

- Base part
- Extension adapter
- Viper bit

*Follow these steps*

1. Insert the Viper capillary into the connection port.
2. Tighten the connection with your fingers.
3. Use the torque screwdriver to tighten the connection further. To access difficult-to-reach capillaries, use the extension adapter.

*Figure 72: Torque screwdriver*

No.	Description
1	Viper bit
2	Extension adapter
3	Base part

4. Tighten the connection until the torque limitation has been reached, which is indicated by a clicking sound.
5. Check whether the connection leaks. If leakage exists, resolve the leakage.

*Resolving Leakage*

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

## 5.11.3 Connecting the Waste Lines

### 5.11.3.1 Waste Connections Overview



#### **WARNING—Escape of Hazardous Substances**

Hazardous substances can escape from waste lines and waste containers if connections and waste containers are not properly installed. Exposure to these substances can pose health and safety risks.

Verify the correct installation of connections and containers by testing the drain system (see [Testing the Drain System](#) (▶ page 124)).

If leakage has occurred in the system, the liquid is directed to waste through the system drain port on the Vanquish system base.

#### *Guiding Liquids to Waste*

These liquids flow off through the drain port at the bottom right of the leak tray into the drain system:

- Leaking liquids that collect in the leak trays.
- Waste liquids from the needle wash systems and the drain pump in the autosampler.
- Waste liquid from the flowmeter.

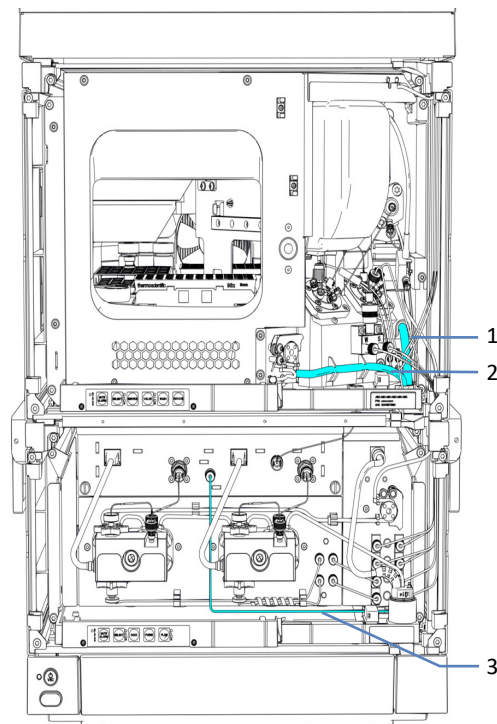


Figure 73: Waste line overview

No.	Description
1	Needle wash waste line
2	Drain pump waste tubing
3	Flowmeter waste line (Purge Out)

To guide the liquids to waste, see [Connecting the Waste Line to the System Drain Port \(Drain Tubing\)](#) (▶ page 123).

To test the drain system, when the waste line is set up, see [Testing the Drain System](#) (▶ page 124).

**TIP** If you have to cut tubing to length, use a tubing cutter. Make sure that the cut is at a right angle to the length of the tubing and that the end is free of nicks or burrs.

### 5.11.3.2 Connecting the Waste Line to the System Drain Port (Drain Tubing)

#### Parts required

- Drain tubing from ship kit
- Elbow connection piece from ship kit
- Suitable waste container

#### Follow these steps

1. Push an elbow connection piece into the system drain port as far as it goes in to establish a self-sealing connection.
2. Push the drain tubing into the elbow connection piece with your hand as far as it goes in to establish a self-sealing connection.
3. Route the free end of the drain tubing into a waste container.
4. *Only if guiding the drain tubing toward the system's rear:* Insert the drain tubing into the clips and make sure that the drain tubing does not form a siphon.



Figure 74: Inserting the drain tubing into clips

5. Ensure proper drainage of waste (see next section).

#### Ensuring Proper Drainage of Waste

1. Position the waste container below the level of the system stack. To prevent solvent vapors from evaporating back into the system, make sure that the distance is sufficient.
2. Make sure the drain tubing is neither bent nor pinched.
3. To prevent liquid from flowing back into the system, the entire drain tubing must remain below the drain port. Avoid the formation of siphons.

4. To allow the waste liquid flowing off properly and avoid liquid accumulation in the system base, the end of the waste line must not be submerged in waste liquid (see figure below):
  - a) Shorten the tubing if required.
  - b) Observe the liquid level in the waste container and empty the waste container as necessary.

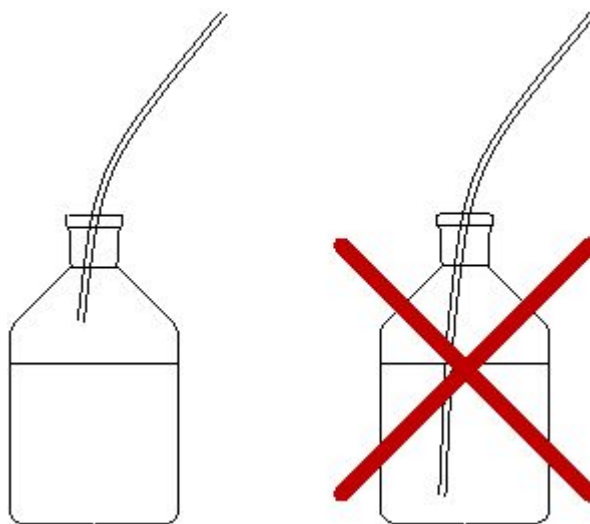


Figure 75: Free end of waste line in waste container

### 5.11.3.3 Testing the Drain System

Check the drain system for proper drainage of waste:

1. Pour water or isopropanol into the drain in the solvent rack.
2. Verify that the liquid leaves the system at the system drain port and into the waste container.
3. If a leak is visible, find and eliminate the problem.



## 5.12 Filling the Solvent Reservoirs

Before operating the system, fill the solvent reservoirs.

**TIP** To avoid the formation of air bubbles in liquid lines, always place reservoirs in the solvent rack on top of the system stack.

### Preparations

1. Rinse the solvent reservoirs and all parts of the solvent line filter thoroughly. Use a high-purity solvent for rinsing.
2. Assemble the solvent line filter, wearing appropriate clean gloves:
  - a) Insert the solvent line adapter into the filter holder (top part).
  - b) Turn the filter holder (top part) with adapter upside down and press onto a suitable surface so that the adapter is seated firmly in the filter holder.
  - c) Place the frit in a level position in the filter holder (bottom part).
  - d) Screw the filter top to the filter bottom.

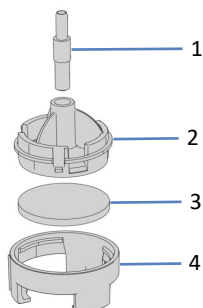


Figure 76: Solvent line filter

No.	Description
1	Solvent line adapter
2	Filter holder, top part
3	Filter frit
4	Filter holder, bottom part

Follow these steps

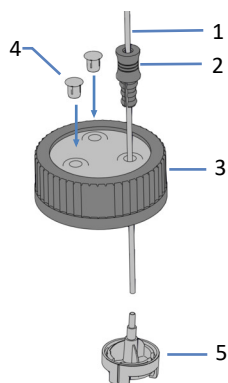


Figure 77: Preparing the solvent line and reservoir cap

No.	Description
1	Solvent line
2	Retaining guide
3	Reservoir cap
4	Cap plugs
5	Solvent line filter with solvent line adapter

1. Feed each solvent line through a retaining guide.
2. Feed the solvent line through an open hole in a cap for a solvent reservoir. The retaining guide keeps the solvent line in place in the reservoir.
3. Close any open holes in the reservoir caps with the cap plugs.
4. Slide a solvent line filter holder onto each solvent line.
5. Fill the solvent reservoirs with solvent.
6. Tighten the reservoir cap hand-tight. Press the retaining guide into the hole in the reservoir cap so that the tubing is kept in place in the cap.
7. Place the solvent reservoirs in the solvent rack.
8. Position the solvent lines straight in the tubing guides.
9. Check the solvent lines across the entire flow path. Make sure that the lines are not bent, pinched, or squeezed at any point in the flow path.

#### See also

 [Solvent and Additive Information](#) (► page 140)

## 5.13 Filling the Needle Wash Reservoirs

Before operating the system, you must fill the needle wash reservoirs and purge the needle wash systems.

**TIP** To avoid the formation of air bubbles in liquid lines, always place reservoirs in the solvent rack on top of the system stack.

### Tools required

Tubing cutter

### Preparations

Rinse the wash reservoirs thoroughly. Use a high-purity solvent for rinsing.

### Wash Liquids

Choose wash liquids that are suitable for your application and that remove residual sample from the needle sufficiently. There is a reservoir for strong and a reservoir for weak wash liquid. Typically, the strong wash liquid is solvent B of your application or a stronger solvent, while the weak wash liquid is close to the starting solvent of your gradient.

Wash liquid type	Description (for reversed-phase applications)	Tubing
Strong	High organic wash liquid, for example, 0.1% formic acid in acetonitrile	Wash line for purging and short term shutdown labeled <b>S</b> (red): connected to Strong degasser inlet port in the pump.
		Wash line for inner and outer needle wash labeled <b>SWP</b> (red): connected to upper inlet port on needle wash pump.
Weak	Low organic wash liquid, for example, 0.1% formic acid in water	Wash line for inner needle wash and purging labeled <b>W</b> (green): connected to Weak degasser inlet port in the pump.
		Wash line for outer needle wash labeled <b>WWP</b> (green): connected to lower inlet port on needle wash pump.

Follow these steps for each reservoir

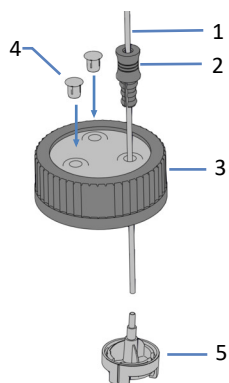


Figure 78: Preparing the wash line and reservoir cap

No.	Description
1	Wash line
2	Retaining guide
3	Reservoir cap
4	Cap plugs
5	Solvent line filter with solvent line adapter

1. Feed each wash line through a retaining guide.
2. Feed each wash line through an open hole in a cap for a reservoir. The retaining guide keeps the solvent line in place in the reservoir.
3. Close any open holes in the reservoir caps with the cap plugs.
4. Slide a filter holder with adapter onto each wash line.
5. Fill the wash reservoir with wash liquid.
6. Tighten the reservoir cap hand-tight. Press the retaining guide into the hole in the reservoir cap so that the tubing is kept in place in the cap.
7. Place the wash reservoir in the solvent rack.
8. Position the wash lines straight in the tubing guides.
9. Check the wash lines over the entire flow path:
  - a) Make sure that no bending (kink), pinching or squeezing of the wash lines is present 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 Systems*

The needle wash systems are purged when you run the **Auto Start Up** script after you have turned on the system. See [Preparing the System for Initial Operation](#) (▶ page 135).

## 5.14 Filling the Seal Wash Reservoir

Before operating the system, fill the seal wash reservoir.

**TIP** To avoid the formation of air bubbles in liquid lines, always place reservoirs in the solvent rack on top of the system stack.

### Tools required

Tubing cutter

### Preparations

Rinse the seal wash reservoir thoroughly. Use a high-purity solvent for rinsing.

### Seal Wash Liquid

Use 75% isopropanol in water and 0.1% formic acid (HPLC-grade; preparation by volume, for example, 75 mL isopropanol + 25 mL water + 0.1 mL formic acid).

### Follow these steps

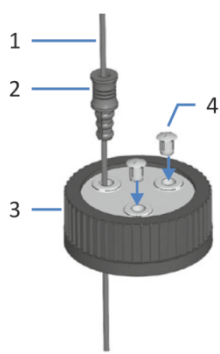


Figure 79: Wash line and reservoir cap

No.	Description
1	Wash line
2	Retaining guide
3	Reservoir cap
4	Cap plugs

1. Feed the wash line through the retaining guide.
2. Feed the wash line through an open hole in the cap of the wash reservoir. The retaining guide keeps the tubing in place in the reservoir.

3. Close any open holes in the reservoir cap with cap plugs.
4. Fill the wash reservoir with wash liquid.
5. Tighten the reservoir cap hand-tight. Press the retaining guide into the hole in the reservoir cap so that the tubing is kept in place in the cap.
6. Place the wash reservoir in the solvent rack.
7. Position the wash lines straight in the tubing guides.
8. Check the wash lines over the entire flow path:
  - a) Make sure that no bending (kink), pinching or squeezing of the wash lines is present 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.

#### *Flushing the Seal Wash System*

The seal wash system will be flushed automatically when you turn on the pump.

**TIP** The Vanquish pump starts and controls the seal wash system. Whenever you turn on power to the pump, the pump starts operation with a seal wash cycle. Before turning on the pump, check the liquid level in the seal wash reservoir.

## 5.15 Turning On the System for the First Time

If your system configuration includes a column compartment, install the column compartment before turning on the system.

### *Power Buttons and Main Power Switches*

The image shows the powering devices of the system.

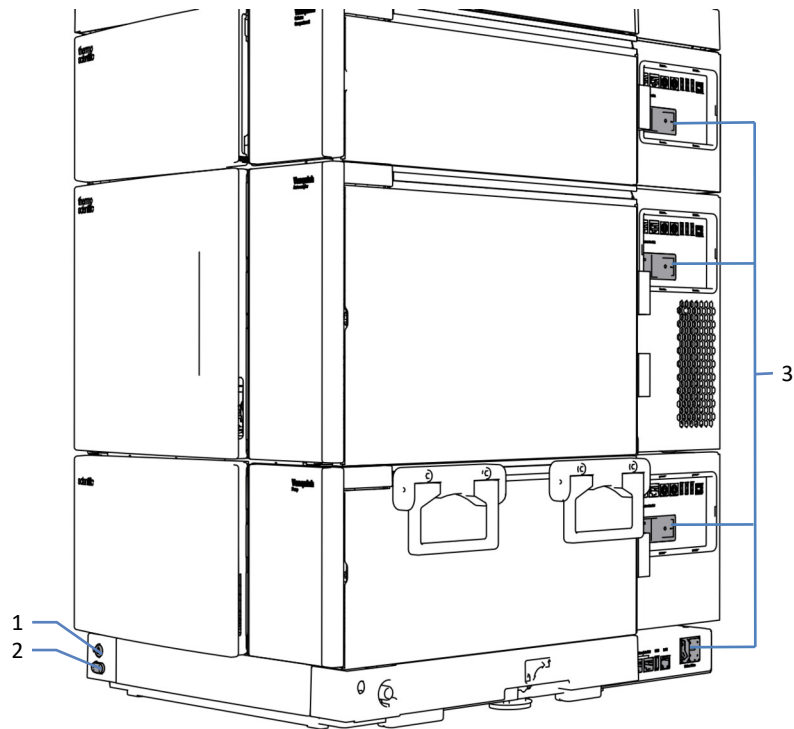


Figure 80: Power buttons and main power switches

No.	Description
1	Power push button of the system controller
2	Power button of the system
3	Main power switches



### Preparations

1. Verify that the shipping lock of the autosampler has been properly loosened.

**NOTICE—System damage**

Before turning on power to the Vanquish system, verify that the shipping lock has been properly loosened to avoid damage to the system.

2. 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 system modules.

### Follow these steps

1. Turn on each system module (pump, autosampler, optional column compartment) with its main power switch. Turn on the autosampler before you start the pump flow and pressure builds up.
2. Turn on the system controller with its main power switch. Using the main power switch is sufficient to turn on the system controller and it is not necessary to use the power push button.
3. Turn on the system power by pressing the power button of the system.

## 5.16 Integrating the System into an Instrument LAN

To enable the communication between the system and an instrument LAN, including the chromatography data system computer and another device, such as a mass spectrometer, you need to integrate it into that instrument LAN. The Vanquish User Interface offers two different connectivity options:

- Via a static IP address  
Needed, for example, if a device within the instrument LAN has a static IP address.
- Via Dynamic Host Configuration Protocol (DHCP)

### *Prerequisites*

- You have connected the system controller to the computer (see [Connecting a LAN Cable](#) (► page 112)).
- You have set up an instrument LAN on a computer with installed chromatography data system.
- *Static IP address option only:* You have obtained the IP address range and the netmask of the instrument LAN.

### *Follow these steps*

1. On the display, open the settings panel.
2. Select the **Connectivity** box.
3. Select one of the connectivity options.
4. If you selected **Static**:
  - a) Enter a netmask.
  - b) Enter a unique IP address for the system.
5. Select **Apply**.

## 5.17 Preparing the System for Initial Operation

### NOTICE—Particles and air bubbles can impair the system functionality

Some components of the system are filled with isopropanol when they were stored or when they are shipped from the manufacturing site.

- To flush out air bubbles (and isopropanol) before operating the system for the first time or after installing additional components into the flow path, run the script: **Auto Start Up**.
- To flush out isopropanol, use solvents that are miscible with isopropanol. If they are not, use an appropriate intermediate solvent.

#### When

- After turning on the system
- After installing new components into the system flow path

#### Solvent and seal wash liquid volumes required

Needed liquid	Consumption during script execution: Auto Start Up	Consumption during analysis	Liquid requirements
Solvent	Max. 10 mL per solvent reservoir	Depends on the flow rate	If operating the system or a component for the first time: Use solvents that are miscible with isopropanol. If they are not, use an appropriate intermediate solvent.  In all other cases, see <a href="#">Solvent and Additive Information</a> (▶ page 140).
Seal wash liquid	Max. 10 mL	Approx. 250 mL per 14 days	See <a href="#">Filling the Seal Wash Reservoir</a> (▶ page 130).

### Needle wash liquid volumes required

Consumption during the script: Auto Start Up	Consumption during analysis		Liquid requirements
Max. 10 mL	Consumption per needle wash reservoir and per injection <sup>1</sup> :		See <a href="#">Filling the Needle Wash Reservoirs</a> (▶ page 127).
	SWP	500 µL	
	WWP	400 µL	
	W	250 µL	
<p><sup>1</sup>: The values apply to: 25-µL sample loop, direct injection (loop in bypass) set in chromatography data system, default wash settings of the chromatography data system.</p> <p><b>Note:</b> The consumption depends on the sample loop size, column size, wash time, workflow, and wash speed. If using other settings, the values can be significantly higher.</p>			

### Follow these steps

- Check the liquid level of all reservoirs, especially that of the needle wash reservoirs. Make sure that the amounts are sufficient for the following:
  - ◆ Script **Auto Start Up** (see the table above)
  - ◆ First analysis (see the table above and add the amounts depending on the flow rate of your application).
- Close the doors of all modules in the Vanquish system, if not already done.
- If you want to operate the system for the first time or if you want to change the solvent type:* To set the solvent A/B, run the script: **Set Pump Solvent Types**.
- Run the script with or without diagnostics (leak test): **Auto Start Up**. The script flushes the system flow path up to the column inlet capillary and, optionally, performs a leak test.
- If you operate the system for the first time:* To set a separation column type, run the script: **Set Column Type**.
- If you operate the system for the first time:* To set the separation column properties, run the script: **Set Column Specifications**.
- To flush the column, perform the following steps:
  - Set the flow rate.
  - Set the solvent gradient.
  - Turn on the pump flow.

# 6 Operation

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

## 6.1 Safety Guidelines for Operation

When operating the system, 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 autosampler are moving when the autosampler prepares and performs the analyses of the sample. These moving parts can pose a pinch point hazard that may cause personal injury.

- Keep the autosampler front doors closed when the autosampler prepares and performs the analyses of the sample.
- During these phases, the LED bar on the autosampler is illuminated blue.



### **WARNING—Flammable and Hazardous Vapors from Spills**

Flammable or hazardous vapors from sample spills can accumulate inside the autosampler. 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.
- If a spill occurs inside the autosampler, turn the autosampler power off. Clean up the spill and leave the autosampler door open. Allow sufficient time for the spill to dry and any vapors to disperse before putting the autosampler back into use.



### **CAUTION—Hot Surfaces**

Surfaces inside the system may become hot during operation. Touching hot parts might cause burns.

Allow hot surfaces to cool down before you touch them.

**NOTICE**

Pay attention also to the following guidelines:

- To prevent damage resulting from leakage or from running the pump dry, always set the lower pressure limit for the pump.
- If there is evidence of leakage in the device, turn off the pump flow and remedy the situation immediately.
- Always verify that the autosampler is turned on before the pump flow is on and pressure builds up. If the autosampler 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 autosampler or other modules again.

## 6.2 Solvent and Additive Information

### 6.2.1 General Compatibility

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

- Use only solvents and additives that are compatible with all parts in the flow path. For information about the materials that are used in the analytical flow path, see the [Performance Specifications](#) (► page 360) for each system module.
- The pump is shipped with UHMW-PE piston seals. Using tetrahydrofuran, ketones, or ammonium hydroxide as solvents can damage the seals.
- 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.
- Anhydrous methanol may lead to stress failures in titanium surfaces, especially when formic acid or TFA is added to the mixture. Thermo Fisher Scientific recommends adding 3% of water to prevent this.

### 6.2.2 Allowed pH Ranges

Allowed pH range for the system:

Allowed pH range	Remark
2-10	<i>pH values of 2:</i> The application time should be as short as possible. Flush the system thoroughly after these applications.

### 6.2.3 Allowed Concentrations

Allowed concentrations for the system:

Concentration	Value
Buffer concentration	n.a.
Chloride concentration	Less than or equal to 1 mol/L <i>High chloride concentration:</i> The application time should be as short as possible. Flush the system thoroughly after these applications.



## 6.2.4 Use of Solvents and Additives

Particles entering the chromatography system can block capillaries and valves, increase wear, and damage the column or system. Especially with aqueous solvents, algae and other microorganisms can grow and deposit in the system and block the solvent line filters. Blocked capillaries or filters can cause increased or unstable system pressure.

For optimum performance of the system, observe the following guidelines.

### *Solvent Quality and Filtration*

- Use high-quality high-purity solvents (filtered) and additives as required by the application, for example, UHPLC-grade or LCMS-grade. Filtered high-purity solvents are usually labeled accordingly by the vendor.
- Use high-quality water for example, UHPLC-grade or LCMS-grade (0.2 µm filtered).
- When you use water from water purification systems, polymeric contamination may occur if the purification system is not maintained properly.
- When preparing salt solutions or buffers and preparation is complete, use membrane filtration (0.2 µm) to remove any particulate matter and to reduce microbial growth.
- Use the appropriate solvent line filters as recommended by Thermo Fisher Scientific. Check the filter frits for permeability at regular intervals and replace them as necessary.
- Use fresh, properly degassed solvents. Replace solvents at least on a weekly basis. Always replace the solvent in the reservoir completely. Do not "top up" solvents to avoid solvent composition changes or unwanted components building up in the reservoirs.
- For longer seal lifetime, do not recycle or recirculate solvents.
- Note the special properties of the solvents, such as viscosity, miscibility, boiling point, UV absorption, as well as the solubility of salts for all proportions during the gradient.

### *Solvent Reservoirs*

- Before filling a solvent reservoir, rinse the reservoir thoroughly with a high-purity solvent.
- To reduce the growth of algae, use amber glassware. Use appropriate additives, for example, formic acid, for aqueous solvents.
- Avoid the use of detergents when cleaning glassware. Rinse glassware used for LCMS applications (including graduated cylinders) with LCMS grade solvents prior to use, and label and store separately.
- Do not use methanol from aluminum reservoirs.

### *Flushing after Operation*

- Flush out buffers and solutions that form peroxides.
- Never leave buffers, salt solutions, or aggressive solvents in the system for a longer period without flow.
- Before you change from a buffer or salt solution to organic solution, flush the system thoroughly with UHPLC-grade or LCMS-grade water.
- Before you change solvents, make sure that the new solvent is miscible with the previous solvent. If the solvents are not miscible, flocculation may occur.
- Switch between two immiscible solvents via an intermediate solvent, for example, isopropanol. Step by step, replace the first solvent by the intermediate solvent, then step by step replace the intermediate solvent by the new solvent.

## 6.3 General Guidelines for System Operation

Consider the following information and guidelines for operation of the system.

### *For Best Performance*

- Wash the inside and outside of the needle to reduce carry-over. The needle wash ensures that the needle is properly cleaned from any remaining sample.
- Keep the column compartment door closed during operation.
- Avoid switching any valves dry, that is, without pump flow. This may damage the valve.
- Do not operate the pump with a dry seal wash system.
- Observe the general guidelines and recommendations on the use of solvents and additives in the system. See [Solvent and Additive Information](#) (▶ page 140).

### *Notes on Sample Processing*

Note the following when operating the autosampler:

#### **TIP—Keep the Autosampler Doors Closed During Sample Processing**

- If the doors are opened during needle and carousel movement, the autosampler stops the current movement of the needle arm. The needle does not puncture the sample container and does not draw sample. An acoustic signal alerts you that the doors are open.
- Every time the doors are closed, the autosampler performs an inventory scan of the sample racks and sample containers in the sample compartment.

#### **See also**

- [Optimizing the System Performance](#) (▶ page 159)

## 6.4 Turning On the System

1. Turn on the system controller by pressing the upper push button on the system base.
2. Turn on the system power by pressing the lower button on the system base.

## 6.5 Control Elements

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

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

- **Keypads:**  
The keypad buttons allow you to perform certain functions directly from the devices.
- **Status indicators:**  
Provide a quick visual check of the operational status of the device. The system provides the following status indicators:
  - ◆ Status indicator LED bar on the bottom on the front side of each device.
  - ◆ **STATUS** LEDs on the keypads.
  - ◆ System controller status LED

### 6.5.1 Keypads

The following elements are available:

- **STATUS LED**  
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.
- **Buttons**  
The buttons allow you to perform certain functions directly from the device. When you press a button, a short beep confirms that the function is performed.

#### *STATUS LED*

The **STATUS** LED on the 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. Check the message on the notification panel. For remedial action, see <a href="#">Troubleshooting</a> (▶ page 325).

For information about the LEDs that are present next to a button on the keypad, see the Keypad Buttons table.

### Keypad Buttons

The buttons have the following functions:

#### Autosampler and Pump

Button	Function
DOCK	<p>Pressing the button moves the selected pump head to the appropriate position for maintenance procedures, such as pump head or piston replacement.</p> <p>When the pump head is in the maintenance position, the LED next to the <b>FLOW</b> button starts flashing green. Pressing the button again, returns the pump head into the position for operation. The LED stops flashing green.</p>
FLOW	<p>Pressing the button starts or stops the flow, considering the selected flow rate, solvent composition, and flow acceleration/deceleration. The LEDs <b>L</b> and <b>R</b> next to the button refer to the left or right pump head:</p> <ul style="list-style-type: none"> <li>• LED is off = pump flow is off or zero</li> <li>• LED is green = pump head is delivering</li> <li>• LED is flashing green = pump head is in the position for maintenance procedures</li> </ul>
MUTE ALARM	<p>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.</p>
PURGE	<p>Reserved for future use. For information on purging, see <a href="#">Purging (Overview)</a> (▶ page 62).</p>
ROTATE	<p>Pressing the button allows rotating the carousel counterclockwise to the next loading position.</p>
SELECT	<p><i>Autosampler</i></p> <ul style="list-style-type: none"> <li>• Reserved for future use.</li> </ul> <p><i>Pump</i></p> <p>Pressing the button selects the pump head for which you can perform a <b>DOCK</b> function from the keypad:</p> <ul style="list-style-type: none"> <li>• LED <b>L</b> is green = left pump head is selected</li> <li>• LED <b>R</b> is green = right pump head is selected</li> </ul>
SERVICE	<p>The button has these functions:</p> <ul style="list-style-type: none"> <li>• Pressing the button one time moves the needle up from the needle seat and sets the injection valve to <b>Bypass</b> position. This is necessary, for example, when securing the needle unit by tightening the shipping lock screw.</li> <li>• Pressing the button a second time initializes the needle and the needle moves over the wash port.</li> <li>• Pressing the button a third time descends the needle back into the needle seat and the needle will be initialized. Note: The shipping lock screw must be loose.</li> </ul>
VALVE	<p>Pressing the button allows switching the injection valve to <b>Bypass</b> position. The LED <b>B</b> lights green when the injection valve is in <b>Bypass</b> position.</p>

Button	Function
WASH	Pressing the button initiates an outer needle wash cycle, in which the outer needle surface is washed in the wash port. After the needle wash cycle, the needle moves back to the needle seat.

### Column Compartment

Button	Function
MUTE ALARM	Beeping alerts you when the device detects a problem. 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.
TEMP CTRL	Pressing the button turns the temperature control on or off: <ul style="list-style-type: none"> <li>• LED next to the button is green = temperature control is on</li> <li>• LED next to the button is off = temperature control is off</li> </ul>
VALVE LEFT	Pressing the button switches the left column switching valve (if installed). Pressing and holding the button activates the catch valve function if a VICI valve is installed in the left valve position. With 2-position 6-port valves, the LEDs next to the button indicate the current valve position: <ul style="list-style-type: none"> <li>• Upper LED is green = valve is in position 1</li> <li>• Lower LED is green = valve is in position 2</li> <li>• LEDs are off = valve switching</li> </ul>
VALVE RIGHT	Pressing the button switches the right column switching valve (if installed). Pressing and holding the button activates the catch valve function if a VICI valve is installed in the right valve position. With 2-position 6-port valves, the LEDs next to the button indicate the current valve position: <ul style="list-style-type: none"> <li>• Upper LED is green = valve is in position 1</li> <li>• Lower LED is green = valve is in position 2</li> <li>• LEDs are off = valve switching</li> </ul>

## 6.5.2 LED bars

The LED bars on the front side of the modules provide the information when the modules are closed. When the system is connected in the chromatography data system, the LED bars may provide less information.

### Autosampler

LED Bar	Description
Off (dark)	The power to the module is turned off.
Dimmed	The doors of the module are open.
Yellow, flashing slowly	The power to the module is turned on or the module is equilibrated, but the system is not connected in the chromatography data system.
Yellow	The system is connected in the chromatography data system, but the module is not equilibrated.
Green, flashing	The module is equilibrating. If you use sample compartment thermostating, the thermostating temperature is not yet achieved.
Green	The system is connected in the chromatography data system and the module is equilibrated, but no data acquisition is running. If you use sample compartment thermostating, the thermostating temperature is achieved.
Blue, running	The autosampler performs preparations for injection. Parts of the autosampler are moving. Or: A diagnostic test is running.
Blue	The system is connected in the chromatography data system and an injection or sequence is running, including data acquisition.
Red	A problem or error has occurred. Check the message on the notification panel. For remedial action, see <a href="#">Troubleshooting</a> (▶ page 325).

### Pump

LED Bar	Description
Off (dark)	The power to the module is turned off.
Dimmed	The doors of the module are open.
Yellow, flashing slowly	The power to the module is turned on or the module is equilibrated, but the system is not connected in the chromatography data system.
Yellow	The system is connected in the chromatography data system, but the module is not equilibrated. The pump flow is off.
Green, flashing	A purge cycle is running.



LED Bar	Description
Green	The system is connected in the chromatography data system and the module is equilibrated, but no data acquisition is running. The pump flow is on.
Blue, running	A diagnostic test is running.
Blue	The system is connected in the chromatography data system and an injection or sequence is running, including data acquisition.
Red	A problem or error has occurred. Check the message on the notification panel. For remedial action, see <a href="#">Troubleshooting</a> (► page 325).

### Column Compartment

LED Bar	Description
Off (dark)	The power to the module is turned off.
Dimmed	The doors of the module are open.
Yellow, flashing slowly	The power to the module is turned on or the module is equilibrated, but the system is not connected in the chromatography data system.
Yellow	The system is connected in the chromatography data system, but the module is not equilibrated.
Green, flashing	The module is equilibrating.
Green	The system is connected in the chromatography data system and the module is equilibrated, but no data acquisition is running.
Blue, running	A diagnostic test is running.
Blue	The system is connected in the chromatography data system and an injection or sequence is running, including data acquisition.
Red	A problem or error has occurred. Check the message on the notification panel. For remedial action, see <a href="#">Troubleshooting</a> (► page 325).

## 6.6 Vanquish User Interface Overview

### 6.6.1 System Controller Information

The system controller information appears in the top left corner.

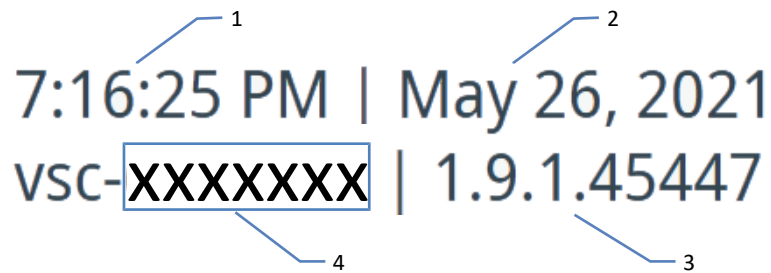




Figure 81: System controller information

No.	Description
1	Time <sup>1</sup>
2	Date <sup>1</sup>
3	System controller firmware version
4	System controller serial number

<sup>1</sup>: The layout depends on the language setting.






### 6.6.2 Overall System Health Status Icons

The following icons represent the overall system health status.

Icon	Overall system health status
	Ok
	Error One or more system modules have issued an error (the LED bar of one or more modules is red). Refer to the messages on the notification panel.

### 6.6.3 Navigation Bar Icons

The following icons are present in the navigation bar.

Icon	Description
	Home panel Gives access to the functional parameters of all system modules attached to the system controller via the system interlink interface. For further information, see <a href="#">Home Panel</a> (▶ page 151).
	Script panel Provides automated scripts. For further information, see <a href="#">Script Panel</a> (▶ page 152).
	Notification panel Stores information about all warnings and errors of the system modules and all events of the system controller since the last system controller reboot For further information, see <a href="#">Messages</a> (▶ page 327).
	Settings panel For further information, see <a href="#">Settings Panel</a> (▶ page 152).
	Information panel Shows various information, for example, attached system modules and their serial number

### 6.6.4 Home Panel

On the home panel, each system module is represented by a box with a specific icon containing:

- Functional parameters, for example, pump pressure
- Colored bar at the bottom of each box representing the LED bar. For a description of the LED bar colors, see [LED bars](#) (▶ page 148).

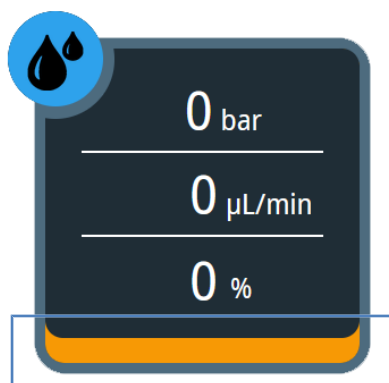


Figure 82: System module box (here: pump)

### 6.6.5 Script Panel

The script panel provides automated scripts for several product life cycle phases, for example, for start up and for troubleshooting.

You can select the scripts to open a dialog box and to get detailed information and instructions.

### 6.6.6 Settings Panel

On this panel, you can do the following:

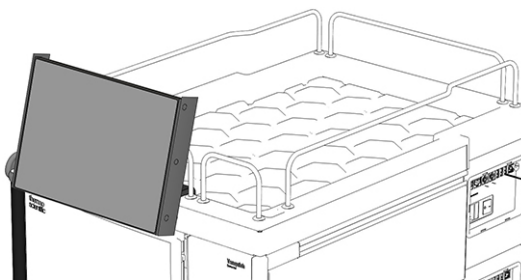
- Configure the Vanquish User Interface:
  - ◆ Language
  - ◆ Units
  - ◆ Time zone
  - ◆ Connectivity mode
- View:
  - ◆ System name, firmware version and operating times
  - ◆ Software licenses

## 6.7 Adjusting the Display

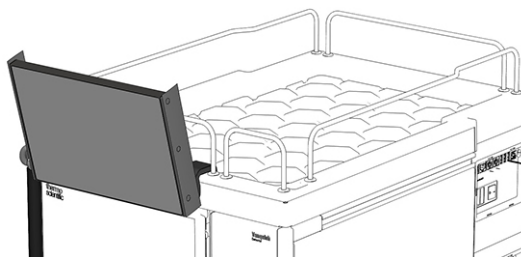
### 6.7.1 Possible Display Positions

There are different ways to position the display:

- Front position
  - ◆ Tilted backward



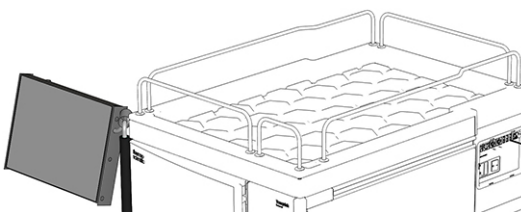
- ◆ Tilted forward



- Lateral position
  - ◆ Swiveled halfway sideways



- ◆ Swiveled completely sideways



## 6.7.2 Moving the Display from the Front Position to the Lateral Position

1. Swivel the display to the left by 180 degrees.

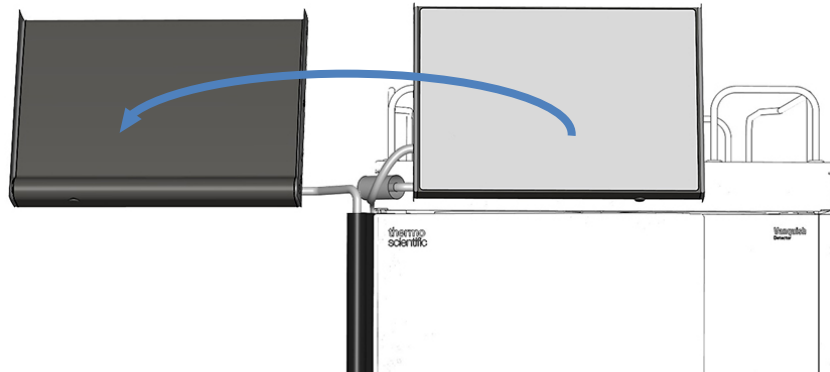


Figure 83: Swivelling the display to the left by 180 degrees

2. Tilt the display downward.

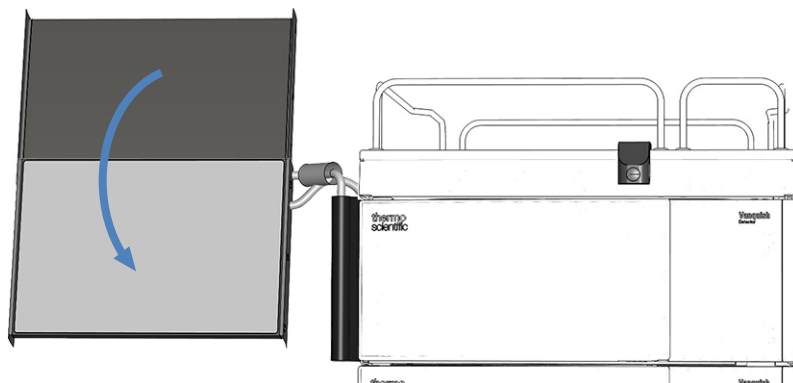


Figure 84: Tilting the display downward

## 6.8 Preparing the System for Operation

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

### 6.8.1 Equilibrating the System

*When*

- After powering up the system and after preparing the system for initial operation
- After a short-term shutdown
- After changing the flow rate
- After changing the temperature setpoints

*Follow these steps*

System equilibration should include the following:

Equilibration steps	Duration
Warming up (or cooling down) all temperature-controlled devices in the system to the starting temperature. Temperature-controlled devices can be, for example: <ul style="list-style-type: none"> <li>• Pump flowmeter</li> <li>• Sample compartment thermostating in the autosampler</li> <li>• Column compartment and column</li> </ul>	5 hours depending on the temperature differences needed for your application
Monitoring the pump pressure drift and checking that the drift is within reasonable limits for the application	5-24 hours depending on the retention time accuracy needed for your application

## 6.8.2 Loading the Carousel

The carousel holds up to four sample racks or well plates.

### *Parts required*

Vials, sample racks and/or well plates

Observe the recommendations in [Recommendations on Vial Caps and Well Plate Covers](#) (▶ page 158).

### *Preparations*

1. Position the vials with your samples in the sample rack.
2. Check the temperature setting for the sample compartment and set the temperature as required. See [Thermostatting the Autosampler Sample Compartment](#) (▶ page 165).
3. Check the LED bar of the autosampler. Do not open the front doors when the LED bar is running blue. Parts of the autosampler are moving.

### *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.
  - ◆ Rotate the carousel manually to the desired direction.
  - ◆ Rotate the carousel from the Vanquish Neo ePanel in the chromatography data system or in the autosampler box on the home panel in the Vanquish User Interface.



2. Position the sample rack or well plate in the selected segment. The sample rack or well plate must sit in the alignment frame and rest on the alignment points of the segment.

**NOTICE—Correct Orientation of Sample Racks**

Positioning sample racks or well plates in the wrong orientation may damage the autosampler or lead to wrong results.

Position sample racks and well plates always in the correct orientation in the carousel, with position A1 on the top left position.

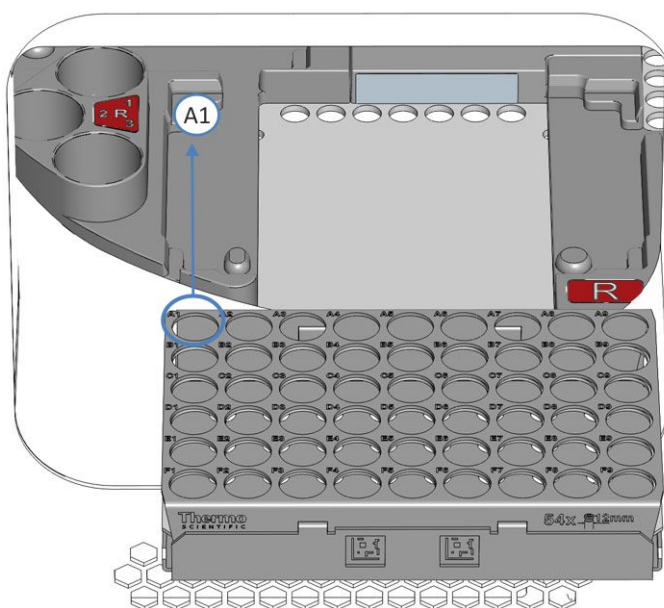


Figure 85: Correct orientation in carousel (here with a sample rack)

3. Load the support vial holders, if required.
4. Rotate to the next loading position and load it as required. Continue until you have loaded all segments as required.
5. Close the front doors of the autosampler.  
The autosampler starts an inventory scan of the sample racks and sample containers in the sample compartment.

*Automatic Rack Type Identification*

If you use sample racks or well plates with Vanquish rack type barcode, the rack type and orientation is automatically identified during the inventory scan.

### *Setting the Rack Type Manually*

If you use sample racks or well plates without Vanquish rack type barcode, you must manually set the rack type for each segment on the Vanquish Neo ePanel in the chromatography data system.

#### **See also**

 [Carousel](#) (▶ page 48)

 [Rack Type Identification](#) (▶ page 49)

## **6.8.3 Recommendations on Vial Caps and Well Plate Covers**

Use only vial caps and well plate covers as outlined below.

### *Vial Caps and Septa*

Use only talcum-free, unfilled silicone/PTFE-based septa. Talcum and seal-filler particles may cause backpressure issues or blockages in the system.

Example of caps that meet the requirements:

Thermo Scientific bonded red PTFE/white silicone vial screw thread caps and septa

### *Well Plate Cover Mats*

Use unfilled silicone cover mats.

Example of mats that meet the requirements:

Thermo Scientific WebSeal™ 96-well non-coated plastic microplate with WebSeal silicone mats

### *Well Plate Sealing Tape*

Use sealing and resealing tape *without* adhesive at the cavity area. Adhesive at the cavity area can lead to injection needle contamination.

Example of tape that meets the requirements:

Thermo Scientific WebSeal 96-well non-coated plastic microplate with WebSeal sealing tape with 3 layer no adhesive at cavity area

Do *not* use well plate seals that are likely to result in seal material being punched out by the autosampler needle. For example, sections of aluminum tape may be punched out of aluminum well plate sealing tape and deposit in the needle seat.

## 6.9 Optimizing the System Performance

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

### 6.9.1 Dependency of Column Pressure and Flow Rate

The maximum pressure that the pump can deliver depends on the following:

- Selected flow rate
- Viscosity of the solvent that is used in either channel (channel A or channel B)

For the pre-calibrated solvents, the graph shows how the maximum available column pressure depends on the selected flow rate and channel.

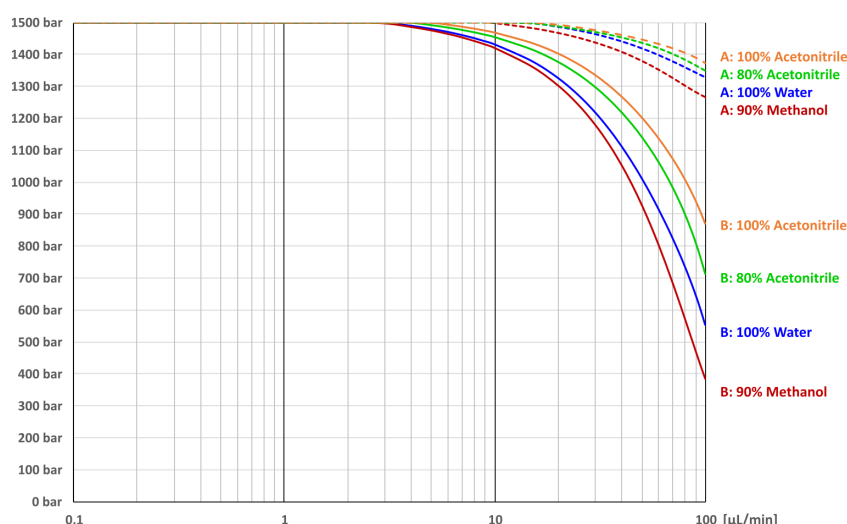


Figure 86: Dependency of column pressure and flow rate for channel A and channel B

For other solvents, observe the following:

- For gradient flow rates up to 10 µL/min, use the aqueous (weak) solvent in channel A and the organic (strong) solvent in channel B.
- If the total flow rate exceeds 10 µL/min and the expected system pressure will exceed 140 MPa (1400 bar), use the solvent with the highest viscosity in channel A.

During operation, the pump monitors continuously whether the selected flow rate can be delivered at the resulting pressure. If the column pressure becomes so high that the pump cannot deliver the selected flow rate, the following happens:

- The injection or sequence is aborted.
- A message appears indicating, for example, that the pump could not deliver the requested flow at this pressure (**code 4531**) or that the pressure exceeded the absolute limit (**code 4503**).

When you reduce the flow rate, the actual column pressure decreases. At the same time, the pump can deliver a higher column pressure. If the pump cannot deliver the selected flow rate, adapt the application setup. For example, reduce the flow rate.

## 6.9.2 Adding Custom Solvents to the Calibration Table

The pump can deliver accurate flow rates only if the solvent that you plan to use has been calibrated for. Solvents for which calibration has been performed are available in the solvent calibration table and available for selection. For the most common solvent types and mixtures, calibration was performed at the factory:

- Water, 100%
- Acetonitrile, 100%
- Mixture of acetonitrile and water, 80:20 (v:v)
- Mixture of methanol and water, 90:10 (v:v)

If you want to use other solvents, calibrate them once to add them to the configuration. Calibration is recommended for a solvent type differing by > 5% (volume-by-volume) from one of the above.

### Examples

#### Example 1

Solvent		Action
A	98:2 (v:v), water:acetonitrile plus 0.1% formic acid	Use the calibration data for 100% water.
B	80:20 (v:v), acetonitrile:water plus 0.1% formic acid	Use the calibration data for 80:20% acetonitrile.

## Example 2

Solvent		Action
A	95:5 (v:v), water:dimethyl sulfoxide plus 0.1% formic acid	Use the calibration data for 100% water.
B	75:20:5 (v:v:v), acetonitrile:water:dimethyl sulfoxide plus 0.1% formic acid	Use the calibration data for 80:20% acetonitrile.

## Example 3

Solvent		Action
A	100% water plus 0.1% formic acid	Use the calibration data for 100% water.
B	90:10 (v:v), acetonitrile:water plus 0.1% formic acid	Calibration is required. See further down.

*General Notes*

- Solvent calibration is per channel.
- If you want to use a solvent in both channels, you must perform the calibration twice to calibrate the solvent for each channel separately.
- The actual calibration is automated and runs unattended. Prior to starting the script for the actual calibration, you must setup and configure the pump for calibration and provide user input. After completion, you must return the pump to the original capillary configuration and reconnect all capillaries and the system as required by the application.
- Calibration scripts guide you through all steps of the process.
- The time required for the actual calibration to complete is approximately 100 minutes. In addition, allow for 30 minutes beforehand to prepare the calibration setup and 30 minutes afterward to restore the operational setup.

*Parts and Items required*

- Solvent suitable for purging to flush out harmful substances
- Solvent for which you want to perform the calibration
- Viper fitting plug (3 plugs)

Follow these steps

1. On the **script panel**, go to **Solvent Calibration**.
2. Run and follow the solvent calibration scripts one after the other.
3. After the operational setup has been restored, test the pump for leakage. Run the script: **Test System Tightness (Subject To Test = Pump)**.

Calibration Results

- Calibration successful: The solvent is added to the solvent calibration table and is available for selection.
- Error occurred during calibration: From the calibration scripts, either complete the calibration or restore the operational setup.

### 6.9.3 Accelerating and Decelerating the Flow (Flow Ramps)

To protect the column, limit how fast the pump changes the flow.

Parameter	Description
Flow acceleration	<p>The flow acceleration determines how fast the pump starts delivering the selected flow rate.</p> <p>If the value is too low, it will take correspondingly long for the pump to build up the necessary pressure and start delivering the required flow. If the value is too high, this may impair the column lifetime.</p> <p>Set the flow acceleration in the chromatography data system.</p>
Flow deceleration	<p>The flow deceleration determines how fast the pump reduces the flow.</p> <p>If the value is too low, it will take correspondingly long for the pump to reduce the flow and thus the pressure. If the value is too high, this may impair the column lifetime.</p> <p>Set the flow deceleration in the chromatography data system.</p>
<i>Recommendation:</i>	Set the parameters to a value between 1/3 and factor 3 of the (column) flow rate.
<i>Example:</i>	With the flow rate set to 300 nL/min and a flow acceleration of 300 nL/min <sup>2</sup> , the ramp up time (0 nL/min to 300 nL/min) is 1 minute.

## 6.9.4 Adjusting the Pump Flow Sensor Offsets

The flow sensor offset adjustment script measures the sensor signal at zero flow and saves the result so that the flow signal can be corrected accordingly. This will remove the offset shift that has occurred since the calibration in the factory.

### *Adjustment not required*

Adjusting the flow sensor offsets is not required when the retention times are stable or in the expected range. Do not adjust the flow sensor offsets in these situations:

- While a scientific study or measurement series is running.
- During a series of measurements that are expected to give comparable results.
- Very frequently, for example, every day.

### *Adjustment may be required*

For accurate and comparable measurement results adjusting the flow sensor offsets may be required in these situations:

- When retention times are noticeably different from the expected range (shifted). This may lead to missing peaks.
- When retention times vary considerably compared to previous measurements.

Estimated, adjusting the flow sensor offsets will be required once every 1 to 3 months, specifically when running < 2  $\mu\text{L}/\text{min}$  analysis.

### *Follow these steps*

Observe the following before you begin:

- The system must have been on for a minimum of 5 hours. Only then, the adjustment will be possible.
  - *Recommendation:* Perform the adjustment using the solvents of your application.
1. Run this adjustment script: **Adjust Pump Flow Sensor Offsets**.
  2. When the adjustment is complete, allow some equilibration time for optimum retention time stability, for example, one blank run.

## 6.9.5 Washing the Needle

The needle wash cycle washes the needle to remove residual sample from the needle. This can be part of the sampling sequence or can be performed manually. This section describes how to trigger a manual needle wash cycle to optimize system performance in addition to the workflow sequence.

### *When*

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

### *Preparations*

Observe the guidelines for needle wash, see [Filling the Needle Wash Reservoirs](#) (▶ page 127).

### *Follow these steps*

To start the outer needle wash, perform the following step:

On the keypad, select the **WASH** button.

This initializes an outer needle wash cycle, in which the outer needle surface is washed in the wash port.

To start the inner and outer needle wash manually, perform the following step:

On the VSC, run the script: **Clean Up System**

This initializes the system to perform a wash procedure for the outside and also the inside of the needle.

After the needle wash cycle has been completed, the needle moves back to the needle seat.

### **See also**

 [Needle Wash System \(Overview\)](#) (▶ page 55)

 [Needle Wash System Maintenance](#) (▶ page 258)



## 6.9.6 Thermostating the Autosampler Sample Compartment

In the autosampler, you can thermostat the sample compartment.

*Follow these steps*

1. Enable temperature control in the chromatography data system or in the autosampler box on the home panel in the Vanquish User Interface.
2. Set the target temperature. Check that the thermostating temperature is suitable for the samples.

**TIP** If you turn off the autosampler, the autosampler saves the set target temperature. Check the temperature when you turn the autosampler on again and adapt it if required.

## 6.9.7 Thermostating the Column Compartment

You can thermostat the column compartment.

*Follow these steps*

1. Enable temperature control in the Vanquish User Interface or by pressing the **TEMP CTRL** button.
2. Set the target temperature in the chromatography data system or in the column compartment box on the home panel in the Vanquish User Interface. Check that the thermostating temperature is suitable for the following parts:
  - ◆ Valves
  - ◆ Columns

*Notes on setting the temperature*

The column compartment has no active cooling system. Note the following:

- ◆ You cannot reduce the temperature in the compartment below a temperature resulting from the ambient temperature and self-heating of the module.
- ◆ The set temperature must be at least 5 °C higher than the ambient temperature.

### *Ready State*

The **Ready** property in the chromatography data system indicates whether the column compartment is ready for operation. When the column compartment is in the **NotReady** state, you cannot start the analysis. The settings for **Ready Temp Delta** and **Equilibration Time** influence the time that the column compartment needs to enter the **Ready** state.

### *Ready Temp Delta*

**Ready Temp Delta** indicates for how many degrees the current temperature may be above or below the temperature setpoint. If the current temperature deviates from the temperature setpoint by more degrees than the value entered here, the column compartment enters the **NotReady** state and is not ready for operation.

Example: Temperature setpoint: 45 °C, **Ready Temp Delta**: 1 °C

The column compartment is ready for operation when the current temperature is between 44 °C and 46 °C for the **Equilibration Time**. If the current temperature is outside this range, the column compartment enters the **NotReady** state.

### *Equilibration Time*

Indicates for how long the preferred temperature must be in the range specified by the temperature setpoint and the setting for **Ready Temp Delta** before the column compartment is ready for operation and the analysis can be started.

Example: Temperature setpoint: 45 °C, **Ready Temp Delta**: 1 °C, **Equilibration Time**: 0.5 min

The column compartment is ready for operation when the current temperature is between 44 °C and 46 °C and has remained in this range for 0.5 minutes.

Observe the following:

- The smaller the value is for **Ready Temp Delta** and the higher the value is for **Equilibration Time**, the longer it takes until the column compartment is ready for operation and you can start the data acquisition and/or the analysis.
- Environmental conditions, such as draft or air conditioning, may also extend the waiting period or even prevent the column compartment from entering the **Ready** state.
- However, keep in mind that the better the system is equilibrated, the better the chromatographic results are.

## 6.10 Shutting Down the System

If the system will not be operated for some time, follow the instructions in this section.

### 6.10.1 Interrupting Operation of the System for a Short Period

To interrupt operation of the system for a short period (short-term shutdown), for example, overnight, observe these guidelines:

#### *Preparations*

If your system configuration includes a column compartment, set the maximum temperature to 40 °C.

#### *Follow these steps*

1. Run the script and follow the instructions: **Shutdown (Short-term)**.
2. Before resuming operation, do the following:
  - a) Let the pump flow and temperature equilibrate back to the operating conditions.
  - b) Purge the autosampler with weak needle wash liquid.

### 6.10.2 Interrupting Operation of the System for a Longer Period

To interrupt operation for a longer period and to keep the system in the laboratory, follow the instructions below.

1. Run the script: **Shutdown (Long-term)** with the following parameter: **Module to remove = System**.
2. Empty the solvent lines:
  - a) Unscrew the caps of the solvent reservoirs.
  - b) Together with the caps, remove the solvent lines from the reservoirs.
  - c) Protect the solvent line filters from contamination as appropriate.

**TIP** Removing the solvent lines from the tubing guides is usually not required (not even for replacing the slide-in module). However, when you remove the solvent lines from the tubing guides in the pump and all modules above the pump in the system stack, be careful not to pull on other tubing in the guides.

3. Empty the solvent reservoirs.
4. Turn off the system with the system power button (lower button on the system base).
5. Turn off the system controller with its power button (upper button on the system base).

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

#### *Restarting the System after Shutdown*

1. Fill the solvent reservoirs (see [Filling the Solvent Reservoirs](#) (▶ page 125)).
2. Turn on the system (see [Turning On the System for the First Time](#) (▶ page 132)).
3. Prepare the system for operation (see [Preparing the System for Initial Operation](#) (▶ page 135)).
4. Equilibrate the system (see [Equilibrating the System](#) (▶ page 155)).

# 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 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 307).

## 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 Injection Needle**

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

To avoid personal injury, never touch the needle tip.



### **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.



### **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.



#### **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—Hot Surfaces**

Surfaces inside the system may become hot during operation. Touching hot parts might cause burns.

Allow hot surfaces to cool down before starting replacement or maintenance procedures.



#### **CAUTION—Hydrostatic Pressure**

Solvent may spill when you open the flow path. 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 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 solvent lines. See [Emptying the Solvent Lines](#) (► page 222).
- 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.



**NOTICE**

Moving the Vanquish system stack even over short distances on the workbench can damage and impair the functionality of the system base.

Before moving the system stack, unlock the system base using the locking tools.

**TIP** When the power is turned off to the autosampler, the left front door of the autosampler is opened automatically for proper ventilation of the sample 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 rules and recommendations below.

### *General Rules*

- 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.
- Follow all instructions step by step and use the tools recommended for the procedure.

### *Opening Flow Path Connections*

- 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.
- After you have performed maintenance or service on the flow connections in the system, test the system for leakage. Run the script: **Test System Tightness**.

### **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.

### *Depot Repair*

- If you need to return the system to Thermo Fisher Scientific for depot repair, contact your local Thermo Fisher Scientific support organization for the appropriate procedure.

#### **See also**

 [Consumables and Replacement Parts](#) (▶ page 373)

## 7.4 Routine and Preventive Maintenance

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

### 7.4.1 Maintenance Plan

Perform the procedures in the following maintenance tables on a regular basis. The frequency given in the tables 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 system.

#### 7.4.1.1 Weekly Maintenance

Product component	What you should do...
System/all modules	<ul style="list-style-type: none"> <li>• Flow connections: Inspect flow connections for signs of:               <ul style="list-style-type: none"> <li>◆ Blockage: Run the script and follow the instructions: Test System Back Pressure.</li> <li>◆ Salt deposits</li> <li>◆ Air bubbles Sonicate the solvents and purge the pump and the autosampler if necessary.</li> </ul> </li> <li>• Solvents: If you use one of the following solvents, proceed as follows:               <ul style="list-style-type: none"> <li>◆ Pure water or an aqueous buffer: To replace the solvent reservoir, run the script: <b>Change Liquids / Solvents</b>.</li> <li>◆ Buffers or salt solutions: Flush the system thoroughly after use with an appropriate solvent that does not contain buffers or salts (see <a href="#">Purging (Overview)</a> (▶ page 62)).</li> <li>◆ Corrosive solvents or methanol with &lt;10% water: Flush the system with water or other suitable non-corrosive solvents (see <a href="#">Purging (Overview)</a> (▶ page 62)).</li> </ul> </li> </ul>
Wash systems	<ul style="list-style-type: none"> <li>• Check the liquid level.</li> <li>• Check if particles, dust, or algae are present in the wash reservoirs. If particles, dust, or algae are present, replace the wash reservoirs with clean ones. Run the script: <b>Change Liquids / Solvents (Refresh Only = On)</b>. Ensure that the wash reservoirs are free of detergents or residual chemicals. We recommend rinsing the wash reservoirs with a small quantity of the planned wash liquid.</li> </ul>
Autosampler	<ul style="list-style-type: none"> <li>• Inspect vials and well plates in the autosampler for cracks or defects.</li> <li>• Clean up spills inside the autosampler if necessary.</li> </ul>

## 7.4.1.2 Regular Maintenance

Product component	What you should do...
System/all modules	<ul style="list-style-type: none"> <li>• Replace the solvent reservoirs every 1 or 2 weeks. To replace the solvent reservoirs, run the script: <b>Change Liquids / Solvents</b>. Before filling reservoirs, rinse them thoroughly.</li> <li>• Inspect the system for leakage: <b>Test System Tightness (Subject To Test = System)</b> after the following actions: <ul style="list-style-type: none"> <li>◆ Replacing the solvent reservoirs</li> <li>◆ Changing the workflow</li> </ul> </li> <li>• Replace the solvent line filter frits at regular intervals. This is especially important when using aqueous solvents. Aqueous solvents may contaminate the filters with algae and other microorganisms that deposit on the filter frits.</li> <li>• Inspect the flow connections for damage, such as cracks, nicks, cuts, or blockage.</li> <li>• Check the drain system for blockage (see <a href="#">Testing the Drain System</a> (▶ page 124)).</li> <li>• Empty the waste containers.</li> <li>• Clean the system (see <a href="#">Cleaning or Decontaminating a System Module or the System</a> (▶ page 180)).</li> <li>• Inspect the warning labels on the system and its modules. If a warning label is missing or illegible, contact Thermo Fisher Scientific for replacement.</li> </ul>
Wash systems	<ul style="list-style-type: none"> <li>• Needle wash systems: Replace the needle wash reservoirs regularly, approximately every 1 or 2 weeks. To replace the needle wash reservoirs, run the script: <b>Change Liquids / Solvents</b>.</li> <li>• Seal wash system: <ul style="list-style-type: none"> <li>◆ Replace the seal wash reservoir. Rinse the reservoir thoroughly before filling it. Use a high-purity solvent for rinsing.</li> <li>◆ Inspect the seal wash lines. If a line is blocked (squeezed or bent), replace the line.</li> <li>◆ Inspect the peristaltic tubing. If it is dislocated or hardened, reposition or replace it (see <a href="#">Replacing the Peristaltic Tubing in the Seal Wash Pump</a> (▶ page 276)).</li> <li>◆ Test the seal wash system for leakage (see <a href="#">Testing the Seal Wash System for Leakage</a> (▶ page 266)).</li> </ul> </li> </ul>
Pump	<ul style="list-style-type: none"> <li>• Clean the pump head check valves once a month (see <a href="#">Cleaning the Check Valves (Pump Head)</a> (▶ page 216)).</li> <li>• Flush the pump with fresh solvents to avoid contamination (see <a href="#">Flushing the Pump to Avoid Contamination</a> (▶ page 178)).</li> </ul>
Autosampler	Replace the drain pump tubing every six months (see <a href="#">Replacing the Drain Pump Tubing</a> (▶ page 255)).
Display	Retighten the screws fixing the display to the system.

**See also**

 [Use of Solvents and Additives](#) (▶ page 141)

### 7.4.1.3 Annual Maintenance

Product component	What you should do...
System/all modules	Have Thermo Fisher Scientific service personnel perform preventive maintenance once a year.
Seal wash system	<ul style="list-style-type: none"> <li>• Replace the seal wash seals (see <a href="#">Replacing the Seal Wash Seal</a> <a href="#">▶ page 204</a>).</li> <li>• Replace the seal wash lines (see <a href="#">Seal Wash System Maintenance</a> <a href="#">▶ page 266</a>).</li> </ul>
Pump	Inspect the pistons for particle deposits or indications of damage, for example, scratches or scores (see <a href="#">Cleaning the Piston</a> <a href="#">▶ page 191</a> ).

## 7.4.2 Flushing the Pump to Avoid Contamination

### Items required

Fresh solvent

### Observe the following guidelines

The following guidelines refer to conventional use of the Vanquish system as recommended in this manual, such as using fresh high-quality solvents (minimum UHPLC-grade or LCMS-grade) that are replaced frequently:

- Regularly flushing the pump with fresh solvent is usually sufficient.
- If you use water, acetonitrile, or methanol for your chromatography, flushing the pump once a week is an appropriate interval.
- Mobile phases containing salts, buffering agents and/or other additives are inherently prone to organic contamination and/or biodegradation. When using non-volatile buffers, observe the following:
  - ◆ Mobile phases must be filtered before use.
  - ◆ For continuous trouble-free operation, the system must be flushed with, for example, > 60 % isopropanol or ethanol as a weekly procedure.
- Adapt the interval to the solvents in use.

**TIP** With persistent contamination, for example, if ghost peaks appear reproducibly in your blank chromatogram without injecting a sample, see [Flushing the Pump with Persistent Contamination Only](#) [▶ page 179](#)).

### See also

 [Use of Solvents and Additives](#) [▶ page 141](#)

### 7.4.3 Flushing the Pump with Persistent Contamination Only

*When*

**TIP** With conventional use of the Vanquish system as recommended in this manual, regularly flushing the pump is usually sufficient (see [Flushing the Pump to Avoid Contamination](#) (► page 178)).

For example, if ghost peaks appear reproducibly in your blank chromatogram without injecting a sample, consider a harsher cleaning procedure. Follow the instructions below.

*Parts and additional items required*

- Appropriate backpressure capillary, generating about 20 – 90 MPa at a flow rate of 50  $\mu\text{L}/\text{min}$  in water (for example, nanoViper capillary, fused silica, inner diameter: 20  $\mu\text{m}$ , length: 350 mm)
- 6 molar (6 M) nitric acid (HPLC-grade)
- Waste container (for collecting the nitric acid)
- Fresh water (HPLC-grade)
- Fresh acetonitrile (HPLC-grade)
- New solvent reservoirs with fresh solvent
- New frits for solvent line filters

*Follow these steps*

1. Install the backpressure capillary on the pump outlet. Guide the free end of the capillary to the waste container.
2. Replace the frits in the solvent line filters with new frits.
3. Replace the installed waste container with the new waste container to prevent any chemical reaction between the nitric acid and the solvent in the waste container.
4. For 1 hour, apply the flow rate of 50  $\mu\text{L}/\text{min}$ . and flush the pump with 6 M nitric acid.
5. Flush the pump with fresh HPLC-grade water until the pH value is neutral.
6. Remove the waste container with the nitric acid and re-install the waste container that was installed previously.
7. For 2 hours, apply the flow rate of 50  $\mu\text{L}/\text{min}$ . and flush the pump with fresh acetonitrile.

8. Connect the new solvent reservoirs, which contain fresh solvent.
9. Uninstall the backpressure capillary and reconnect the system as required by your application.
10. Purge the pump.
11. Equilibrate the system.

**See also**

 [Purging \(Overview\)](#) (▶ page 62)

## 7.4.4 Cleaning or Decontaminating a System Module or the System

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 system modules or system. Use a suitable cleaning detergent or disinfectant to ensure that the treatment renders the system modules or the system 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*

1. *If you want to clean or decontaminate the autosampler or the system only:*
  - a) Move the needle unit into service position.
  - b) Tighten the shipping lock screw (see [Securing the Needle Unit](#) (▶ page 238)).
  - c) Remove all sample containers and sample racks from the sample compartment.
2. Proceed as required:
  - ◆ *If you want to clean or decontaminate an individual system module:* Turn off the power to the system module and disconnect the power cord from the power source.
  - ◆ *If you want to clean or decontaminate the system:* Turn off the power to all system modules and to the system and disconnect the power cords from the power source.

*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.

*Post-Cleaning/Decontamination Steps*

1. *If you cleaned or decontaminated the autosampler or the system only:*
  - a) Loosen the shipping lock screw.
  - b) Place the sample containers and sample racks in the sample compartment.
2. Connect the power cord(s) to the power source.
3. Turn on the power to the system module(s).  
When the autosampler has powered up, the needle unit automatically moves into Inject position.
4. Prepare the system for operation (see [Preparing the System for Initial Operation](#) (▶ page 135)).

## 7.5 Pump Head Maintenance

This section describes how to maintain or replace the pump head or pump head parts. Follow the instructions for the maintenance procedure that you want to perform.

- To replace a pump head, see [Replacing the Pump Head](#) (▶ page 185).
- To replace a piston, see [Replacing the Pistons](#) (▶ page 189).
- To clean a piston, see [Cleaning the Piston](#) (▶ page 191).
- To replace a support ring, see [Replacing the Support Ring](#) (▶ page 192).
- To replace a piston seal, see [Replacing the Piston Seal](#) (▶ page 197).
- To replace a seal wash seal, see [Replacing the Seal Wash Seal](#) (▶ page 204).
- To replace a pump head seal, see [Replacing the Pump Head Seals](#) (▶ page 208).
- To clean or replace a check valve, see [Maintaining the Pump Head Check Valves](#) (▶ page 213).

### See also

- 📄 [Overview of Pump Head Parts](#) (▶ page 184)

### 7.5.1 Overview of Pump Head Parts

The picture shows the main pump head parts.

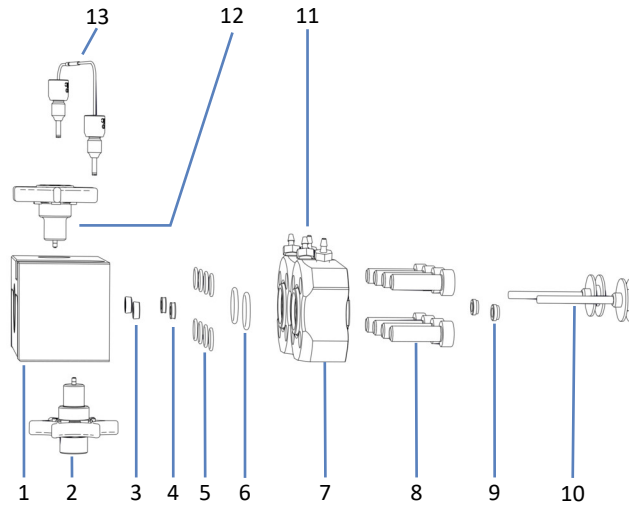


Figure 87: Overview of pump head parts

No.	Description
1	Pump head
2	Inlet check valve
3	Piston seals
4	Support rings
5	Pump head seals, for seal wash plate screws (O-ring seals 6.5x1)
6	Pump head seals, for seal wash plates (O-ring seals 11x1.5)
7	Seal wash plates
8	Screws, seal wash plates
9	Seal wash seals
10	Pistons
11	Connectors for seal wash tubing (screwable)
12	Outlet check valve
13	U-tube

## 7.5.2 Replacing the Pump Head

*When*

Damage of pump head

*Follow these steps*

1. Remove the pump head. See [Removing the Pump Head](#) (▶ page 185).
2. Install the pump head. See [Installing the Pump Head](#) (▶ page 186).

### 7.5.2.1 Removing the Pump Head

*When*

- To replace a pump head
- During maintenance of pump head parts

*Tools and additional items required*

- Hexagon wrench, size 6
- Solvent suitable for purging to flush out harmful substances

*Preparations*

1. To flush out harmful substances, purge the pump with an appropriate solvent.

*Parts affected on the pump head*

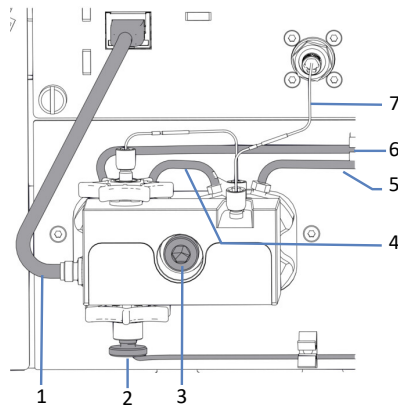




Figure 88: Pump head

No.	Description
1	Pressure sensor cable
2	Solvent line on inlet check valve
3	Pump head screw
4-6	Seal wash lines
7	Capillary connecting pump head and flowmeter

*Follow these steps*

1. For the pump head for which you want to perform the procedure, undock the pistons from either the keypad (**SELECT** and **DOCK** buttons) or the **ePanel** in the chromatography data system.
2. Wait until undocking is complete, before proceeding. Undocking is complete when the pump has stopped and the LED next to the **FLOW** button is flashing green for the selected pump head.
3. Unplug the cable of the pressure sensor from the **Pressure** connector.
4. Disconnect the solvent line on the inlet check valve.
5. Remove the capillary that connects the pump head to the flowmeter.
6. Remove the seal wash lines from the tubing connectors on the pump head. Do not remove the tubing connectors.
7. Loosen the pump head screw with the hexagon wrench.
8. Hold the pump head with one hand and remove the pump head screw.
9. Remove the pump head by pulling out the head about 10 mm (0.5"), away from the pump front panel, and tilting down. The pistons are usually removed from the pump together with the pump head. If a piston remains in the pump, tilt and pull out the piston with your fingers.

**See also**

-  [Installing the Pump Head](#) (▶ page 186)
-  [Purging \(Overview\)](#) (▶ page 62)

### 7.5.2.2 Installing the Pump Head

*When*

- To install a replacement pump head
- During maintenance of pump head parts

*Parts required*

Pump head

*Tools and additional items required*

- Hexagon wrench, size 6
- Solvent suitable for your application

Parts affected on the pump head

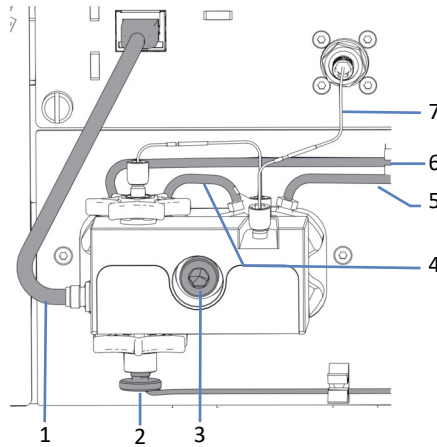


Figure 89: Pump head

No.	Description
1	Pressure sensor cable
2	Solvent line on inlet check valve
3	Pump head screw
4-6	Seal wash lines
7	Capillary connecting pump head and flowmeter

Observe the following



Situation	Description
Reinstallation of pump head	Do not interchange the pump heads. Note the labeling on the pressure sensor cable ( <b>A</b> for the left pump head, <b>B</b> for the right pump head). If you have to reinstall a piston, see <a href="#">Installing the Pistons</a> (▶ page 190).
Installation of new pump head (replacement pump head)	New pump heads can be installed in either position when installed for the first time. They have no label on the pressure sensor cable. For easier identification during future maintenance, consider labeling them according to the installation position.

*Follow these steps*

1. Check that the pistons are inserted in the pump head as far as they go in.
2. Insert the pump head into the pump and tighten the pump head screw with the hexagon wrench.
3. Connect the seal wash lines to the tubing connectors on the pump head.
4. Connect the capillary that connects the pump head to the flowmeter.
5. Connect the solvent line to the inlet check valve.
6. Connect the cable of the pressure sensor to the **Pressure** connector.
7. Dock the pistons from either the keypad (**SELECT** and **DOCK** buttons) or the **ePanel** in the chromatography data system.
8. Wait until docking is complete before proceeding.  
Docking is complete when the pump has stopped and the LED next to the **FLOW** button stops flashing green for the selected pump head.
9. Turn off the pump with the main power switch and on again.
10. Purge the pump using the solvent for your application.
11. Inspect all flow connections on the pump head for indications of leakage. Tighten leaky connections when the system pressure is down to zero.
12. Test the seal wash system for leakage. See [Testing the Seal Wash System for Leakage](#) (► page 266).
13. Depends on the situation:

Situation	Description
Reinstallation of pump head	Test the pump for leakage. Run the script: <b>Test System Tightness (Subject To Test = Pump)</b> .
Installation of new pump head (replacement pump head)	1. Adjust the pressure sensors. Run the script: <b>Adjust System Pressure Sensors</b> . 2. Test the pump for leakage. Run the script: <b>Test System Tightness (Subject To Test = Pump)</b> .

**See also**

-  [Removing the Pump Head](#) (► page 185)
-  [Purging \(Overview\)](#) (► page 62)



## 7.5.3 Replacing the Pistons

*When*

Damage of piston

*Follow these steps*

1. Remove the piston. See [Removing the Pistons](#) (▶ page 189).
2. Install the piston. See [Installing the Pistons](#) (▶ page 190).

### 7.5.3.1 Removing the Pistons

*When*

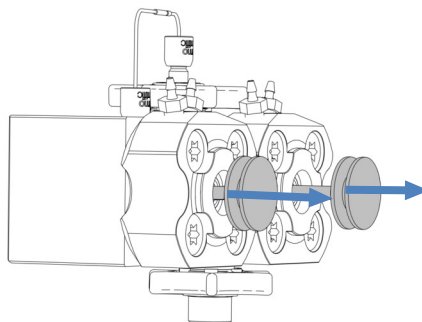
- To replace a piston
- For maintenance of pump head parts

*Preparations*

Remove the pump head. See [Removing the Pump Head](#) (▶ page 185).

*Follow these steps*

With your fingers, pull out the piston that you want to remove from the pump head. If you remove the piston during maintenance of pump head parts, grasp the piston by the piston base and avoid touching the piston surface.



*Figure 90: Removing the pistons*

**See also**

📖 [Installing the Pistons](#) (▶ page 190)

### 7.5.3.2 Installing the Pistons

#### When

- To install a replacement piston after piston removal
- During maintenance of pump head parts

#### Parts and additional items required

- Piston
- Isopropanol

#### Preparations

When reinstalling a piston that you removed, clean the piston. See [Cleaning the Piston](#) (► page 191).

#### Follow these steps

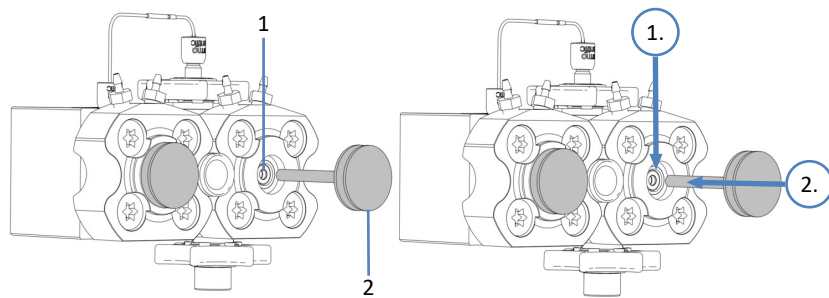


Figure 91: Installing the pistons

No.	Description
1	Piston cavity
2	Piston base

1. Pipette a few drops of isopropanol into the piston cavity in which you want to install the piston.  
When reinstalling a piston, install the piston to the position from which you removed it.
2. Grasp the piston by the piston base.
3. Insert the piston into the piston cavity as far as the piston goes in.
4. Install the pump head. See [Installing the Pump Head](#) (► page 186).

#### See also

- 📄 [Removing the Pistons](#) (► page 189)

## 7.5.4 Cleaning the Piston

### When

Before reinstalling a piston that you removed

### Items required

- Dry, lint-free tissue
- Isopropanol

### Follow these steps

1. Inspect the piston for signs of damage.
2. Carefully rinse the piston, using isopropanol.
3. With a dry, lint-free tissue, rub the piston several times.
4. Hold the piston and carefully move your fingernail over the piston surface. You should not feel inconsistent or rough areas.
5. Depends on the situation:

Situation	Action
No damage visible No inconsistent or rough areas	<ol style="list-style-type: none"> <li>1. Carefully rinse the piston again, using isopropanol.</li> <li>2. With a dry, lint-free tissue, rub the piston several times.</li> <li>3. Reinstall the piston.</li> </ol>
Piston is scratched or scored	Install a new piston.

### See also

 [Installing the Pistons \(► page 190\)](#)

## 7.5.5 Replacing the Support Ring

*When*

Damage of support ring

*Follow these steps*

1. Remove the support ring. See [Removing the Support Ring](#) (▶ page 192).
2. Install the support ring. See [Installing the Support Ring](#) (▶ page 194).

### 7.5.5.1 Removing the Support Ring

*When*

To replace a support ring

*Tools required*

- Screwdriver, Torx T30
- Seal-handling tool

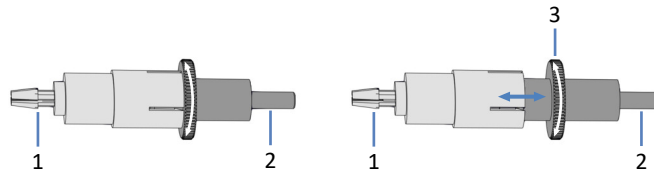


Figure 92: Seal-handling tool (left: closed tool; right: open tool)

No.	Description
1	Removal pin
2	Insertion pin
3	Knurl for opening and closing the seal-handling tool (opening and closing is required only when using the removal pin)

*Preparations*

1. Remove the pump head. See [Removing the Pump Head](#) (▶ page 185).
2. Remove the piston for which you want to replace the support ring. See [Removing the Pistons](#) (▶ page 189).

### Parts affected on the pump head

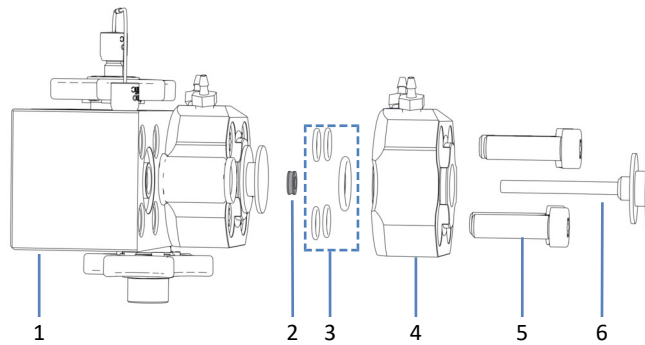


Figure 93: Support ring (here: for left piston)

No.	Description
1	Pump head
2	Support ring
3	Pump head seals (for seal wash plate and seal wash plate screws)
4	Seal wash plate
5	Screws, seal wash plate (4 screws)
6	Piston

### Follow these steps

1. With the screwdriver, remove the screws on the seal wash plate.

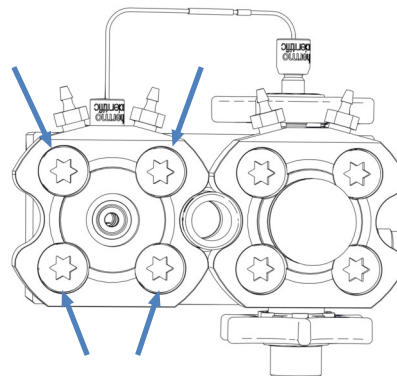


Figure 94: Screws on seal wash plate (here: left plate)

2. Remove the seal wash plate from the pump head.
3. If one or more pump head seals come off when you remove the seal wash plate, keep them for reinstallation.

- Remove the support ring: Push the *insertion* pin of the seal-handling tool at a slight angle into the pump head. Do not use the *removal* pin.

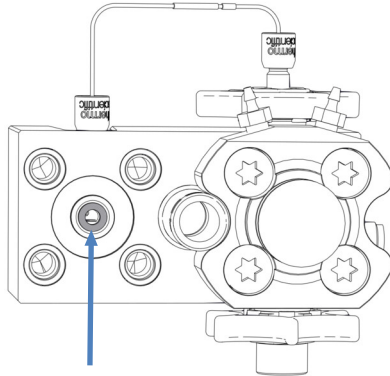


Figure 95: Support ring (here: for left piston)

- Remove the tool. The support ring is removed together with the tool.

**See also**

[Installing the Support Ring \(▶ page 194\)](#)

### 7.5.5.2 Installing the Support Ring

*When*

To install a replacement support ring after support ring removal

*Parts required*

- Support ring
- Pump head seals for reinstallation if necessary

*Tools required*

- Screwdriver, Torx T30
- Seal-handling tool

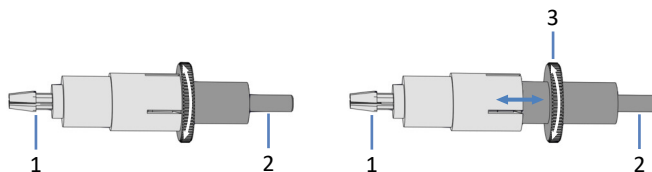


Figure 96: Seal-handling tool (left: closed tool; right: open tool)

No.	Description
1	Removal pin
2	Insertion pin
3	Knurl for opening and closing the seal-handling tool (opening and closing is required only when using the removal pin)

### Parts affected on the pump head

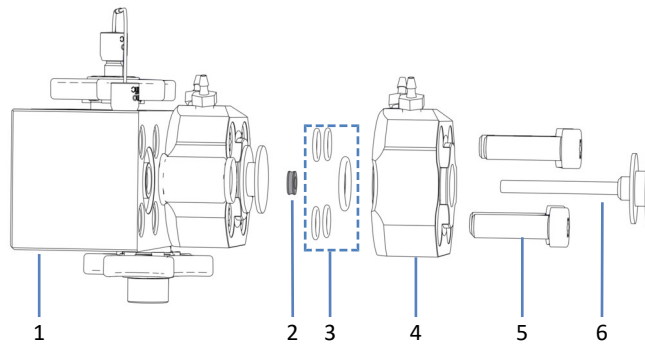


Figure 97: Support ring (here: for left piston)

No.	Description
1	Pump head
2	Support ring
3	Pump head seals (for seal wash plate and seal wash plate screws)
4	Seal wash plate
5	Screws, seal wash plate (4 screws)
6	Piston

### Follow these steps

1. Slide the support ring onto the *insertion* pin of the seal-handling tool.

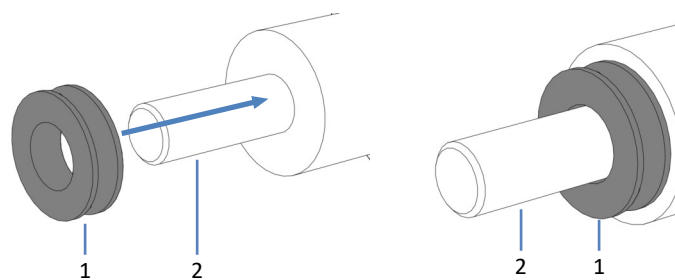


Figure 98: Sliding the support ring onto the insertion pin

No.	Description
1	Support ring
2	Insertion pin, seal-handling tool

2. With the insertion pin, push the seal-handling tool into the pump head and remove the tool. The support ring remains in the pump head.

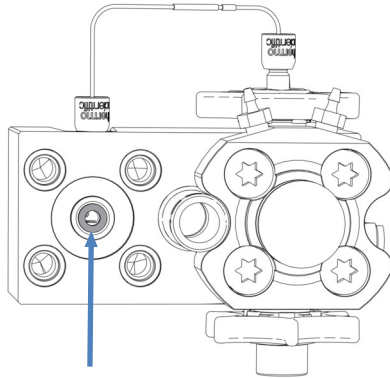


Figure 99: Support ring installed (here: for left piston)

3. Check that the pump head seals are correctly installed. If the seals came off or if they do not rest properly in the receiving grooves, reinstall the seals. See [Installing the Pump Head Seals](#) (▶ page 210).
4. Place the seal wash plate onto the pump head and insert the screws.

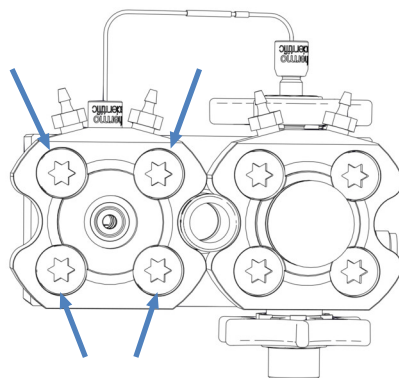


Figure 100: Screws on seal wash plate (here: left plate)

5. With the screwdriver, tighten the screws crosswise.
6. Tighten the screws crosswise once again.
7. Install the piston. See [Installing the Pistons](#) (▶ page 190).
8. Install the pump head. See [Installing the Pump Head](#) (▶ page 186).

**See also**

- 📄 [Removing the Support Ring](#) (▶ page 192)



## 7.5.6 Replacing the Piston Seal

*When*

- Damage of piston seal, leaky seal
- Unstable flow rates or baseline noise

*Follow these steps*

1. Remove the piston seal. See [Removing the Piston Seal](#) (▶ page 197).
2. Install the piston seal. See [Installing the Piston Seal](#) (▶ page 200).

### 7.5.6.1 Removing the Piston Seal

*When*

To replace the piston seal

*Tools required*

- Screwdriver, Torx T30
- Seal-handling tool

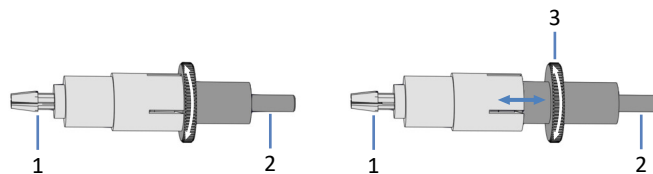


Figure 101: Seal-handling tool (left: closed tool; right: open tool)

No.	Description
1	Removal pin
2	Insertion pin
3	Knurl for opening and closing the seal-handling tool (opening and closing is required only when using the removal pin)

*Preparations*

1. Remove the pump head. See [Removing the Pump Head](#) (▶ page 185).
2. Remove the piston for which you want to replace the piston seal. See [Removing the Pistons](#) (▶ page 189).

*Parts affected on the pump head*

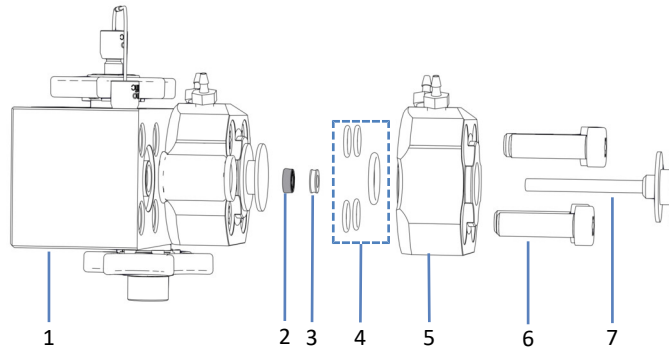


Figure 102: Piston seal (here: for left piston)

No.	Description
1	Pump head
2	Piston seal
3	Support ring
4	Pump head seals (for seal wash plate and seal wash plate screws)
5	Seal wash plate
6	Screws, seal wash plate (4 screws)
7	Piston

*Follow these steps*

1. With the screwdriver, remove the screws on the seal wash plate.

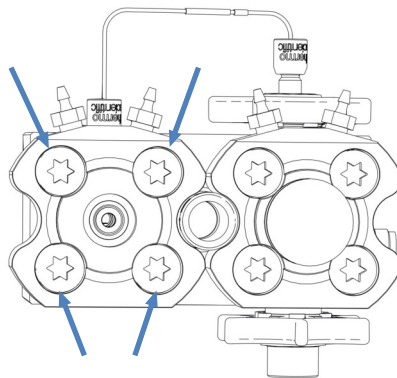


Figure 103: Screws on seal wash plate (here: left plate)

2. Remove the seal wash plate from the pump head.
3. If one or more pump head seals come off when you remove the seal wash plate, keep them for reinstallation.

4. Remove the support ring: Push the *insertion* pin of the seal-handling tool at a slight angle into the pump head. Do not use the *removal* pin.

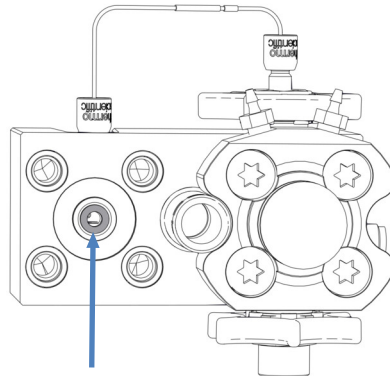


Figure 104: Support ring (here: for left piston)

5. Remove the tool. The support ring is removed together with the tool.  
Keep the support ring for reinstallation. The support ring is not a wear part and needs not to be replaced whenever you replace the piston seal.
6. Open the seal-handling tool and push the *removal* pin into the pump head as far as the pin goes in.

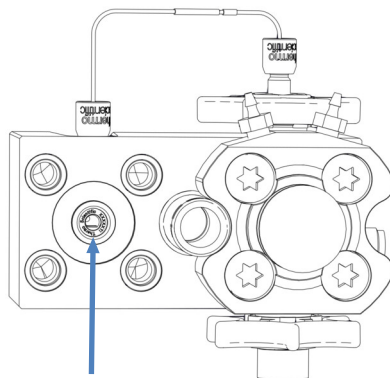


Figure 105: Piston seal (here: for left piston)

7. Close the seal-handling tool and remove the tool from the pump head. The seal is removed together with the tool.
8. To remove the seal from the seal-handling tool: Open the tool and pull off the seal from the tool. Once the seal has been removed, it cannot be reused.

#### See also

📄 [Installing the Piston Seal](#) (► page 200)

### 7.5.6.2 Installing the Piston Seal

*When*

To install a replacement piston seal after seal removal

*Parts required*

- Piston seal
- Support ring that was removed during piston seal removal  
The support ring is not a wear part and can be reinstated. Install a new support ring only when the ring is damaged.
- Pump head seals for reinstallation if necessary

*Tools and additional items required*

- Screwdriver, Torx T30
- Syringe filled with isopropanol
- Cleaning swab
- Lint-free tissue
- Seal-handling tool

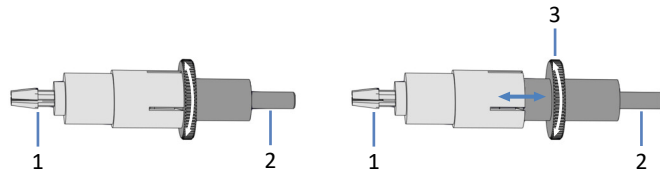


Figure 106: Seal-handling tool (left: closed tool; right: open tool)

No.	Description
1	Removal pin
2	Insertion pin
3	Knurl for opening and closing the seal-handling tool (opening and closing is required only when using the removal pin)

### Parts affected on the pump head

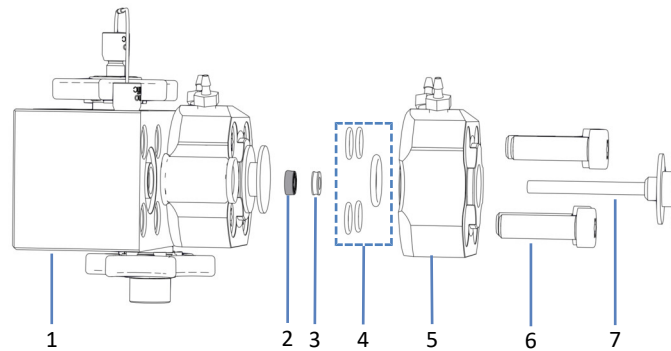


Figure 107: Piston seal (here: for left piston)

No.	Description
1	Pump head
2	Piston seal
3	Support ring
4	Pump head seals (for seal wash plate and seal wash plate screws)
5	Seal wash plate
6	Screws, seal wash plate (4 screws)
7	Piston

### Follow these steps

1. Clean the support ring from the inside and outside, using isopropanol, a cleaning swab, and a lint-free tissue.
2. Pipette a few drops of isopropanol into the cavity of the pump head, on the edge on which the piston seal will rest.

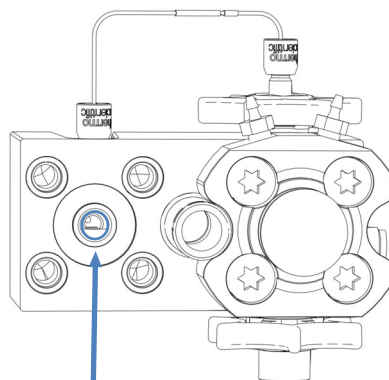


Figure 108: Edge on which the piston seal will rest

- Slide the support ring and the piston seal onto the *insertion* pin of the seal-handling tool. The open side of the piston seal faces away from the tool.

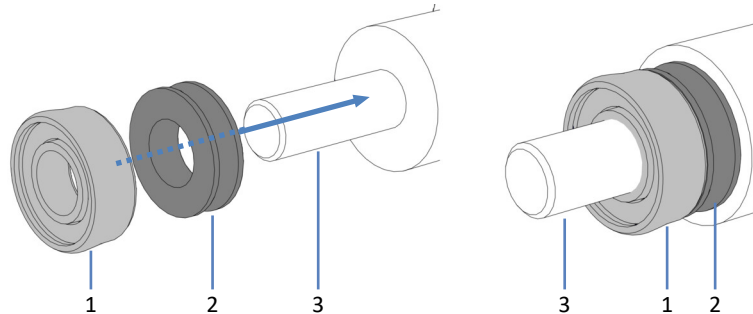


Figure 109: Sliding the support ring and piston seal onto the insertion pin

No.	Description
1	Piston seal (open side facing away from tool)
2	Support ring
3	Insertion pin, seal-handling tool

- With the insertion pin, push the seal-handling tool into the pump head as far as it goes in and remove the tool. The piston seal and support ring remain in the pump head.

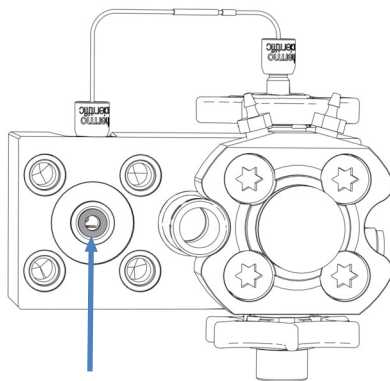


Figure 110: Support ring installed, covering the piston seal (here: for left piston)

- Check that the pump head seals are correctly installed. If the seals came off or if they do not rest properly in the receiving grooves, reinstall the seals. See [Installing the Pump Head Seals](#) (► page 210).

6. Place the seal wash plate onto the pump head and insert the screws.

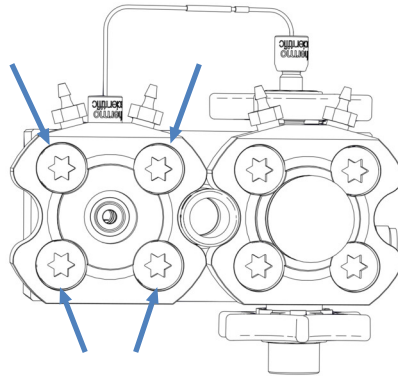


Figure 111: Screws on seal wash plate (here: left plate)

7. With the screwdriver, tighten the screws crosswise.
8. Tighten the screws crosswise once again.
9. Install the piston. See [Installing the Pistons](#) (▶ page 190).
10. Install the pump head. See [Installing the Pump Head](#) (▶ page 186). However, *before* you run the script to test the pump for leakage, operate the pump for 30 minutes at a column pressure of 80 MPa (recommended) to allow the new piston seals to run in.

#### See also

- 📄 [Removing the Piston Seal](#) (▶ page 197)

## 7.5.7 Replacing the Seal Wash Seal

### When

Damage of seal wash seal, liquid observed underneath the pump head (leaky seal)

### Follow these steps

1. Remove the seal wash seal. See [Removing the Seal Wash Seal](#) (▶ page 204).
2. Install the seal wash seal. See [Installing the Seal Wash Seal](#) (▶ page 206).

### 7.5.7.1 Removing the Seal Wash Seal

#### When

To replace the seal wash seal

#### Tools required

Seal-handling tool

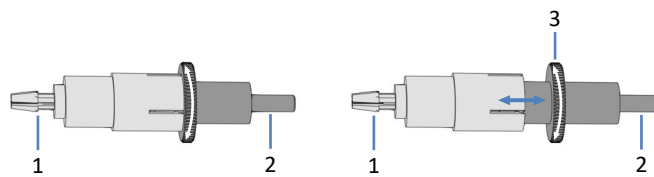


Figure 112: Seal-handling tool (left: closed tool; right: open tool)

No.	Description
1	Removal pin
2	Insertion pin
3	Knurl for opening and closing the seal-handling tool (opening and closing is required only when using the removal pin)

#### Preparations

1. Remove the pump head. See [Removing the Pump Head](#) (▶ page 185).
2. Remove the piston for which you want to replace the seal wash seal. See [Removing the Pistons](#) (▶ page 189).



### Parts affected on the pump head

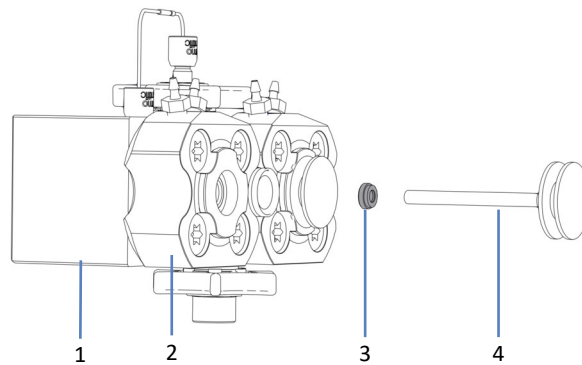


Figure 113: Seal wash seal (here: for left piston)

No.	Description
1	Pump head
2	Seal wash plate
3	Seal wash seal
4	Piston

### Follow these steps

1. Open the seal-handling tool and push the *removal* pin into the seal wash plate as far as the pin goes in.

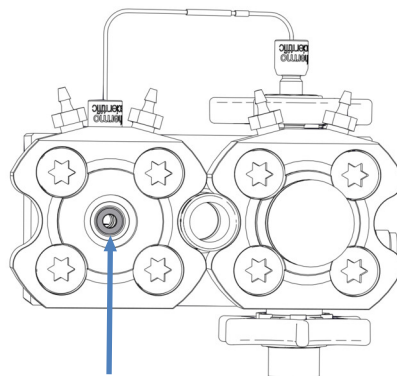


Figure 114: Seal wash seal (here: for left piston)

2. Close the seal-handling tool and remove the tool from the seal-wash plate. The seal is removed together with the tool.
3. To remove the seal from the seal-handling tool: Open the tool and pull off the seal from the tool. Once the seal has been removed, it cannot be reused.

### See also

- 📄 [Installing the Seal Wash Seal](#) (► page 206)

### 7.5.7.2 Installing the Seal Wash Seal

When

To install a replacement seal wash seal after seal removal

Parts and tools required

- Seal wash seal
- Seal-handling tool

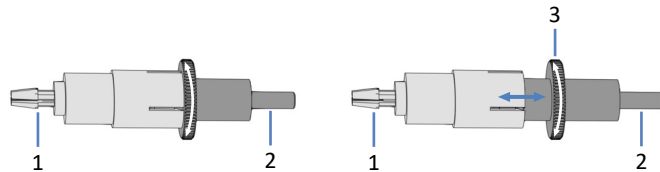


Figure 115: Seal-handling tool (left: closed tool; right: open tool)

No.	Description
1	Removal pin
2	Insertion pin
3	Knurl for opening and closing the seal-handling tool (opening and closing is required only when using the removal pin)

Parts affected on the pump head

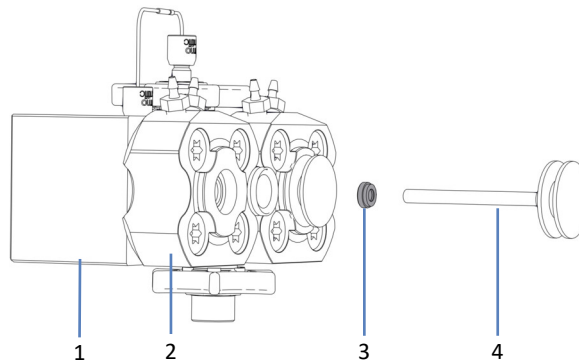


Figure 116: Seal wash seal (here: for left piston)

No.	Description
1	Pump head
2	Seal wash plate
3	Seal wash seal
4	Piston

1. Slide the seal wash seal onto the insertion pin of the seal-handling tool. Mind the orientation of the seal.

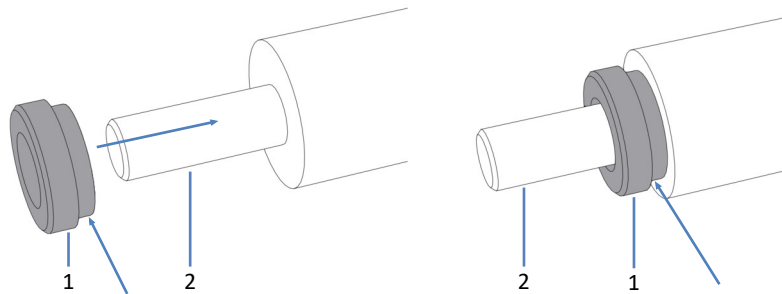


Figure 117: Sliding the seal wash seal onto the insertion pin

No.	Description
1	Seal wash seal (the arrow indicates which side faces the tool)
2	Insertion pin, seal-handling tool

2. With the insertion pin, push the seal-handling tool into the seal wash plate and remove the tool. The seal wash seal remains in the seal wash plate.

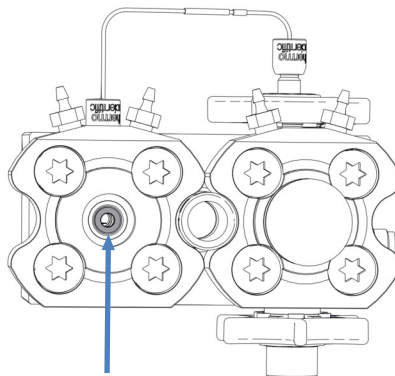


Figure 118: Seal wash seal installed (here: for left piston)

3. Install the piston. See [Installing the Pistons](#) (► page 190).
4. Install the pump head. See [Installing the Pump Head](#) (► page 186).

#### See also

- 📄 [Removing the Seal Wash Seal](#) (► page 204)

## 7.5.8 Replacing the Pump Head Seals

*When*

- Damage of pump head seals
- Liquid observed underneath the pump head (leaky seals)

*Follow these steps*

1. Remove the pump head seals. See [Removing the Pump Head Seals](#) (▶ page 208).
2. Install the pump head seals. See [Installing the Pump Head Seals](#) (▶ page 210).

### 7.5.8.1 Removing the Pump Head Seals

*When*

To replace the pump head seals

*Tools required*

- Screwdriver, Torx T30
- Tweezers

*Preparations*

1. Remove the pump head. See [Removing the Pump Head](#) (▶ page 185).
2. Remove the pistons. See [Removing the Pistons](#) (▶ page 189).

*Parts affected on the pump head*

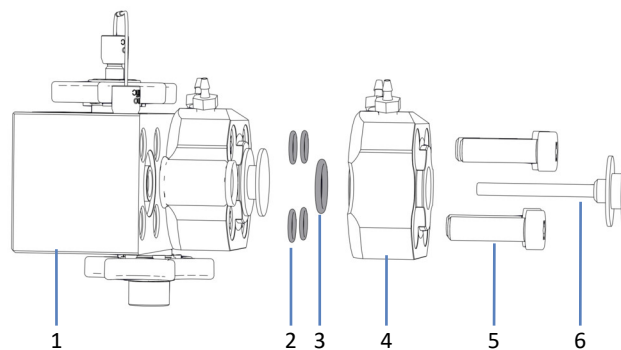


Figure 119: Pump head seals (here: left side of pump head)

No.	Description
1	Pump head
2	Pump head seals, for seal wash plate screws (O-ring seals 6.5x1)
3	Pump head seal, for seal wash plate (O-ring seal 11x1.5)
4	Seal wash plate
5	Seal wash plate screws
6	Piston

Follow these steps

**Recommended:** Replace all pump head seals of the pump head at the same time (left side and right side of pump head).

1. With the screwdriver, remove the screws on the seal wash plate.

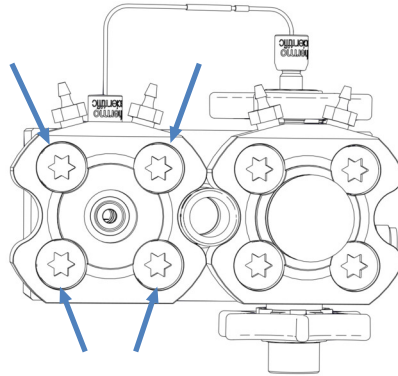


Figure 120: Screws on seal wash plate (here: left plate)

2. Remove the seal wash plate from the pump head.
3. Remove all pump head seals. Using tweezers facilitates the procedure.

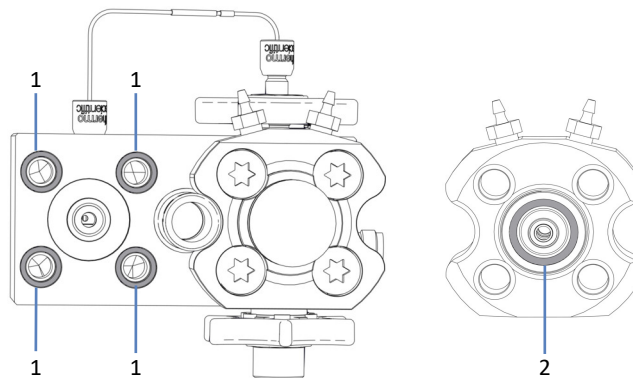


Figure 121: Pump head seals (here: left side of pump head)

No.	Description
1	Pump head seals, for seal wash plate screws (O-ring seals 6.5x1), resting in the pump head
2	Pump head seal, for seal wash plate (O-ring seal 11x1.5), resting in the seal wash plate, side facing the pump head

#### See also

 [Installing the Pump Head Seals](#) (► page 210)

### 7.5.8.2 Installing the Pump Head Seals

*When*

- To install replacement pump head seals after seal removal
- To reinstall a pump head seal that came off during maintenance of pump head parts

*Parts and tools required*

- Pump head seals
- Screwdriver, Torx T30
- Syringe filled with isopropanol
- Lint-free tissue

*Parts affected on the pump head*

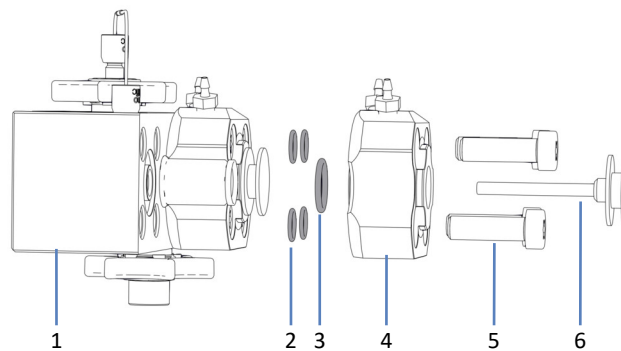


Figure 122: Pump head seals (here: left side of pump head)

No.	Description
1	Pump head
2	Pump head seals, for seal wash plate screws (O-ring seals 6.5x1)
3	Pump head seal, for seal wash plate (O-ring seal 11x1.5)
4	Seal wash plate
5	Seal wash plate screws
6	Piston

Follow these steps

1. Only when reinstalling a pump head seal: Clean the pump head seal, using isopropanol and a lint-free tissue.
2. Place the pump head seal onto the receiving groove.

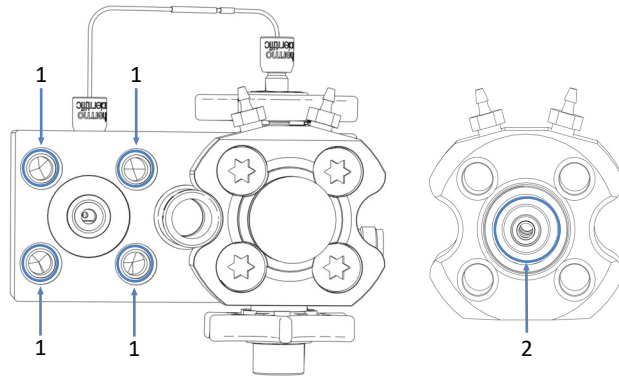


Figure 123: Receiving grooves for pump head seals (here: left side of pump head), in pump head and seal wash plate

No.	Description
1	Receiving grooves for pump head seals in pump head; seals for seal wash plate screws (O-ring seals 6.5x1)
2	Receiving groove for pump head seal in seal wash plate (side facing the pump head); seal for seal wash plate (O-ring seal 11x1.5)

3. With your fingers, press the pump head seal into the groove as far as it goes in.

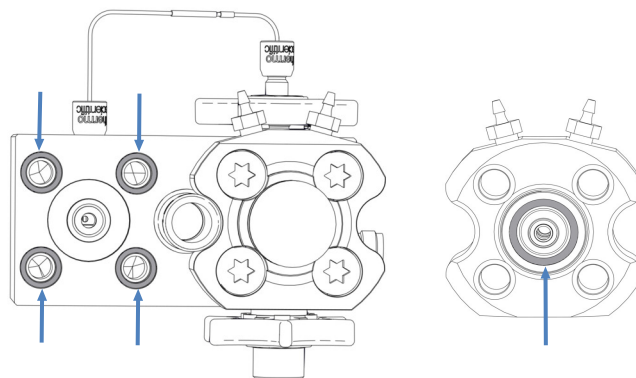
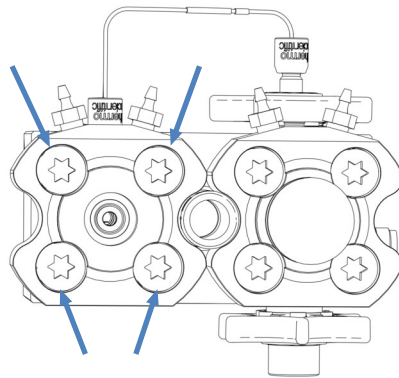


Figure 124: Pump head seals installed, in pump head and seal wash plate (here: left side of pump head)

4. Place the seal wash plate onto the pump head and insert the screws.



*Figure 125: Screws on seal wash plate (here: left plate)*

5. With the screwdriver, tighten the screws crosswise.
6. Tighten the screws crosswise once again.
7. Install the piston. See [Installing the Pistons](#) (▶ page 190).
8. Install the pump head. See [Installing the Pump Head](#) (▶ page 186).

**See also**

- 📄 [Removing the Pump Head Seals](#) (▶ page 208)



## 7.5.9 Maintaining the Pump Head Check Valves

The pump head has two check valves: one inlet check valve and one outlet check valve.

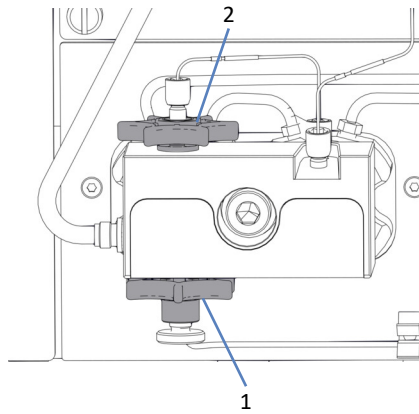


Figure 126: Pump head check valves

No.	Description
1	Inlet check valve
2	Outlet check valve

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

- To replace the inlet check valve, see [Replacing the Inlet Check Valve \(Pump Head\)](#) (▶ page 213).
- To replace the outlet check valve, see [Replacing the Outlet Check Valve \(Pump Head\)](#) (▶ page 215).
- To clean the check valves, see [Cleaning the Check Valves \(Pump Head\)](#) (▶ page 216).

### 7.5.9.1 Replacing the Inlet Check Valve (Pump Head)

#### When

- Issue with the check valve that could not be solved by cleaning (for example, persistent leakage)
- Damage of inlet check valve

#### Parts required

Inlet check valve

#### Tools and additional items required

- Solvent suitable for purging to flush out harmful substances
- Solvent suitable for your application

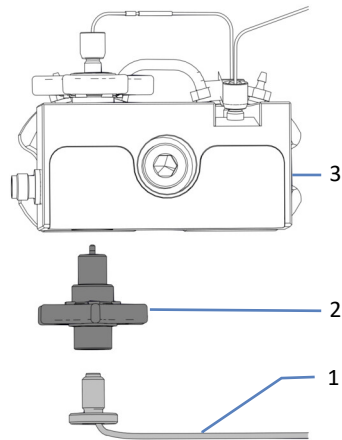
*Parts affected on the pump head*

Figure 127: Inlet check valve on pump head

No.	Description
1	Solvent line
2	Inlet check valve
3	Pump head

*Preparations*

1. To flush out harmful substances, purge the pump with an appropriate solvent.

*Follow these steps*

1. On the inlet check valve, disconnect the solvent line.
2. Loosen and remove the inlet check valve with your fingers.
3. Tighten the new inlet check valve with your fingers.
4. On the inlet check valve, connect the solvent line.
5. Purge the pump using the solvent of your application.
6. Inspect the check valve and connections for indications of leakage. Tighten leaky connections only when the system pressure is down to zero.
7. Test the pump for leakage. Run the script: **Test System Tightness (Subject To Test = Pump)**.

**See also**

 [Purging \(Overview\)](#) (▶ page 62)

### 7.5.9.2 Replacing the Outlet Check Valve (Pump Head)

#### When

- Issue with the check valve that could not be solved by cleaning (for example, persistent leakage)
- Damage of outlet check valve

#### Parts required

Outlet check valve

#### Tools and additional items required

- Solvent suitable for purging to flush out harmful substances
- Solvent suitable for your application

#### Parts affected on the pump head

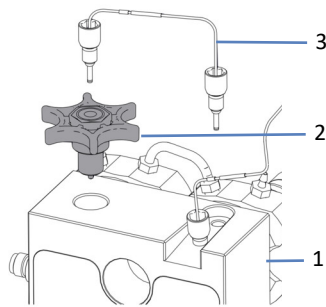


Figure 128: Outlet check valve on pump head

No.	Description
1	Pump head
2	Outlet check valve
3	U-tube

#### Preparations

1. To flush out harmful substances, purge the pump with an appropriate solvent.

#### Follow these steps

1. On the pump head, remove the U-tube.
2. Loosen and remove the outlet check valve with your fingers.
3. Insert and tighten the new outlet check valve with your fingers.
4. On the pump head, connect the U-tube.

5. Purge the pump using the solvent for your application.
6. Inspect the check valve and connections for indications of leakage. Tighten leaky connections only when the system pressure is down to zero.
7. Test the pump for leakage. Run the script: **Test System Tightness (Subject To Test = Pump)**.

**See also**

 [Purging \(Overview\)](#) (▶ page 62)

### 7.5.9.3 Cleaning the Check Valves (Pump Head)

*When*

- Once a month
- Dirty or leaky check valves

*Items required*

- Syringe (12 mL), filled with isopropanol
- Small beaker filled with isopropanol
- Ultrasonic bath
- Appropriate backpressure capillary, generating about 75 MPa at a flow rate of 50  $\mu\text{L}/\text{min}$  in water (for example, nanoViper capillary, fused silica, inner diameter: 20  $\mu\text{m}$ , length: 350 mm)
- Solvent suitable for cleaning – observe the following:  
You can use the solvent of your application unless you are using water-free normal-phase solvents. In this case, use solvent with a minimum of 20% water in the 50%B mixture to avoid electrostatic discharge in the system capillary.
- Solvent suitable for your application

*Preparations*

Remove the check valves that you want to clean.

*Recommended:* Clean the inlet check valves and outlet check valves of both pump heads at the same time.

*Follow these steps*

1. In the direction of flow, fill the check valves with isopropanol, using the syringe.
2. Place the check valves in the beaker. Clean them in the ultrasonic bath for 10 minutes.
3. In the direction of flow, flush the check valves with isopropanol, using the syringe.
4. Insert and tighten the check valves. Reconnect the U-tube or solvent line.
5. Install the backpressure capillary on the pump outlet. Guide the free end of the capillary to the waste container.
6. Have the pump deliver the solvent suitable for cleaning: Start with a flow rate of 10  $\mu\text{L}/\text{min}$ . Increase the flow rate until the system pressure is about 90 MPa and run the pump for 20 minutes.
7. Inspect the pump head and check valves for indications of leakage. Tighten leaky connections only when the system pressure is down to zero.
8. Uninstall the backpressure capillary and reconnect the system as required by your application.
9. Purge the pump using the solvent for your application.
10. Test the pump for leakage. Run the script: **Test System Tightness (Subject To Test = Pump)**.

**See also**

-  [Replacing the Inlet Check Valve \(Pump Head\) \(► page 213\)](#)
-  [Replacing the Outlet Check Valve \(Pump Head\) \(► page 215\)](#)

## 7.6 Flowmeter Maintenance

This section describes how to maintain or replace flowmeter parts. Follow the instructions for the maintenance procedure that you want to perform.

### 7.6.1 Replacing the Flowmeter Filter

#### When

Filter clogged

#### Parts required

Flowmeter filter kit

#### Tools and additional items required

- Open-end wrench, size 13 mm
- Solvent suitable to flush out harmful substances
- Solvent suitable for your application

#### Parts affected

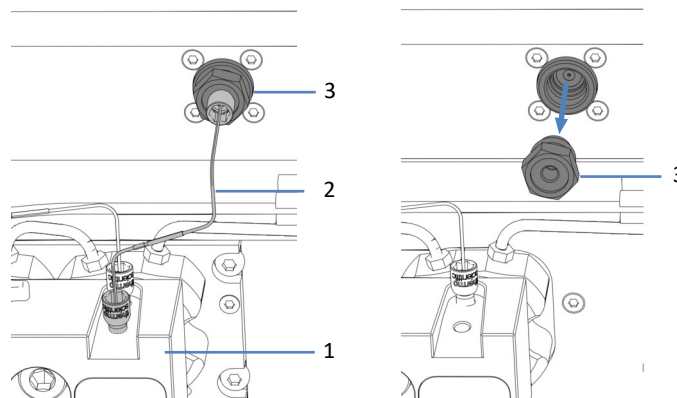


Figure 129: Flowmeter filter (left: parts installed; right: filter removed)

No.	Description
1	Pump head
2	Capillary connecting pump head and flowmeter
3	Flowmeter filter

### Preparations

1. To flush out harmful substances, purge the pump with an appropriate solvent.
2. Prepare the replacement filter.

### Preparing the Replacement Filter

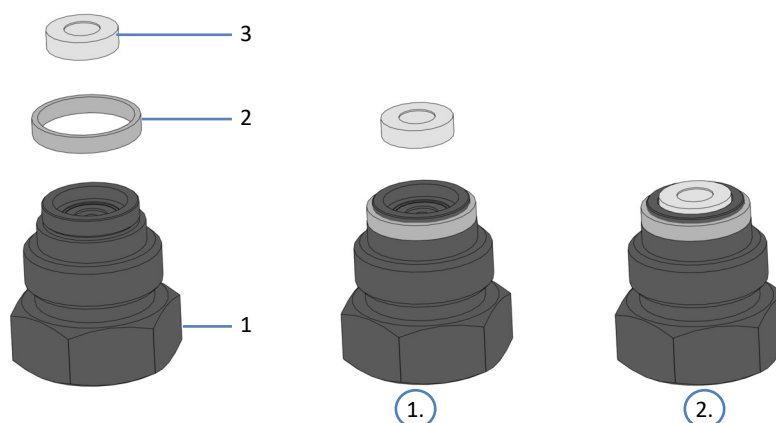


Figure 130: Assembling the flowmeter filter

No.	Description
1	Filter screw
2	Filter screw seal
3	Filter frit

1. With your fingers, push the seal onto the filter screw until the seal rests on the receiving edge.
2. Pipette a drop of solvent into the filter screw and insert the filter frit. The solvent keeps the frit in the screw.

### Follow these steps

1. Remove the capillary that connects the pump head and the flowmeter.
2. With the wrench, loosen the filter screw and remove the filter from the pump.
3. Insert the new filter and tighten the filter screw with the wrench.
4. Connect the capillary that connects the pump head and the flowmeter.
5. Purge the pump and flowmeter using the solvent for your application.

6. Inspect the connections for indication of leakage. Tighten leaky connections when the system pressure is down to zero.
7. Test the pump for leakage. Run the script: **Test System Tightness (Subject To Test = Pump)**.

**See also**

 [Purging \(Overview\)](#) (▶ page 62)

## 7.6.2 Replacing the Flowmeter Waste Line

*When*

Damage or blockage of waste line

*Parts and additional items required*

- Flowmeter waste line
- Solvent suitable to flush out harmful substances

*Parts affected*

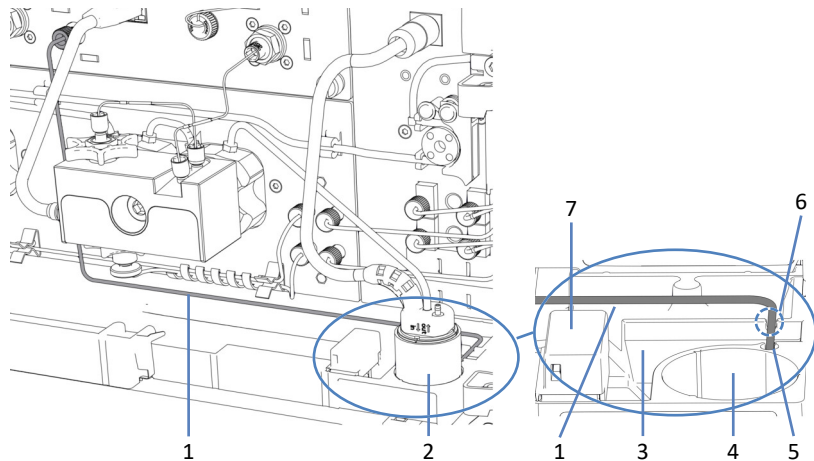


Figure 131: Flowmeter waste line (left: overview; right: detailed view)

No.	Description
1	Flowmeter waste line
2	Seal wash detector assembly
3	Drain port
4	Installation position for seal wash detector assembly
5	Waste outlet port (to drain system)
6	Groove in drain port wall
7	Leak sensor



### Preparations

1. To flush out harmful substances, purge the pump with an appropriate solvent.
2. For easier access to the drain port wall and waste outlet port, remove the seal wash detector assembly (funnel and detector).

### Removing the Seal Wash Detector Assembly

Grasp and pull the seal wash detector assembly (funnel and detector) upward by the funnel. The detector including the tubing and cable can remain connected to the funnel.

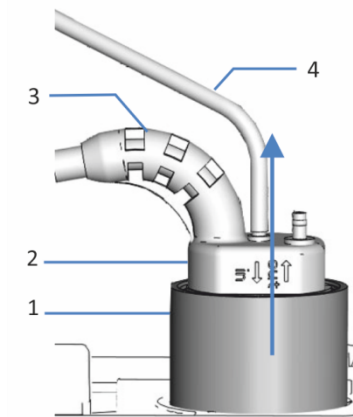


Figure 132: Removing the seal wash detector assembly

No.	Description
1	Funnel, seal wash detector
2	Seal wash detector
3	Detector cable
4	Seal wash line

### Follow these steps

1. Remove the waste line from the Purge Out port on the flowmeter and from the waste outlet port.
2. Connect the new waste line to the Purge Out port.
3. Route the line through the groove in the drain port wall into the waste outlet port.  
To avoid false leak alarms, the waste line must sit properly in the waste outlet port. If it does not, liquid may accumulate in the drain port and activate the leak sensor.
4. Reinsert the seal wash detector assembly.

### See also

 [Purging \(Overview\)](#) (► page 62)

## 7.7 Solvent Line Maintenance

This section describes how to maintain or replace solvent lines or the solvent line filter. Follow the instructions for the maintenance procedure that you want to perform.

### 7.7.1 Emptying the Solvent Lines

*When*

To empty the solvent lines, for example, for maintenance or service procedures

*Items required*

Solvent suitable to flush out harmful substances if necessary

*Follow these steps*

1. To flush out harmful substances, if applicable, purge the pump.
2. Unscrew the cap of the solvent reservoir and remove the cap together with the solvent line from the reservoir.
3. Start a purge cycle as appropriate.
4. Stop purging as soon as the solvent line is empty.

**See also**

 [Purging \(Overview\)](#) (▶ page 62)

### 7.7.2 Replacing Solvent Lines from Reservoir to Pump

*When*

Damage or blockage of the solvent line

*Parts and additional item required*

- Solvent lines from solvent reservoir to pump
- Solvent suitable for your application

## Parts affected

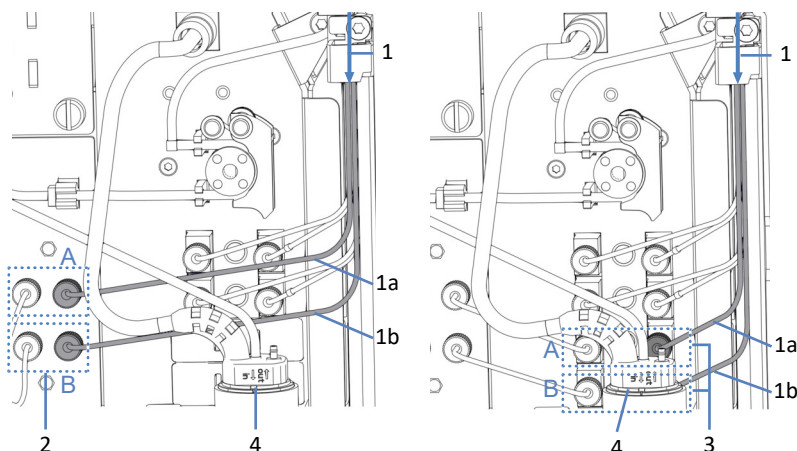


Figure 133: Solvent lines from reservoir to pump, depending on the configuration (left: standard configuration; right: configuration with retrofitted solvent degasser, optional only)

No.	Description
1	Solvent lines from reservoirs, routed to the pump through all modules above the pump in the system stack, with
1a	Solvent line, channel A
1b	Solvent line, channel B
2	Shut-off valves, A and B
3	Solvent degasser, channels A and B (only if retrofitted for special applications)
4	Seal wash detector assembly

## Preparations

1. Empty the solvent lines (see [Emptying the Solvent Lines](#) (▶ page 222)).
2. If you want to replace the solvent line filter together with the solvent line, prepare the filter (see [Replacing the Solvent Line Filter](#) (▶ page 230)).
3. *Pump with solvent degasser:* For easier access to the degasser, remove the seal wash detector assembly (funnel and detector).

### Removing the Seal Wash Detector Assembly

Grasp and pull the seal wash detector assembly (funnel and detector) upward by the funnel. The detector including the tubing and cable can remain connected to the funnel.

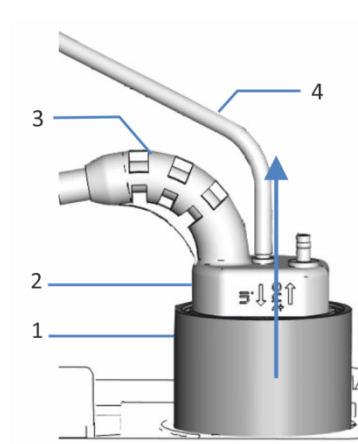


Figure 134: Removing the seal wash detector assembly

No.	Description
1	Funnel, seal wash detector
2	Seal wash detector
3	Detector cable
4	Seal wash line

### Removing the Solvent Line

1. Remove the solvent line from the reservoir cap:
  - a) Remove the filter from the solvent line.
  - b) Remove the retaining guide.
  - c) Pull the solvent line out of the reservoir cap.
2. Disconnect the solvent line in the pump.
3. Remove the solvent line from the pump and all modules above the pump in the system stack. When removing the solvent line from the tubing guides, do not pull on other tubing in the guides.

### Routing the New Solvent Line to the Solvent Rack

1. Connect each solvent line to the inlet port in the pump for which it is intended (see labeling on the solvent lines and in the pump).
2. Route the solvent lines from the pump to the solvent rack, through the tubing guides in the pump and all modules above the pump in the system stack. Observe the routing guidelines in Guiding Capillaries and Tubing Through the System.
3. Route the solvent lines through the guide hole in the solvent rack and push them into one or more of the tubing guides.

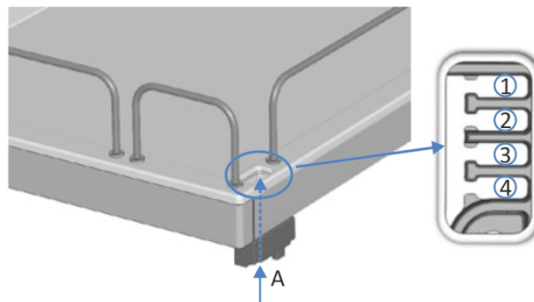


Figure 135: Guide hole and tubing guides in the solvent rack

No.	Description
A	Guide hole (solvent rack)
1-4	Tubing guides

### Connecting the Solvent Line to the Solvent Reservoir

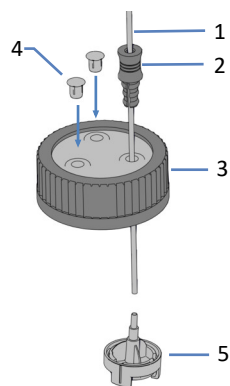


Figure 136: Preparing the solvent line and reservoir cap

No.	Description
1	Solvent line
2	Retaining guide
3	Reservoir cap
4	Cap plugs
5	Solvent line filter with solvent line adapter

1. Feed each solvent line through a retaining guide.
2. Feed the solvent line through an open hole in a cap for a solvent reservoir. The retaining guide keeps the solvent line in place in the reservoir.
3. Close any open holes in the reservoir caps with the cap plugs.
4. Slide a solvent line filter holder onto each solvent line.
5. Tighten the reservoir cap hand-tight. Press the retaining guide into the hole in the reservoir cap so that the tubing is kept in place in the cap.
6. Position the solvent lines straight in the tubing guides.
7. Check the solvent lines across the entire flow path. Make sure that the lines are not bent, pinched, or squeezed at any point in the flow path.
8. If applicable, reinsert the seal wash detector assembly.
9. Purge the pump using the solvent for your application.

**See also**

 [Purging \(Overview\)](#) (▶ page 62)

### 7.7.3 Replacing Solvent Lines from Degasser to Shut-off Valve

Only relevant for pumps with retrofitted solvent degasser

#### When

Damage or blockage of the solvent line

#### Parts and additional item required

- Solvent lines from degasser to shut-off valve
- Solvent suitable for your application

#### Parts affected

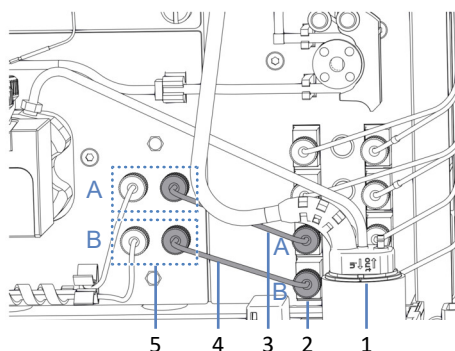


Figure 137: Solvent lines from optional pump degasser to shut-off valves

No.	Description
1	Seal wash detector assembly
2	Solvent degasser, channels A and B
3	Solvent line from degassing channel A to shut-off valve A
4	Solvent line from degassing channel B to shut-off valve B
5	Shut-off valves, A and B

#### Preparations

1. Empty the solvent lines (see [Emptying the Solvent Lines](#) (► page 222)).
2. For easier access to the degasser, remove the seal wash detector assembly (funnel and detector).

### Removing the Seal Wash Detector Assembly

Grasp and pull the seal wash detector assembly (funnel and detector) upward by the funnel. The detector including the tubing and cable can remain connected to the funnel.

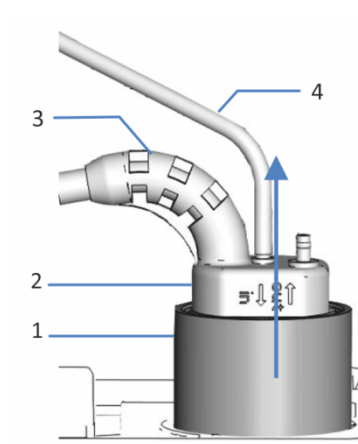


Figure 138: Removing the seal wash detector assembly

No.	Description
1	Funnel, seal wash detector
2	Seal wash detector
3	Detector cable
4	Seal wash line

### Follow these steps

1. Disconnect the solvent line on the degasser and on the shut-off valve.
2. Install the new solvent line.
3. Reinsert the seal wash detector assembly.
4. Purge the pump using the solvent for your application.

### See also

 [Purging \(Overview\)](#) (▶ page 62)



## 7.7.4 Replacing Solvent Lines from Shut-off Valve to Pump Head

### When

Damage or blockage of the solvent line

### Parts and additional items required

- Solvent lines from shut-off valve to pump head
- Solvent suitable to flush out harmful substances
- Solvent suitable for your application

### Preparations

- To flush out harmful substances, purge the pump with an appropriate solvent.

### Parts affected

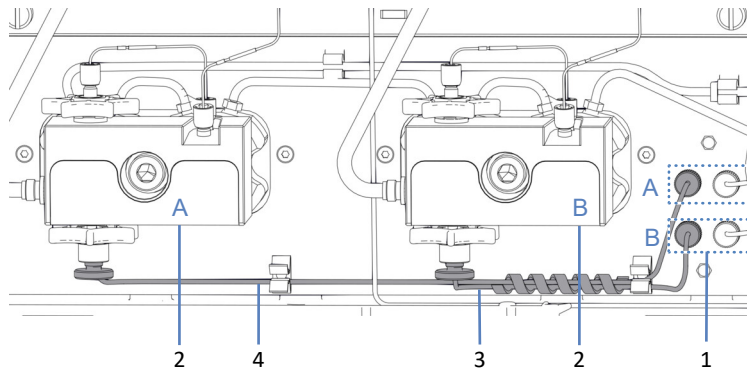


Figure 139: Solvent lines from shut-off valves to pump heads

No.	Description
1	Shut-off valves, A and B
2	Pump heads, A and B
3	Solvent line from shut-off valve B to pump head B
4	Solvent line from shut-off valve A to pump head A

### Follow these steps

1. Disconnect the solvent line on the shut-off valve and on the pump head.
2. Install the new solvent line.
3. Purge the pump using the solvent for your application.

### See also

 [Purging \(Overview\)](#) (► page 62)

## 7.7.5 Replacing the Solvent Line Filter

### When

- Impaired permeability of solvent line filter frit
- Damage of solvent line filter

### Parts and additional items required

- As applicable
  - ◆ Filter frit
  - ◆ Solvent line filter (with filter holder, filter frit, and solvent line adapter)
- Solvent suitable for your application

### Parts affected

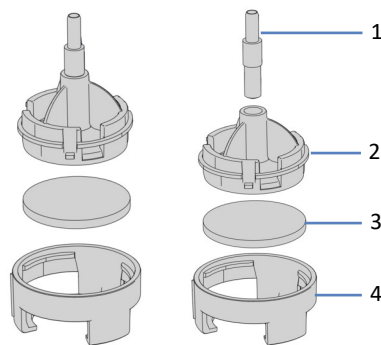


Figure 140: Solvent line filter (left: when replacing only the filter frit; right: when replacing the solvent line filter)

No.	Description
1	Solvent line adapter
2	Filter holder, top part
3	Filter frit
4	Filter holder, bottom part

### Preparations

1. Unscrew the cap of the solvent reservoir and remove the cap together with the solvent line from the reservoir.
2. Remove the filter holder (with adapter) from the solvent line.

*Follow these steps*

As necessary, follow the steps for replacing the filter frit or for replacing the filter.

*Steps for Replacing the Frit in the Solvent Line Filter*

1. Open the filter holder and remove the filter frit.
2. Assemble the solvent line filter, wearing appropriate clean gloves:
  - a) Place the frit in a level position in the filter holder (bottom part).
  - b) Screw the filter top to the filter bottom.
3. Slide the filter holder with the adapter onto the solvent line.
4. Retighten the reservoir cap hand-tight. The retaining guide must remain in the hole in the reservoir cap. If it does not, press the retaining guide into the hole so that the tubing is kept in place in the cap.
5. To remove any air from the solvent lines, purge the pump using the solvent of your application.

*Steps for Replacing the Solvent Line Filter*

1. Assemble the solvent line filter, wearing appropriate clean gloves:
  - a) Insert the solvent line adapter into the filter holder (top part).
  - b) Turn the filter holder (top part) with adapter upside down and press onto a suitable surface so that the adapter is seated firmly in the filter holder.
  - c) Place the frit in a level position in the filter holder (bottom part).
  - d) Screw the filter top to the filter bottom.
2. Slide the filter holder with the adapter onto the solvent line.
3. Retighten the reservoir cap hand-tight. The retaining guide must remain in the hole in the reservoir cap. If it does not, press the retaining guide into the hole so that the tubing is kept in place in the cap.
4. Purge the pump using the solvent of your application.

**See also**

 [Purging \(Overview\)](#) (► page 62)

## 7.8 Sample Loop Maintenance

### When

- Sample loop is clogged or damaged
- Different sample loop volume needed

### Parts required

Replacement sample loop or sample loop with different size

### Follow these steps

1. Remove the sample loop.
2. Install the replacement sample loop.
3. Complete the replacement procedure and choose the corresponding sample loop in the chromatography data system.

### 7.8.1 Components of the Sample Loop

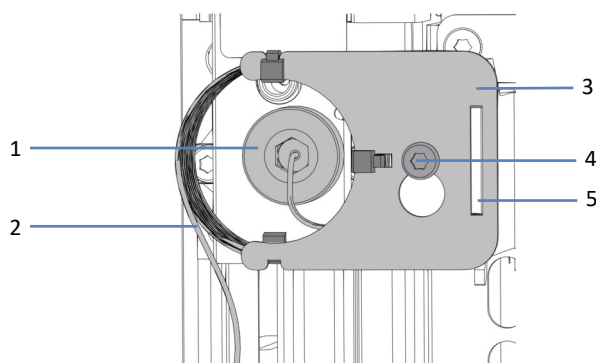


Figure 141: Sample loop installed to needle unit

No.	Description
1	Sample loop fitting on the needle unit
2	Sample loop
3	Sample loop plate
4	Attachment screw for sample loop plate
5	Recess in the sample loop plate

## 7.8.2 Removing the Sample Loop

### Tools required

Screwdriver, Torx T10

### Preparations

1. Move the needle unit into service position.
2. Remove the insulation cover.
3. Secure the needle unit.
4. Turn off the autosampler with its main power switch.

### Follow these steps

1. Slightly loosen the attachment screw with the screwdriver. The screw can remain loosely screwed on the holder of the sample loop unit.
2. Disconnect the sample loop fitting from the needle unit. Use the torque screwdriver with viper bit for easier access.
3. Disconnect the sample loop fitting from the injection valve.
4. Push the sample loop unit slightly upward so that the attachment screw matches the large recess in the sample loop plate. Remove the sample loop unit from the needle unit.

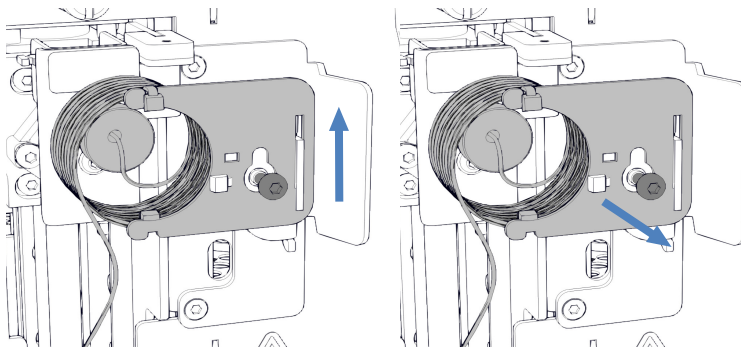


Figure 142: Sample loop removal

5. *If the sample loop will be reinstalled again:*  
Protect open sample loop fittings with a cap.

### 7.8.3 Installing the Sample Loop

#### Parts and tools required

- *If the sample loop is to be replaced:* Replacement sample loop
- Screwdriver, Torx T10
- Torque screwdriver with extension adapter and viper bit

#### Follow these steps

1. Remove cap from the lower sample loop fitting and connect the sample loop to the injection valve. For more details where to connect see [Port Assignments of the Autosampler Valves](#) (► page 45).
2. Remove cap from the upper sample loop fitting and connect the sample loop to the needle unit.
3. Hang the sample loop plate to the holder for the sample loop unit:
  - a) Hook the screw hole of the sample loop plate onto the attachment screw. Make sure that the screw is loosened.
  - b) Align the long recess in the plate with the holder.
4. Insert the sample loop fitting in the needle unit and screw it in. Make sure that the capillary coming from the needle unit connection is leaving the connector pointing to 5 o'clock.
5. Tighten the sample loop fitting at the needle unit with the torque screwdriver. After the tightening, the capillary should point to 6 o'clock.
6. Tighten the attachment screw for the sample loop plate with the screwdriver.

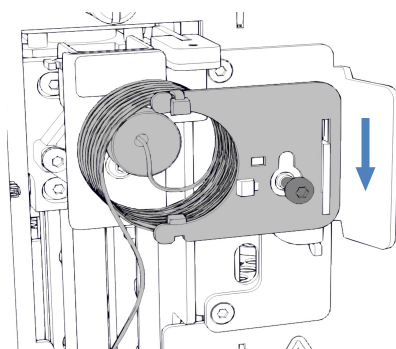
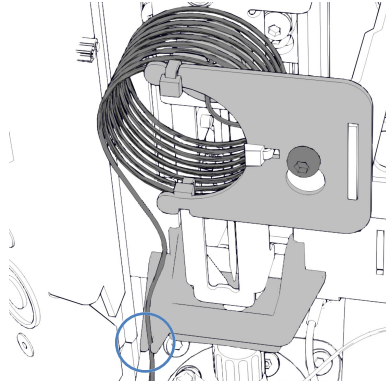


Figure 143: Aligning the sample loop unit to the screw

7. Guide the capillary to the injection valve into the insulation cover mounting bracket.



*Figure 144: Guiding the capillary through the insulation cover mounting bracket*

8. Complete the replacement procedure. See [Completing the Sample Loop Replacement](#) (▶ page 236).

## 7.8.4 Completing the Sample Loop Replacement

After installation of the sample loop, proceed as follows:

1. Unlock the needle unit.
2. Check that the sample loop moves freely when pushing the needle unit into the sample compartment.  
If the sample loop gets stuck on the interior panel, remove and reinstall the sample loop following the steps in this section. Make sure that the sample loop is aligned correctly and connector with capillary points to 6 o'clock.
3. Mount the insulation cover.
4. Turn on the autosampler with its main power switch. The autosampler performs a self-test. The needle initializes and adjusts its position.
5. Run the script: **Change Sample Loop** to enable the specific sample loop volume in the chromatography data system.  
If required, set the **Nominal Loop Volume** parameter manually for the installed sample loop. Observe the volumes that are specified on the sample loop label.

Description	Nominal Loop Volume	Total Loop Volume
Sample Loop, 10 µL	10 µL	23 µL
Sample Loop, 25 µL	25 µL	50 µL
Sample Loop, 100 µL	100 µL	130 µL

6. Prepare the autosampler for operation. See [Preparing the System for Operation](#) (▶ page 155).



## 7.9 Needle Unit Maintenance

### 7.9.1 Components of Needle Unit and Needle Seat

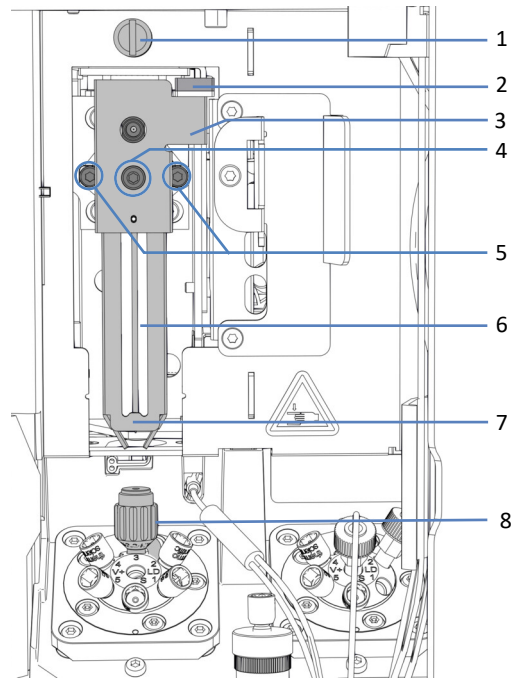


Figure 145: Needle unit components and needle seat

No.	Description
1	Shipping lock screw
2	Lock for the vial pusher
3	Positioning sheet on the pusher of the needle unit
4	Attachment screw for vial pusher
5	Screws attaching the needle unit to the needle carriage
6	Needle
7	Vial pusher
8	Needle seat

## 7.9.2 Securing the Needle Unit

### When

Before maintenance procedures or for transport

### NOTICE

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

### Tools required

Slotted screwdriver (optional)

### Preparations

Remove the insulation cover. See [Removing the Insulation Cover](#) (► page 94).

### Driving the Needle Unit into Service Position

Press the **SERVICE** button on the keypad one time to move the needle unit upward from the needle seat into first service position.

### Tightening the Shipping Lock Screw

Above the needle unit, tighten the shipping lock screw with your fingers until you cannot turn it further. The use of a slotted screwdriver may facilitate turning the screw.

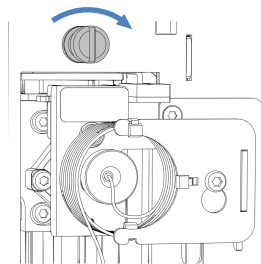


Figure 146: Tightening the shipping lock screw

### 7.9.3 Unlocking the Needle Unit

#### Tools required

Slotted screwdriver (optional)

#### Loosening the Shipping Lock Screw

##### NOTICE

If the shipping lock screw is not properly loosened, the autosampler may not work properly or get damaged. Always ensure that the shipping lock screw is completely loosened before you turn on the autosampler.

Loosen the shipping lock screw above the needle unit: Turn the captive screw counterclockwise with your fingers until it hangs loosely in its spring. The use of a slotted screwdriver may facilitate turning the screw.

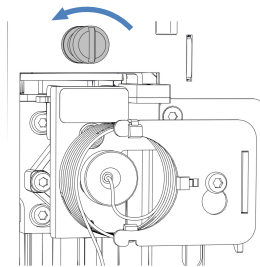


Figure 147: Loosening the shipping lock screw

#### Checking the Needle Unit

As required:

Autosampler state	Actions
Autosampler was turned off during the maintenance procedure	Check that the needle unit can be moved freely: Push the needle unit along the horizontal needle drive into the sample compartment. See image below. If the needle unit moves easily, the shipping lock screw is loosened properly.
Autosampler remained turned on during the maintenance procedure	Press the <b>SERVICE</b> button to move the needle unit into the compartment.

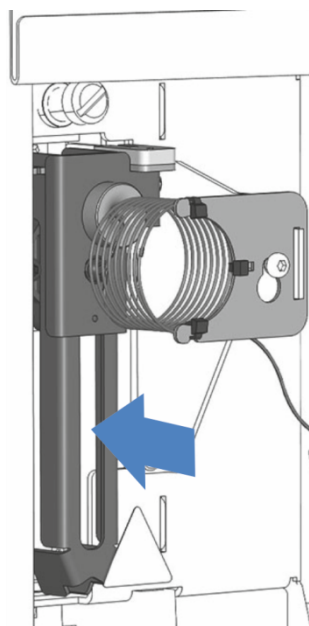


Figure 148: Moving the needle unit (autosampler turned off)

*Restarting the Needle Unit after Service Position*

As required:

Autosampler state	Actions
Autosampler was turned off during the maintenance procedure	Upon turning on power to the autosampler, the needle unit initializes automatically.
Autosampler remained turned on during the maintenance procedure	Depending on which service position was used before: <ol style="list-style-type: none"> <li>1. Press the <b>SERVICE</b> button on the keypad and wait until the needle is in the first service position (needle up).</li> <li>2. Press the <b>SERVICE</b> button again and wait until the needle is in the second service position (needle over wash port).</li> <li>3. Press the <b>SERVICE</b> button a third time to initialize the needle unit after the service position. During needle movement check visually that the sample loop can move freely.</li> </ol>

## 7.9.4 Replacing Needle Seat and Needle Unit

### When

Depending on the type of issue it might be required to replace needle seat and needle unit together or separately.

When	Remedial Action
Needle seat is clogged	<ol style="list-style-type: none"> <li>1. Replace needle seat, refer to <a href="#">Replacing Needle Seat</a> (▶ page 242).</li> <li>2. Check needle unit for damages.</li> </ol>
Needle seat is leaking	<ol style="list-style-type: none"> <li>1. Tighten the needle seat with the torque screwdriver with needle seat bit. Also refer to <a href="#">Inspecting the Autosampler Valves for Leakage</a> (▶ page 283). If the needle seat is still leaking: Replace needle seat and needle unit together.</li> <li>2. Replace needle seat, refer to <a href="#">Replacing Needle Seat</a> (▶ page 242).</li> <li>3. Replace needle unit, refer to <a href="#">Replacing Needle Unit</a> (▶ page 244).</li> </ol>
Needle is damaged	Replace needle seat and needle unit together: <ol style="list-style-type: none"> <li>1. Replace needle seat, refer to <a href="#">Replacing Needle Seat</a> (▶ page 242).</li> <li>2. Replace needle unit, refer to <a href="#">Replacing Needle Unit</a> (▶ page 244).</li> </ol>

### Parts required

- Needle unit
- Needle seat

### Tools required

- Screwdriver, Torx T10
- Torque screwdriver with needle seat bit

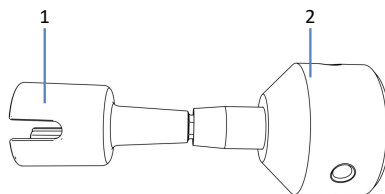


Figure 149: Tool to tighten the needle seat

No.	Description
1	Needle seat bit
2	Base part of the torque screwdriver

### 7.9.4.1 Replacing Needle Seat

Follow these steps

1. Press the **SERVICE** button two times to set the needle in the second service position over the wash port.
2. Turn off the autosampler with its main power switch.
3. Remove insulation cover.
4. Remove the capillary from the insulation cover mounting bracket.
5. Squeeze the insulation cover mounting bracket and push it upward to remove it.

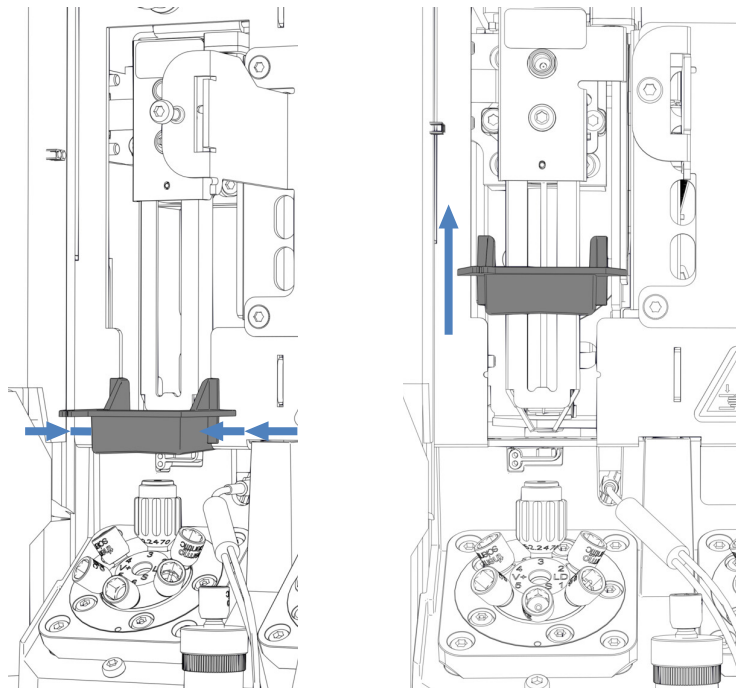


Figure 150: Removing the insulation cover mounting bracket

**NOTICE—The torque screwdriver with needle seat bit can get damaged if not used correctly.**

- Insert the needle seat bit completely into the torque screwdriver.
- Insert the torque screwdriver with needle seat bit straight on the needle seat.
- Never push or pull the tool with unnecessary force.

6. Insert the needle seat bit into the torque screwdriver.
7. Position the torque screwdriver with needle seat bit at the needle seat.

- Turn the tool counterclockwise to remove the needle seat.

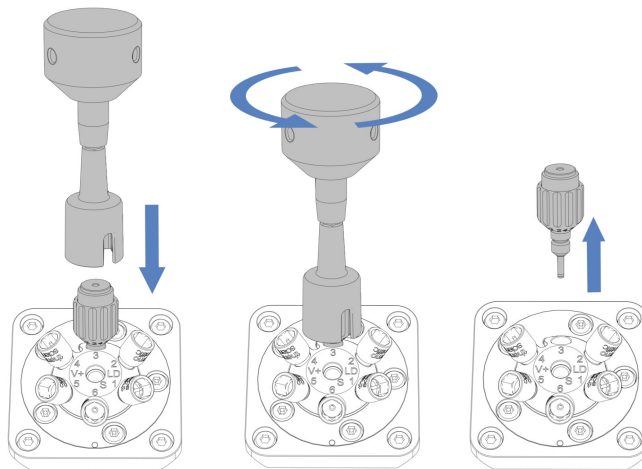


Figure 151: Removing the needle seat with the torque screwdriver

- Unpack the replacement needle seat.
- Insert the needle seat and turn it clockwise with your fingers until it is hand-tight.

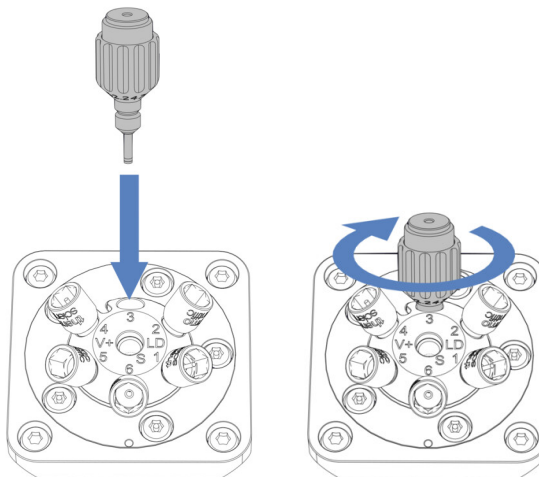


Figure 152: Inserting the needle seat

- Use the torque screwdriver with needle seat bit and turn it clockwise to tighten the needle seat until the torque limitation has been reached, which is indicated by a clicking sound.

**NOTICE—Needle seat can get damaged when using other tools**

The torque screwdriver with needle seat bit is intended for tightening the needle seat. With the help of this tool the needle seat is tightened correctly and will not be overtightened. Do not use any other tool.

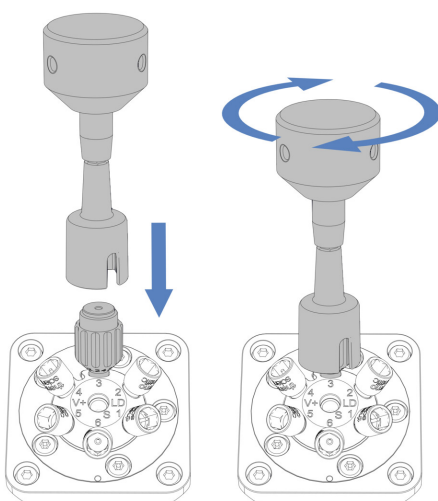


Figure 153: Tightening the needle seat

- Depending on the issue, continue with steps in section [Replacing Needle Unit](#) (▶ page 244) or [Completing the Needle Seat and Needle Unit Replacement](#) (▶ page 247).

#### 7.9.4.2 Replacing Needle Unit

**TIP** A damaged needle unit also causes a damaged needle seat. For this reason, it is recommended to replace the needle seat together with the needle unit.

Follow these steps

- Remove the sample loop. Follow the corresponding removal steps in section [Removing the Sample Loop](#) (▶ page 233). The connection to the injection valve can remain connected.
- Move the needle unit slightly to the front by hand.
- Secure the needle unit.



- Loosen the two screws that attach the needle unit to the needle carriage with the screwdriver.

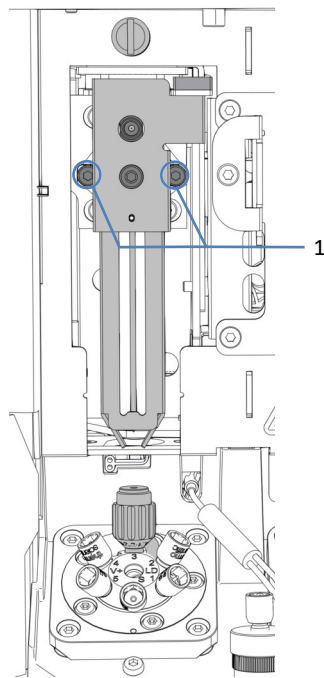


Figure 154: Unscrewing the needle unit

No.	Description
1	Screws attaching the needle unit to the needle carriage

- Pull the needle unit slightly to the front and remove it from the needle carriage.

**NOTICE—The opening for the positioning sheet is sensitive to dust and debris.**

Prevent any dust and debris from entering the interior of the autosampler.

**NOTICE—Needle in the needle unit is not fixed.**

- Remove the needle unit carefully after unscrewing.
- Handle the replacement needle unit with care.

- Unpack the replacement needle unit.
- Remove the protection tube from the needle.

8. Position the replacement needle unit on the needle carriage. Observe the following:
  - ◆ The protruding edge on the rear of the needle unit must fit properly in the opening on the needle carriage (see image).
  - ◆ The ridge on the rear side of the needle unit must match the recess on the needle carriage.

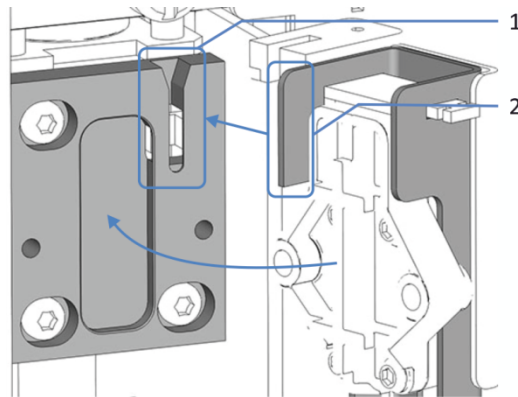


Figure 155: Installing the needle unit to the needle carriage

No.	Description
1	Opening on the needle carriage
2	Protruding edge on the needle unit

9. Attach and tighten the two screws on the needle unit.
10. Check if the lock and the vial pusher move upward easily.

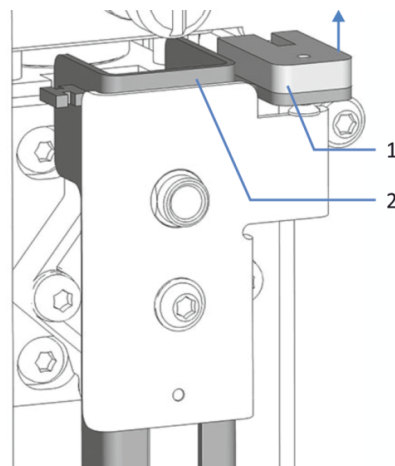


Figure 156: Moving lock for vial pusher upward

No.	Description
1	Lock for the vial pusher
2	Vial pusher

11. Unlock the needle unit.
12. Move the needle unit slightly backwards above the wash port.
13. Continue with steps in section [Completing the Needle Seat and Needle Unit Replacement](#) (▶ page 247).

### 7.9.4.3 Completing the Needle Seat and Needle Unit Replacement

1. Reinstall the insulation cover mounting bracket by pushing it into the guide rails until it snaps into place.

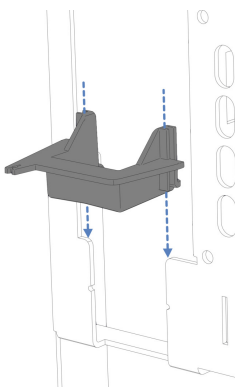


Figure 157: Installing the insulation cover mounting bracket

2. Move the needle unit slightly to the front by hand.
3. Secure the needle unit.
4. If removed before: Reinstall the sample loop. Follow the corresponding installation steps in section [Installing the Sample Loop](#) (▶ page 234).
5. Guide the capillary from sample loop to the injection valve through the insulation cover mounting bracket.
6. Unlock the needle unit.
7. Remount insulation cover.
8. Restart the autosampler with its main power switch. The autosampler performs a self-test. The needle initializes and adjusts its position.
9. Depending on the replacement:  
Set the corresponding parameters in the chromatography data system e.g. **NeedleChanged** and **NeedleSeatChanged**.

## 7.10 Metering Device Head Maintenance

### 7.10.1 Components of the Metering Device Head

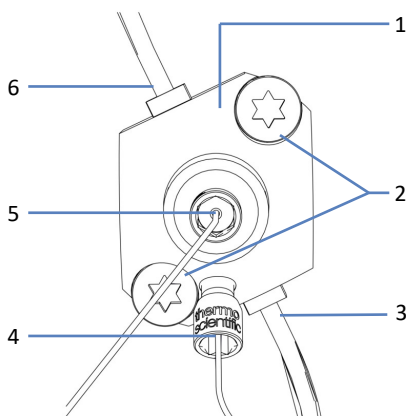


Figure 158: Metering device head overview

No.	Description
1	Metering device head
2	Attachment screws
3	Seal wash outlet
4	Capillary to pressure sensor
5	Capillary to injection valve
6	Seal wash inlet

### 7.10.2 Disconnecting and Connecting Metering Device Head Capillaries

1. Prepare the autosampler for maintenance:
  - ◆ Turn off the pump flow. Wait until the system pressure is down to zero before you continue the shutdown of the autosampler.
  - ◆ To empty the drain pump, leave the drain pump turned on until no condensing water is present in the waste tubing. After that, turn off the drain pump and remove the peristaltic tubing from the drain pump. Any liquid that is present in the drain pump tubing flows off to waste.
  - ◆ Move the needle into service position and secure the needle unit. See [Securing the Needle Unit](#) (▶ page 238).

*Disconnecting Metering Device Head Capillaries*

1. Disconnect the injection valve capillary from the front port of the metering device head.
2. Disconnect the pressure sensor capillary from the bottom port of the metering device head.
3. If capillaries are to be reinstalled, protect the open ends of the capillaries with caps.

*Connecting Metering Device Head Capillaries*

1. Connect the injection valve capillary to the front port of the metering device head.
2. Connect the pressure sensor capillary to the bottom port of the metering device head.  
To enable easier access, the pressures sensor fixing screw can be loosened and retightened.
3. Complete the autosampler maintenance:
  - ◆ Unlock the needle unit. See [Unlocking the Needle Unit](#) (▶ page 239).
  - ◆ Restart the autosampler.
  - ◆ Prepare the autosampler for operation. See [Preparing the System for Operation](#) (▶ page 155).

**7.10.3 Replacing the Metering Device Head***When*

Damage of a metering device head

*Parts required*

Replacement metering device head

*Tools required*

- Screwdriver, Torx T30
- Tweezers (optional)

### Preparations

1. Run the script: **Replace Metering Device Head** to undock the metering device head.
2. Prepare the autosampler for maintenance:
  - ◆ Turn off the pump flow. Wait until the system pressure is down to zero before you continue the shutdown of the autosampler.
  - ◆ To empty the drain pump, leave the drain pump turned on until no condensing water is present in the waste tubing. After that, turn off the drain pump and remove the peristaltic tubing from the drain pump. Any liquid that is present in the drain pump tubing flows off to waste.
  - ◆ Move the needle into service position and secure the needle unit. See [Securing the Needle Unit](#) (▶ page 238).
3. Empty the seal wash system:
  - a) Unscrew the cap of the seal wash reservoir.
  - b) Together with the cap, remove the seal wash line from the seal wash reservoir.
  - c) To empty the seal wash line, lift up the lever of the seal wash pump. Release the lever when the line is empty.
4. Disconnect the capillaries from the metering device head. See [Disconnecting and Connecting Metering Device Head Capillaries](#) (▶ page 248).
5. Disconnect the seal wash lines from the metering device head. To facilitate the removal, disconnect the tubing connectors with the lines connected from the metering device head and use tweezers.

### Removing the Metering Device Head

1. Loosen the two screws that attach the metering device head to the autosampler with the screwdriver.
2. Remove the metering device head:
  - a) Take the metering device head by its front. Carefully move the metering device head to the left and the right a few times to detach the piston from the metering device.
  - b) Check that the metering device head stands out by approximately 5 mm from the front panel of the autosampler.
  - c) Carefully push the front of the metering device head downward and pull the metering device head away from the front panel.
  - d) Check that the metering device head is removed with the piston.

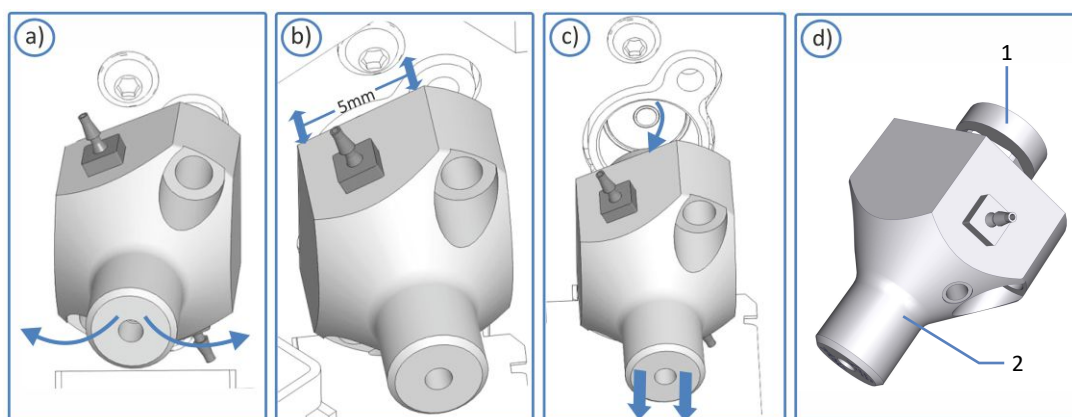


Figure 159: Detaching the metering device head

No.	Description
1	Piston
2	Metering device head

**TIP** If the piston is stuck in the metering device, remove the piston first before you continue with the replacement procedure.

### Installing the Metering Device Head

1. Unpack the replacement metering device head. Leave the fitting plugs installed and the seal wash lines interconnected on the replacement metering device head.
2. Insert the metering device head in the opening in the front panel.
3. Tighten the two screws on the metering device head with the screwdriver (Torx T30) until they cannot be turned further.

4. Remove the fitting plugs from the metering device head.
5. Disconnect the interconnected seal wash lines from the interconnecting tubing connector. The seal wash lines can remain connected to the metering device head.
6. Connect the seal wash lines of the new metering device head in the seal wash system. Follow the corresponding installation steps for the seal wash lines to install in [Replacing the Seal Wash Lines](#)
7. Connect the capillaries on the metering device head. See [Disconnecting and Connecting Metering Device Head Capillaries](#) (▶ page 248).
8. Complete the autosampler maintenance:
  - ◆ Unlock the needle unit. See [Unlocking the Needle Unit](#) (▶ page 239).
  - ◆ Restart the autosampler.
  - ◆ Prepare the autosampler for operation. See [Preparing the System for Operation](#) (▶ page 155).
9. Run the script: **Replace Metering Device Head**. The autosampler prepares the metering device head for operation.
10. Test the seal wash system for leakage. See [Testing the Seal Wash System for Leakage](#) (▶ page 266).
11. Turn the pump off and on again to flush the seal wash system.



## 7.11 Drain Pump Maintenance

The drain pump (peristaltic pump) removes any condensation from the sample compartment that may occur during sample cooling and drains it through a separate drain port to waste.

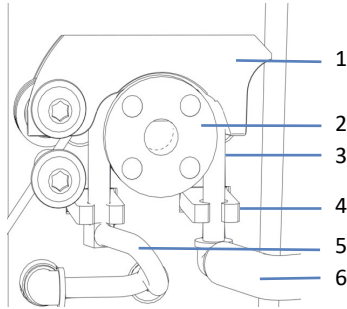


Figure 160: Drain pump

No.	Description
1	Pump lever
2	Drain pump rotor
3	Peristaltic tubing
4	Tubing holder
5	Condensation tubing to sample compartment
6	Waste tubing to drain port

### 7.11.1 Testing the Drain Pump Tubing

Test the drain pump tubing for blockage and leakage.

*When*

At regular intervals

*Parts required*

Syringe (12 mL)

*Preparations*

1. Turn off the drain pump.
2. Draw air into the syringe.

3. Disconnect the waste tubing and the elbow tubing connector from the peristaltic tubing.

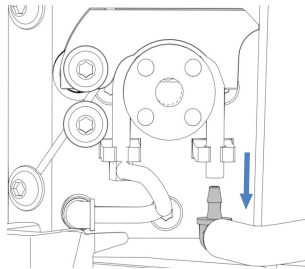


Figure 161: Disconnecting the waste tubing and elbow tubing connector

4. Insert the syringe into the open end of the peristaltic tubing.
5. To allow the air to travel easily through the drain pump tubes, push the pump lever on the drain pump upward, and hold it in that position with one hand.

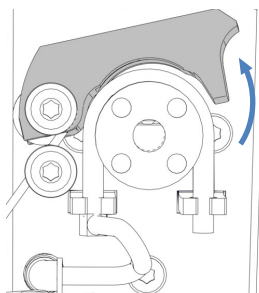


Figure 162: Pushing the drain pump lever upward

#### Testing for Blockage

1. Push the syringe plunger to push the air into the tubing.
2. Observe if a resistance of the plunger is present when pushing the syringe plunger:

Observation	Steps
Resistance is present	The peristaltic tubing may be blocked. Remove the syringe and replace the peristaltic tubing (see <a href="#">Replacing the Drain Pump Tubing</a> (▶ page 255)).
No resistance is present	Test for leakage.

### Testing for Leakage

1. Draw air into the syringe.
2. Disconnect the condensation tubing and the elbow tubing connector from the peristaltic tubing.

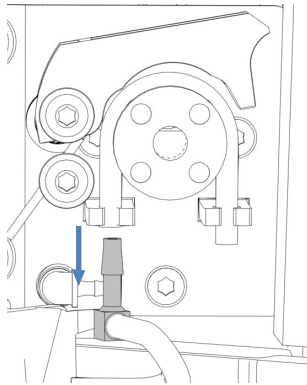


Figure 163: Disconnecting the condensation tubing and elbow tubing connector

3. Close one end of the peristaltic tubing with a finger.
4. Push the syringe plunger to push the air into the tubing.
5. Observe if a pressure builds up when pushing the syringe plunger:

Observation	Steps
No pressure is present	The peristaltic tubing may be leaking or damaged. Remove the syringe and replace the peristaltic tubing (see <a href="#">Replacing the Drain Pump Tubing</a> (▶ page 255)).
Pressure is present	Remove the syringe and reconnect the elbow tubing connectors, the condensation tubing and waste tubing. Release the pump lever.

## 7.11.2 Replacing the Drain Pump Tubing

### When

- Every six months as preventive maintenance for the drain pump
- Drain pump tubing is blocked (see [Testing the Drain Pump Tubing](#) (▶ page 253))
- Drain pump tubing is leaking or damaged (see [Testing the Drain Pump Tubing](#) (▶ page 253))

*Parts required*

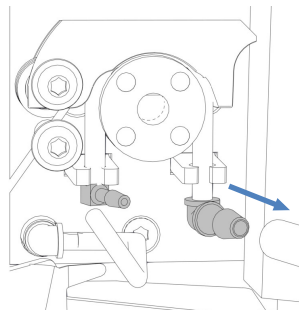
- Replacement peristaltic tubing for the drain pump
- 2 elbow tubing connectors for condensation tubing and waste tubing

*Tools required*

Tubing cutter (optional)

*Preparations*

1. Turn off the drain pump.
2. Disconnect the waste tubing and the condensation tubing from the tubing connectors on the drain pump tubing (peristaltic tubing). Leave the tubing connectors connected to the peristaltic tubing.

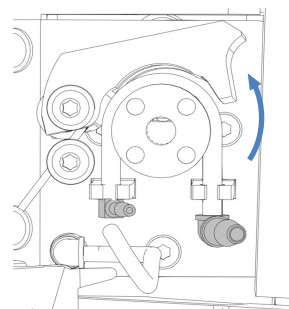


*Figure 164: Disconnecting the waste tubing and the condensation tubing*

3. Unpack the replacement peristaltic tubing and the elbow tubing connectors.
4. Connect the elbow tubing connectors to both ends of the replacement peristaltic tubing.

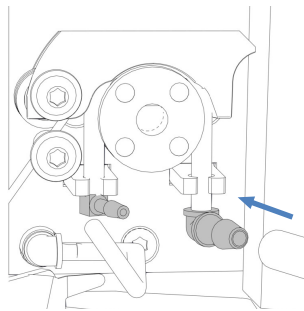
*Follow these steps*

1. Push the pump lever on the drain pump upward, and hold it in this position with one hand.



*Figure 165: Pushing the pump lever upward*

2. With your other hand, unwind the installed peristaltic tubing from the drain pump rotor and remove the peristaltic tubing from the drain pump. Release the pump lever.
3. Check that the replacement peristaltic tubing has the same length as the installed tubing. If required, cut the replacement peristaltic tubing to length with the tubing cutter.
4. Push the replacement peristaltic tubing into the tubing holders. Check that the tubing is properly inserted in the holders.
5. Push the pump lever on the drain pump upward. Insert the replacement peristaltic tubing between the pump lever and drain pump rotor and wind it around the rotor.
6. Release the pump lever.
7. Connect the waste tubing and the condensation tubing to the tubing connectors on the peristaltic tubing.



*Figure 166: Connecting the waste tubing and the condensation tubing*

8. Turn on the drain pump to check proper functionality.

## 7.12 Needle Wash System Maintenance

For an overview of all wash lines refer to [Needle Wash System \(Overview\)](#) (▶ page 55).

### 7.12.1 Replacing Wash Lines from Reservoir to Needle Wash Pump Inlet

Follow the steps below to replace the two wash lines between the needle wash reservoirs and the needle wash pump inlet ports of the autosampler.

#### *When*

Wash line is clogged or damaged

#### *Parts and additional items required*

- Fresh needle wash liquid
- Replacement wash lines labeled with **SWP (red)** and **WWP (green)**

#### *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 needle wash liquid.
2. Empty the washing system for the outside of the needle:
  - a) Unscrew the caps of the needle wash reservoirs.
  - b) Together with the cap, remove the wash lines (labeled WWP and SWP) from the reservoir.
  - c) When removing the lines from the tubing guides, be careful not to pull on other tubing in the guides.
  - d) Place the wash lines in a waste reservoir to empty them.

Follow these steps

1. Remove the retaining guide from the wash lines.
2. Pull the lines out of the reservoir caps.
3. Disconnect the wash lines from the needle wash inlet ports on the needle wash pump.

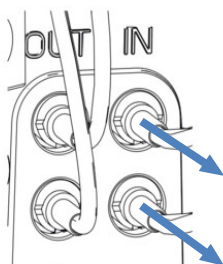


Figure 167: Disconnecting the wash lines from the needle wash pump inlet

4. Connect the replacement wash lines to the needle wash pump inlet ports:
  - a) Push the rigid tube into the connector.
  - b) Push the silicon tube over the connector.
5. Route the wash lines from the autosampler to the solvent rack, through the tubing guides in the autosampler and all modules above the autosampler in the system stack.
6. Route the wash lines through the guide hole in the solvent rack and push them into one or more of the tubing guides.

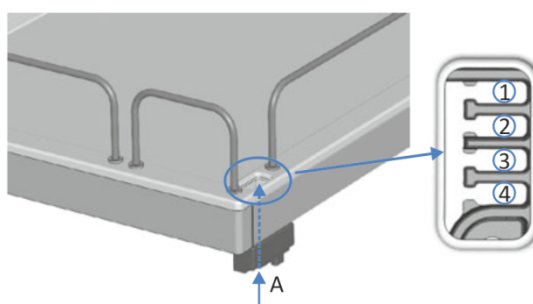


Figure 168: Guide hole and tubing guides in the solvent rack

No.	Description
A	Guide hole (solvent rack)
1-4	Tubing guides

7. Feed each wash line through a retaining guide.
8. Feed each wash line through an open hole in a cap for a reservoir. The retaining guide keeps the solvent line in place in the reservoir.
9. Close any open holes in the reservoir caps with the cap plugs.
10. Slide a filter holder with adapter onto each wash line.
11. Fill the needle wash reservoirs with fresh needle wash liquid and restart the needle wash system. For details, see [Filling the Needle Wash Reservoirs](#) (▶ page 127).

### 7.12.2 Replacing Wash Line from Needle Wash Pump Outlet to Wash Port

Follow the steps below to replace the wash line between the needle wash pump outlet ports and the needle wash port.

#### *When*

Wash Line is clogged or damaged

#### *Parts and additional items required*

- Fresh needle wash liquid
- Replacement wash line

#### *Preparations*

1. Prepare fresh needle wash liquid.
2. Empty the washing system for the outside of the needle:
  - a) Unscrew the caps of the needle wash reservoirs.
  - b) Together with the cap, remove the wash lines (labeled WWP and SWP) from the reservoir.
  - c) When removing the lines from the tubing guides, be careful not to pull on other tubing in the guides.
  - d) Place the wash lines in a waste reservoir to empty them.



Follow these steps

1. Disconnect the two ends of the wash line from the needle wash pump outlet ports.

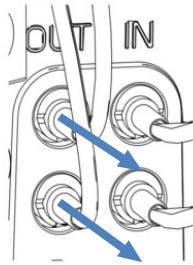


Figure 169: Disconnecting the wash lines from the needle wash pump outlet

2. Disconnect the wash line from the wash port inlet.

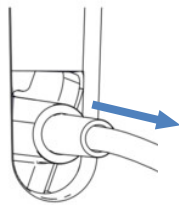


Figure 170: Disconnecting the wash line from the wash port

3. Connect the replacement wash line to the needle wash pump outlet ports and the wash port inlet.
4. Fill the needle wash reservoirs with fresh needle wash liquid and restart the needle wash system. For details, see [Filling the Needle Wash Reservoirs](#) (▶ page 127).

### 7.12.3 Replacing Wash Lines from Reservoir to Degasser Inlet Ports

Follow the steps below to replace the two wash lines between the needle wash reservoirs and the inlet port of the degasser in the pump.

*When*

Wash line from reservoir to degasser is clogged or damaged

*Parts and additional items required*

- Fresh needle wash liquid
- Replacement wash lines labeled W (green) and S (red)

*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 needle wash liquid.
2. Empty the needle wash system:
  - a) Unscrew the caps of the needle wash reservoirs.
  - b) Together with the cap, remove the wash lines (labeled W and S) from the reservoirs.
  - c) Place the wash lines in a waste reservoir to empty them.

*Follow these steps*

1. Remove the retaining guide from the wash lines.
2. Pull the lines out of the reservoir caps.
3. Disconnect the wash lines from the degasser of the pump.
4. Connect the replacement wash lines to the pump degasser inlet ports.

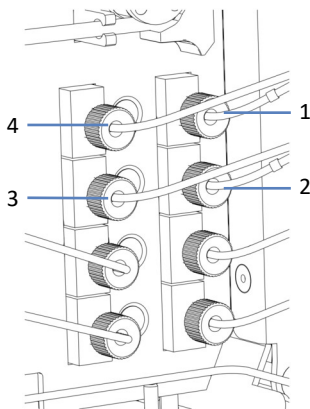


Figure 171: Pump degasser inlet and outlet ports

No.	Description
1	Inlet for wash line labeled <b>W</b> (green) to reservoir
2	Inlet for wash line labeled <b>S</b> (red) to reservoir
3	Outlet for wash line labeled <b>S</b> (red) to autosampler
4	Outlet for wash line labeled <b>W</b> (green) to autosampler

5. Route the wash lines from the autosampler to the solvent rack, through the tubing guides in the autosampler and all modules above the autosampler in the system stack.
6. Route the wash lines through the guide hole in the solvent rack and push them into one or more of the tubing guides.

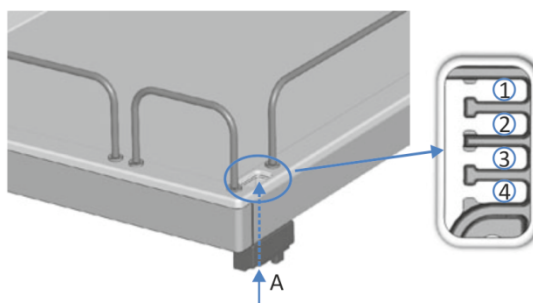


Figure 172: Guide hole and tubing guides in the solvent rack

No.	Description
A	Guide hole (solvent rack)
1-4	Tubing guides

7. Feed each wash line through a retaining guide.
8. Feed each wash line through an open hole in a cap for a reservoir. The retaining guide keeps the solvent line in place in the reservoir.
9. Close any open holes in the reservoir caps with the cap plugs.
10. Slide a filter holder with adapter onto each wash line.
11. Fill the needle wash reservoirs with fresh needle wash liquid and restart the needle wash system. For details, see [Filling the Needle Wash Reservoirs](#) (▶ page 127).

### 7.12.4 Replacing Wash Lines from Degasser Outlet Port to the Selector Valve

Follow the steps below to replace the two wash lines between the outlet port of the degasser of the pump and the needle wash inlet ports of the selector valve of the autosampler.

#### *When*

Wash line is clogged or damaged

#### *Parts and additional items required*

- Fresh needle wash liquid
- Replacement wash lines

#### *Preparations*

1. Prepare fresh needle wash liquid.
2. Empty the needle wash system:
  - a) Unscrew the caps of the needle wash reservoirs.
  - b) Together with the cap, remove the wash lines (labeled W and S) from the reservoirs.
  - c) Place the wash lines in a waste reservoir to empty them.

#### *Follow these steps*

1. Remove the retaining guide from the wash lines.
2. Disconnect the wash lines out of the selector valve of the autosampler.
3. Disconnect the lines from the degasser outlet port of the pump.
4. Connect the replacement wash lines to the degasser outlet ports:
5. Connect the needle wash lines to the selector valve of the autosampler.
6. Fill the needle wash reservoirs with fresh needle wash liquid and restart the needle wash system. For details, see [Filling the Needle Wash Reservoirs](#) (▶ page 127).

#### **See also**

 [Needle Wash System \(Overview\)](#) (▶ page 55)

### 7.12.5 Replacing the Needle Wash Check Valve

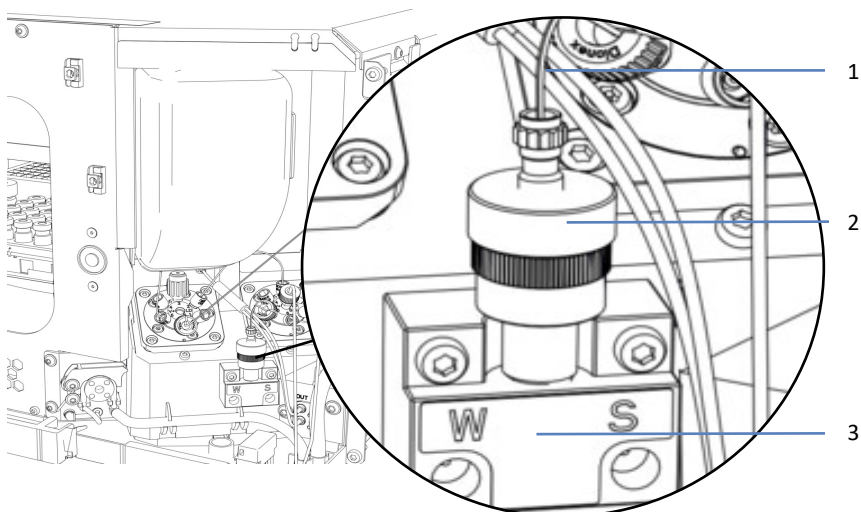


Figure 173: Selector valve with check valve

No.	Description
1	Viper capillary to solvent valve
2	Check valve for needle wash
3	Selector valve for needle wash

#### When

Check valve is defective

#### Parts required

Replacement check valve

#### Follow these steps

1. Loosen the Viper fitting on the check valve and disconnect the Viper capillary from the solvent valve.
2. Unscrew the check valve from the selector valve.
3. Install the replacement check valve.
4. Connect the Viper capillary to the solvent valve. Tighten the connection.
5. Purge the sampler.

#### See also

- 📄 [Port Assignments of the Autosampler Valves](#) (► page 45)
- 📄 [Purging \(Overview\)](#) (► page 62)

## 7.13 Seal Wash System Maintenance

This section describes how to maintain and replace parts of the seal wash system. Follow the instructions for the maintenance procedure that you want to perform.

### 7.13.1 Testing the Seal Wash System for Leakage

#### *When*

- At regular intervals
- When you installed the pump head during maintenance procedures
- After you replaced the metering device head

#### *Items required*

- Syringe (12 mL)
- Seal wash liquid

#### *Follow these steps*

1. Disconnect the tubing from the seal wash detector.

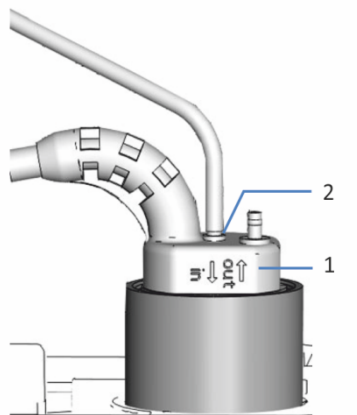


Figure 174: Seal wash detector

No.	Description
1	Seal wash detector
2	Tubing connection port (port labeled in)

2. Insert a syringe into the open end of the tubing.

3. To allow the liquid to travel easily through the seal wash system, lift up the lever of the seal wash pump and hold it in that position with one hand.
4. Pull out the syringe plunger to draw seal wash liquid into the syringe.
5. When about 10 mL of liquid are present in the syringe, release the lever of the seal wash pump.
6. Take the seal wash reservoir line above the metering device head and squeeze the tubing to block it.
7. Slightly press the syringe plunger to apply some pressure to the seal wash system.

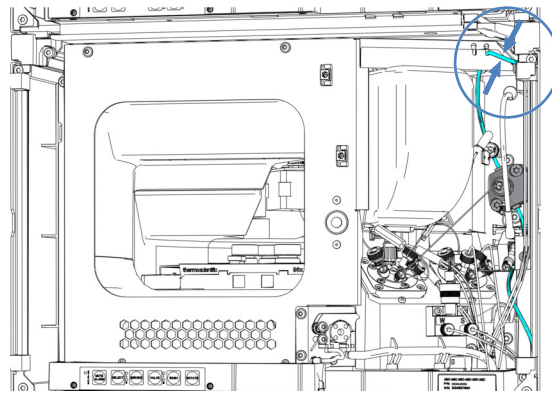


Figure 175: Position where to grab the seal wash reservoir line

8. Check whether liquid escapes from the connections of the seal wash system, under the pump heads or under the metering device head.

Observation	Remedial Action
Leakage is present at a connection	<ol style="list-style-type: none"> <li>1. Tighten or replace leaky connections.</li> <li>2. Repeat the test.</li> </ol>
Leakage is present under the pump heads	<ol style="list-style-type: none"> <li>1. Check that the pump head seals and the seal wash seal are properly installed.</li> <li>2. Repeat the test.</li> </ol>
Leakage is present under the metering device head	<ol style="list-style-type: none"> <li>1. Check that metering device head is installed properly. If leakage is still present, replace the metering device head.</li> <li>2. Repeat the test.</li> </ol>
No leakage is present	Remove the syringe and reconnect the tubing to the seal wash detector (port labeled <b>in</b> ).

#### See also

 [Replacing the Metering Device Head](#) (► page 249)

### 7.13.2 Replacing the Seal Wash Reservoir Line

Follow the steps below to replace the wash line between seal wash reservoir and the seal wash inlet port on the autosampler.

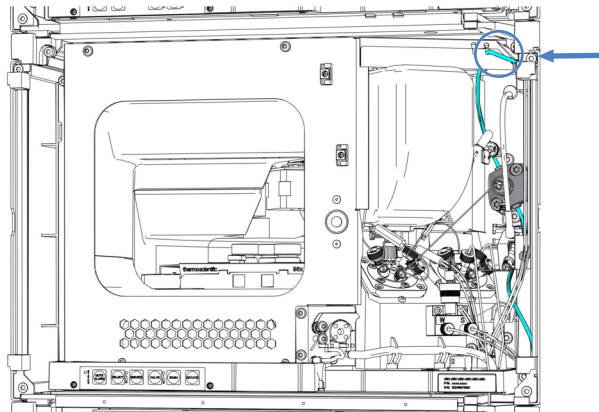


Figure 176: Position of seal wash reservoir line

*When*

Seal wash reservoir line is clogged or damaged

*Parts required*

Silicone tubing and connectors

*Tools required*

Tubing cutter

*Preparations*

1. Empty the seal wash system:
  - a) Unscrew the cap of the seal wash reservoir.
  - b) Together with the cap, remove the seal wash line from the seal wash reservoir.
  - c) To empty the seal wash line, lift up the lever of the seal wash pump. Release the lever when the line is empty.



### Removing the Seal Wash Reservoir Line

1. Pull the seal wash reservoir line with the tubing connector out of the seal wash inlet port.

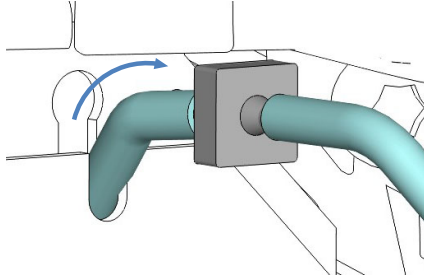


Figure 177: Pulling the tubing connector out of the seal wash inlet port

2. Disconnect the seal wash reservoir line, the tubing connector, and the seal wash inlet line. The seal wash line on the metering device head can remain connected.

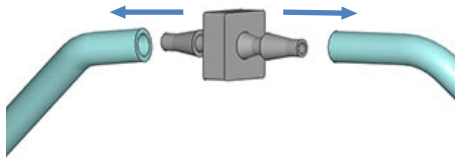


Figure 178: Disconnecting the seal wash reservoir line and seal wash inlet line

3. Disconnect the line from the seal wash reservoir:
  - a) Remove the retaining guide from the wash line.
  - b) Pull the wash line out of the reservoir cap.

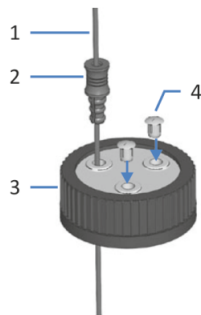


Figure 179: Wash line and reservoir cap

No.	Description
1	Wash line
2	Retaining guide
3	Reservoir cap
4	Cap plugs

### Connecting the New Seal Wash Reservoir Line

1. Cut tubing to required length, if applicable.
2. Connect the seal wash line with a new tubing connector to the seal wash inlet line.
3. Push the tubing connector with the lines into the seal wash inlet port.
4. Route the seal wash line from the autosampler to the solvent rack through the tubing guides in the autosampler and all modules above the autosampler in the system stack.
5. Route the seal wash line through the guide hole in the solvent rack and fix it in one of the tubing guides.

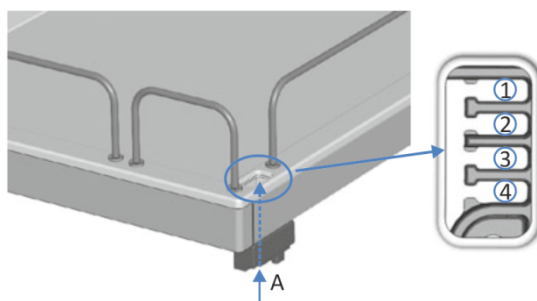


Figure 180: Guide hole and tubing guides in the solvent rack

No.	Description
A	Guide hole (solvent rack)
1-4	Tubing guides

6. Connect the seal wash reservoir to the line:
  - a) Rinse the seal wash reservoir thoroughly with a high-purity solvent.
  - b) Fill the seal wash reservoir with fresh seal wash liquid.
  - c) Feed the seal wash line through the retaining guide and through an open hole in the cap of the seal wash reservoir. The retaining guide keeps the tubing in place in the reservoir. Close any open holes in the reservoir cap with cap plugs.

### Restarting the Seal Wash System

1. Retighten the reservoir cap hand-tight. The retaining guide must remain in the hole in the reservoir cap. If it does not, press the retaining guide into the hole so that the tubing is kept in place in the cap.

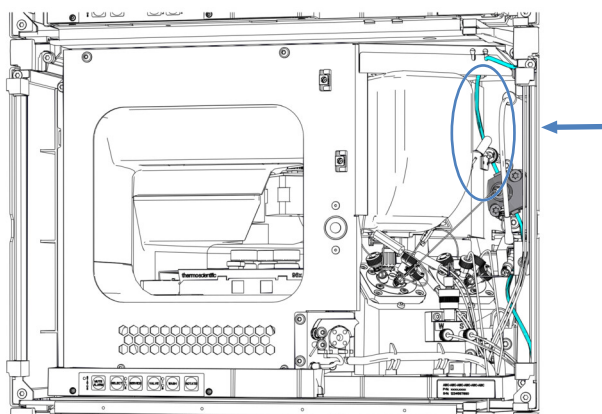
2. Check the wash lines over the entire flow path:
  - a) Make sure that no bending (kink), pinching or squeezing of the wash lines is present at any point in the flow path.
  - b) If you have to cut tubing to length, use a tubing cutter. Make sure that the cut is at right angle to the length of the line.
3. Turn the pump off and on again to flush the seal wash system.

**See also**

 [Seal Wash System \(Overview\)](#) (▶ page 57)

### 7.13.3 Replacing the Seal Wash Inlet Line

Follow the steps below to replace the wash line between seal wash inlet port on the autosampler and the seal wash inlet of the metering device head.



*Figure 181: Position of seal wash inlet line*

*When*

Seal wash inlet line is clogged or damaged

*Parts required*

Silicone tubing and connectors

*Tools required*

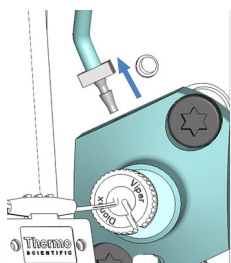
Tubing cutter

*Preparations*

1. Empty the seal wash system:
  - a) Unscrew the cap of the seal wash reservoir.
  - b) Together with the cap, remove the seal wash line from the seal wash reservoir.
  - c) To empty the seal wash line, lift up the lever of the seal wash pump. Release the lever when the line is empty.

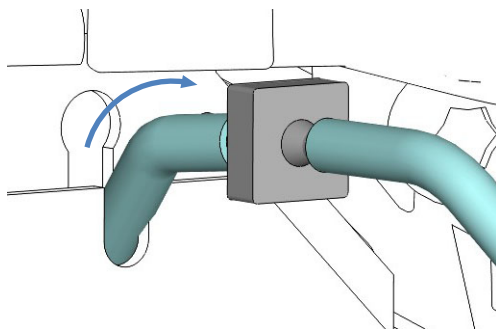
*Follow these steps*

1. Pull the seal wash inlet line with the tubing connector out of the seal wash inlet on top of the metering device head.



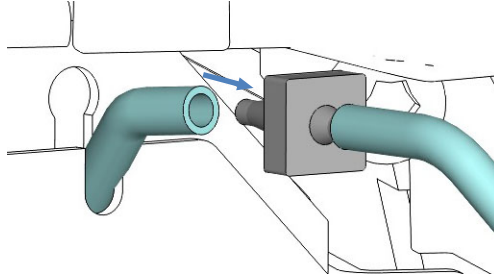
*Figure 182: Disconnecting the seal wash inlet line from the metering device head*

2. Pull the seal wash line with the tubing connector out of the seal wash inlet port.



*Figure 183: Pulling the tubing connector out of the seal wash inlet port*

3. Disconnect the seal wash inlet line from the tubing connector. The seal wash reservoir line on the other side of the tubing connector can remain connected.



*Figure 184: Disconnecting the seal wash inlet line from the seal wash inlet port*

4. Connect the new seal wash line with a new tubing connector to the metering device head. Cut tubing to required length, if applicable.
5. Guide the seal wash inlet line to the seal wash inlet port.
6. Connect the seal wash inlet line to the tubing connector.
7. Push the tubing connector with the lines into the seal wash inlet port.

#### *Restarting the Seal Wash System*

1. Retighten the reservoir cap hand-tight. The retaining guide must remain in the hole in the reservoir cap. If it does not, press the retaining guide into the hole so that the tubing is kept in place in the cap.
2. Check the wash lines over the entire flow path:
  - a) Make sure that no bending (kink), pinching or squeezing of the wash lines is present 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.
3. Turn the pump off and on again to flush the seal wash system.

### 7.13.4 Replacing the Seal Wash Pump Inlet Line

Follow the steps below to replace the wash line between outlet of the metering device head and the inlet of the seal wash pump.

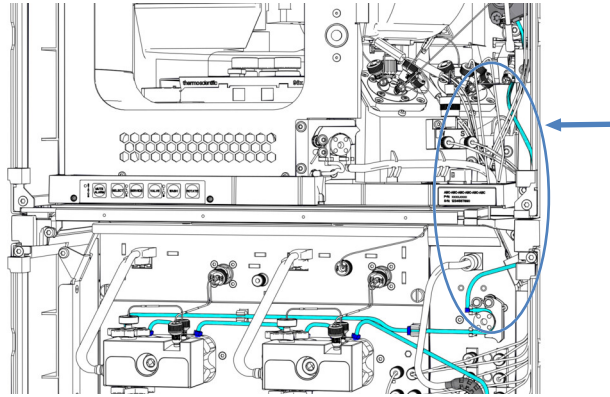


Figure 185: Position of seal wash pump inlet line

*When*

Seal was pump inlet line is clogged or damaged

*Parts required*

Silicone tubing and connectors

*Tools required*

Tubing cutter

*Preparations*

1. Empty the seal wash system:
  - a) Unscrew the cap of the seal wash reservoir.
  - b) Together with the cap, remove the seal wash line from the seal wash reservoir.
  - c) To empty the seal wash line, lift up the lever of the seal wash pump. Release the lever when the line is empty.

Follow these steps

1. Pull the tubing connector with the seal wash pump inlet line out of the seal wash outlet port on the metering device head.

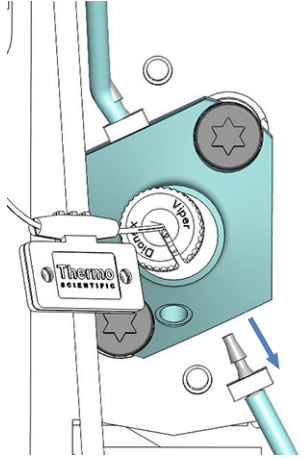


Figure 186: Disconnecting the seal wash pump inlet line from the metering device head

2. Disconnect the seal wash pump inlet line from the peristaltic tubing on the seal wash pump in the pump.

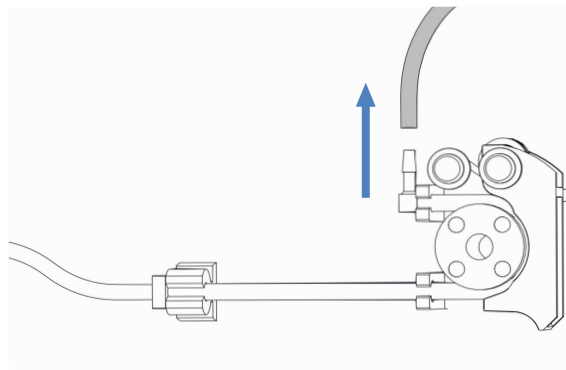


Figure 187: Disconnecting the seal wash pump inlet line

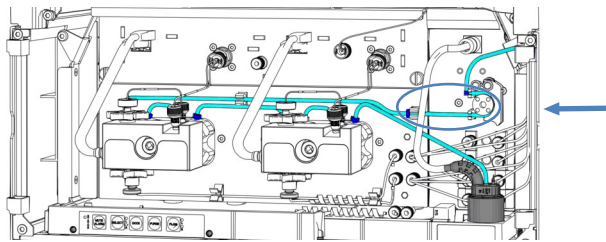
3. Connect a new tubing connector to the new seal wash pump inlet line. Cut tubing to required length, if applicable.
4. Connect the new seal wash pump inlet line to the seal wash outlet on the metering device head.
5. Connect the seal wash pump inlet line to the peristaltic tubing on the seal wash pump.

*Restarting the Seal Wash System*

1. Retighten the reservoir cap hand-tight. The retaining guide must remain in the hole in the reservoir cap. If it does not, press the retaining guide into the hole so that the tubing is kept in place in the cap.
2. Check the wash lines over the entire flow path:
  - a) Make sure that no bending (kink), pinching or squeezing of the wash lines is present 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.
3. Turn the pump off and on again to flush the seal wash system.

**7.13.5 Replacing the Peristaltic Tubing in the Seal Wash Pump**

Follow the steps below to replace the peristaltic tubing in the seal wash pump.



*Figure 188: Position of peristaltic tubing in seal wash pump*

*When*

Tubing is clogged or damaged

*Parts required*

Peristaltic tubing (PharMed™ tubing), tubing connectors and holders

*Tools required*

Tubing cutter

*Preparations*

1. Empty the seal wash system:
  - a) Unscrew the cap of the seal wash reservoir.
  - b) Together with the cap, remove the seal wash line from the seal wash reservoir.
  - c) To empty the seal wash line, lift up the lever of the seal wash pump. Release the lever when the line is empty.



### Replacing the Peristaltic Tubing

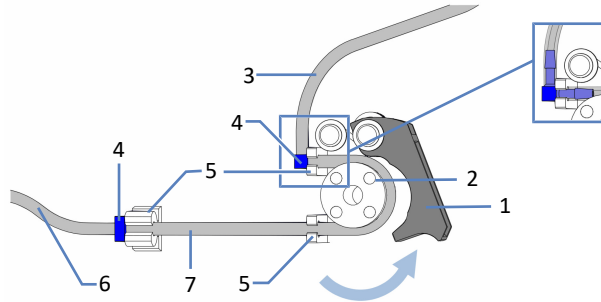


Figure 189: Seal wash pump

No.	Description
1	Pump lever (lifted)
2	Pump rotor
3	Seal wash line from autosampler (silicone tubing)
4	Tubing connectors
5	Tubing holders for peristaltic tubing
6	Seal wash tubing to pump head (silicone tubing)
7	Peristaltic tubing

1. Disconnect the peristaltic tubing from the tubing connectors that connect it to the silicone tubing.
2. Lift up the lever on the seal wash pump, and remove the peristaltic tubing from the pump and from the tubing holders.
3. Connect the new peristaltic tubing to the silicone tubing using the tubing connectors. Cut tubing to required length, if applicable.
4. Insert the peristaltic tubing into the top right tubing holder.
5. Lift up the lever on the seal wash pump and hold it in that position with one hand.
6. With your other hand, insert the tubing between the lever and the rotor and wind it around the rotor.
7. Release the lever.
8. Insert the peristaltic tubing into the bottom right tubing holder.
9. Insert the peristaltic tubing into the left tubing holder.
10. Check that the peristaltic tubing is inserted properly in the tubing holders. If it is not, push the tubing into the holders. Make sure that the tubing is not pinched or squeezed in the holders.

### *Restarting the Seal Wash System*

1. Retighten the reservoir cap hand-tight. The retaining guide must remain in the hole in the reservoir cap. If it does not, press the retaining guide into the hole so that the tubing is kept in place in the cap.
2. Check the wash lines over the entire flow path:
  - a) Make sure that no bending (kink), pinching or squeezing of the wash lines is present 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.
3. Turn the pump off and on again to flush the seal wash system.

### 7.13.6 Replacing the Seal Wash Lines between Seal Wash Pump and Seal Wash Detector

Follow the steps below to replace the wash lines between peristaltic tubing (seal wash pump) and the seal wash detector.

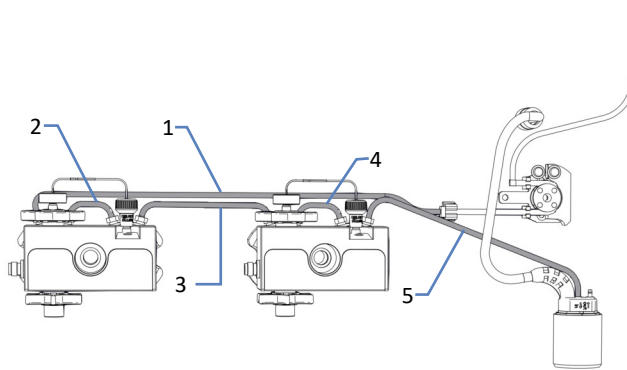


Figure 190: Seal wash lines between peristaltic tubing and seal wash detector

No.	Description
1	Wash line between peristaltic tubing and left pump head
2	Wash line on left pump head
3	Wash line between pump heads
4	Wash line on right pump head
5	Wash line between right pump head and seal wash detector

#### When

Seal wash lines are clogged or damaged

#### Parts required

Silicone tubing

#### Tools required

Tubing cutter

#### Preparations

1. Empty the seal wash system:
  - a) Unscrew the cap of the seal wash reservoir.
  - b) Together with the cap, remove the seal wash line from the seal wash reservoir.
  - c) To empty the seal wash line, lift up the lever of the seal wash pump. Release the lever when the line is empty.

*Follow these steps*

1. Disconnect the seal wash tubing from the tubing connectors. Do not remove the tubing connectors.
2. Connect the new seal wash lines. Cut tubing to required length, if applicable.

*Restarting the Seal Wash System*

1. Retighten the reservoir cap hand-tight. The retaining guide must remain in the hole in the reservoir cap. If it does not, press the retaining guide into the hole so that the tubing is kept in place in the cap.
2. Check the wash lines over the entire flow path:
  - a) Make sure that no bending (kink), pinching or squeezing of the wash lines is present 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.
3. Turn the pump off and on again to flush the seal wash system.

### **7.13.7 Replacing the Seal Wash Detector**

*When*

- Contamination of detector electrodes
- Impaired functionality of the seal wash system

*Parts required*

Seal wash detector assembly, consisting of the detector and funnel

*Preparations*

The seal wash detector and funnel come as an assembled unit. If you have to assemble both parts for any reason, push the detector into the funnel first. Mind the orientation of the funnel.

Follow these steps

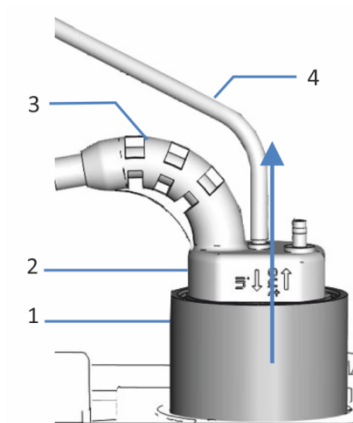


Figure 191: Removing the seal wash detector assembly

No.	Description
1	Funnel, seal wash detector
2	Seal wash detector
3	Detector cable
4	Seal wash line

1. Disconnect the tubing from the seal wash detector (port labeled **in**).
2. Unplug the detector cable from the **DROP DET** port.
3. Grasp and pull the seal wash detector assembly upward by the funnel.
4. Push the new seal wash detector assembly into the pump.

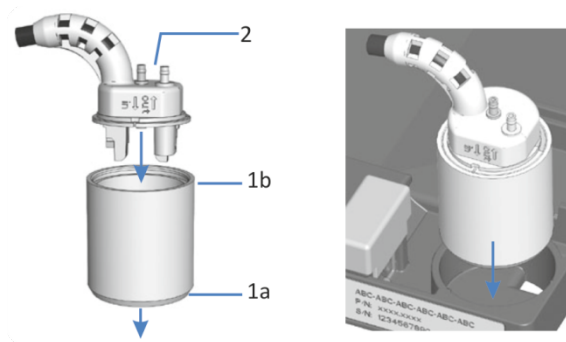


Figure 192: Installing the seal wash detector assembly

No.	Description
1a	Funnel (bottom side)
1b	Funnel (top side)
2	Seal wash detector

5. Reconnect the tubing to the seal wash detector (port labeled **in**).
6. Connect the detector cable to the **DROP DET** port.
7. Turn the pump off and on again to flush the seal wash system.

## 7.14 Inspecting the Autosampler Valves for Leakage

*When*

- Liquid droplets appear at a viper connection
- Liquid droplets appear at the drain hole

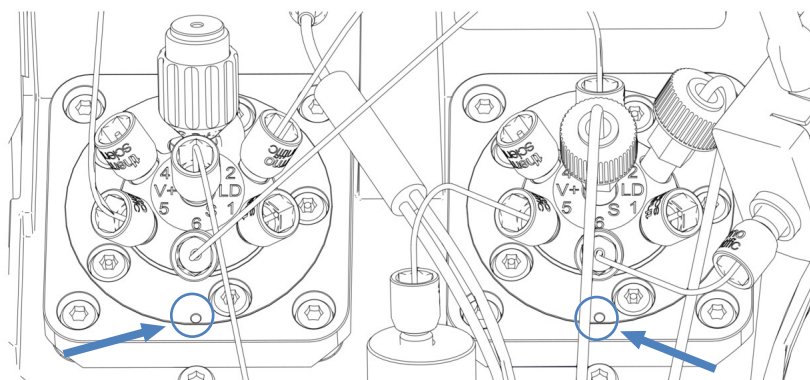


Figure 193: Drain holes at the autosampler valves

*Tools required*

Torque screwdriver with Viper bit and needle seat bit

*Follow these steps*

1. Liquid droplets appear at the drain hole of a valve:  
Wipe the droplet away and observe the valve. If liquid droplets still appear at the drain hole, contact Thermo Fisher Scientific Technical Support. Otherwise continue with next steps.
2. As leakage usually occurs at a connection, visually inspect all connections in the flow path.
3. Loosen the capillary connections at the affected valve and retighten them with the torque screwdriver using the Viper bit.

### NOTICE

- Tighten or loosen Viper capillaries *only* with your fingers and the special torque tool. Do not use tools others than those provided by Thermo Fisher Scientific for this purpose. Use the tool only for the connections for which it is intended.
- To avoid damage to the capillary or connection, tighten and loosen the Viper capillaries *only* when the system pressure is down to zero.

4. If the injection valve with the needle seat is the affected valve:  
Loosen and retighten the needle seat with the torque screwdriver with needle seat bit.

**NOTICE—Needle seat can get damaged when using other tools**

The torque screwdriver with needle seat bit is intended for tightening the needle seat. With the help of this tool the needle seat is tightened correctly and will not be overtightened. Do not use any other tool.

**NOTICE—The torque screwdriver with needle seat bit can get damaged if not used correctly.**

- Insert the needle seat bit completely into the torque screwdriver.
  - Insert the torque screwdriver with needle seat bit straight on the needle seat.
  - Never push or pull the tool with unnecessary force.
5. Tighten all connections in the flow path with the torque screwdriver using the Viper bit.
  6. Run the script: **Test System Tightness (Subject To Test = Sampler)** if the leakage still occurs.
  7. Liquid droplets continue to appear on the injection valve:  
Replace the needle unit and the needle seat. See [Replacing Needle Seat and Needle Unit](#) (▶ page 241).



## 7.15 Column Compartment Maintenance

### 7.15.1 Replacing Columns



#### CAUTION—Hot Columns

Columns inside the device may become hot during operation. Touching hot parts might cause burns.

Allow columns to cool down before starting replacement or maintenance procedures.

#### When

To change between columns

#### Parts required

Column as required by the application

#### Preparations

1. Turn off the pump flow.

#### Follow these steps

1. Remove the capillaries from the column inlet and column outlet.
2. Remove the column that is to be replaced from the column clip. To remove the ring from the bottom part of the column clip, slightly press the ring in the direction of the arrows indicated on the ring and pull it towards you.

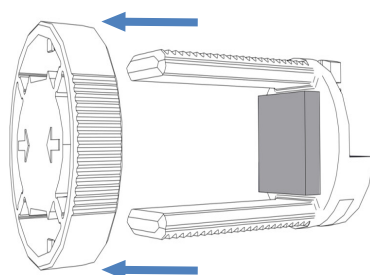


Figure 194: Removing the ring

3. Connect the capillaries to the inlet and outlet of the replacement column.
4. Place the column into the bottom part of the column clip and reinstall the ring.

- Route the capillaries through one of the capillary guides shown in the figure.

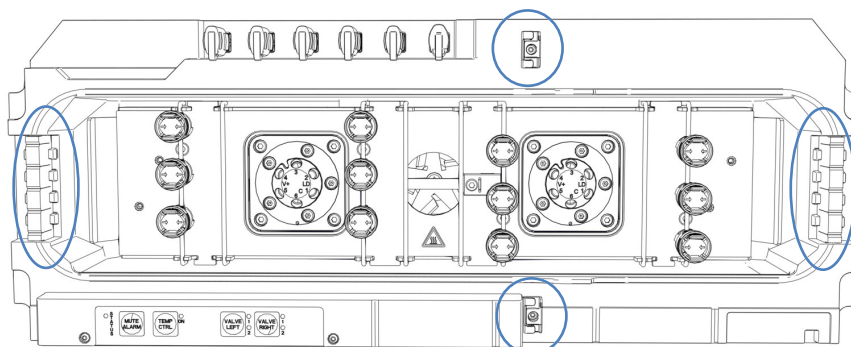


Figure 195: Capillary guides

- To set the column properties, run the script: **Set Column Specifications**.
- Turn on the pump flow.

### 7.15.2 Inspecting the Column Switching Valves for Leakage

The Vanquish valve and the VICI valve each have one drain hole.

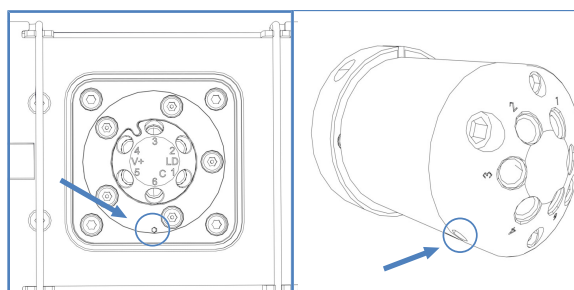


Figure 196: Drain holes on the Vanquish valve (left) and on the VICI valve (right)

*When*

- Liquid droplets appear at the drain hole
- Liquid has collected in the leak tray

*Follow these steps*

- As leakage usually occurs at a connection, visually inspect all connections in the flow path.
- Remove the capillaries and install them again.
- Tighten all connections in the flow path.

4. Inspect the valves visually for leakage.
5. For valves on the left valve position, run the script: **Test System Tightness (Subject To Test = Sampler)**. This script also tests the column switching valves for leakage.
6. If leakage still occurs, replace the Vanquish valve or the VICI valve stator and/or rotor seal depending on the valve.  
For the Vanquish valve, see [Replacing the Vanquish Switching Valve](#) (▶ page 287).  
For the VICI valve stator and/or rotor seal, see [Replacing the VICI Switching Valve Stator and/or Rotor Seal](#) (▶ page 291).

### 7.15.3 Replacing the Vanquish Switching Valve

#### *When*

- Switching valve is defective
- To change between different valve types

#### *Parts required*

- Vanquish switching valve as required by the application
- 4 screws

#### *Tools required*

Screwdriver, Torx T10

#### *Preparations*

1. Turn off the pump flow.
2. Disconnect all liquid lines connected to the switching valve.
3. Turn off the power to the column compartment. If the power is on, the switching valve can be damaged during replacement.
4. Do not yet remove the fitting plugs that cover the valve ports on the replacement switching valve.

### Removing the Vanquish Switching Valve

1. Loosen the 4 screws on the switching valve. Keep the screws for installation of the replacement switching valve.

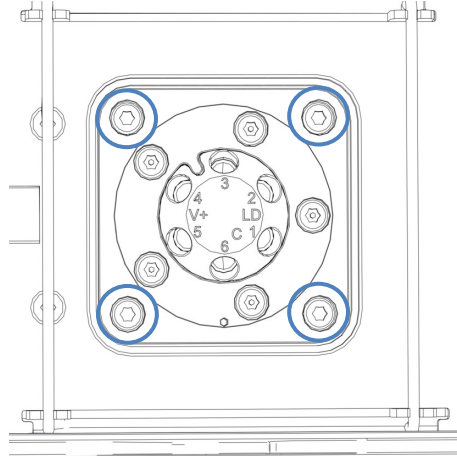


Figure 197: 4 screws on the switching valve

2. Carefully pull the switching valve out of the housing. To facilitate the removal, screw a fitting plug into a valve port.

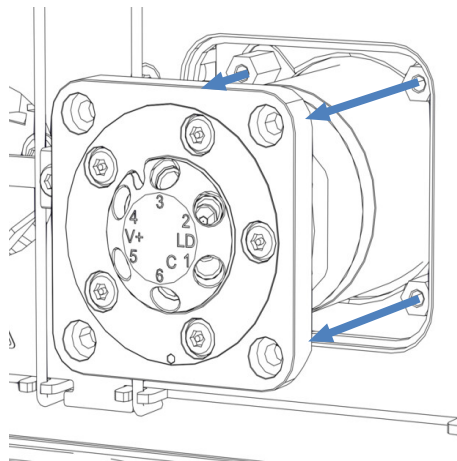


Figure 198: Removing the Vanquish switching valve

3. Disconnect the cable from the connector on the rear of the switching valve.

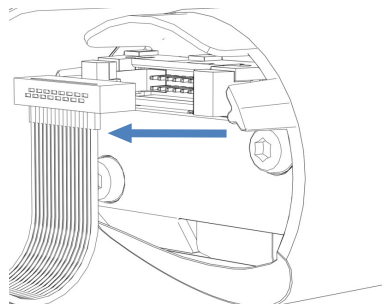


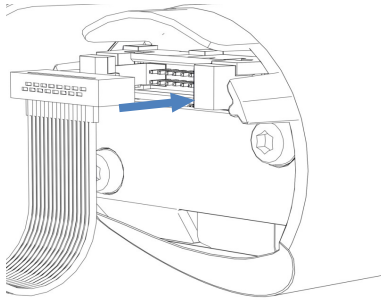
Figure 199: Disconnecting the cable from the connector

*If no Valve is Installed after Replacement*

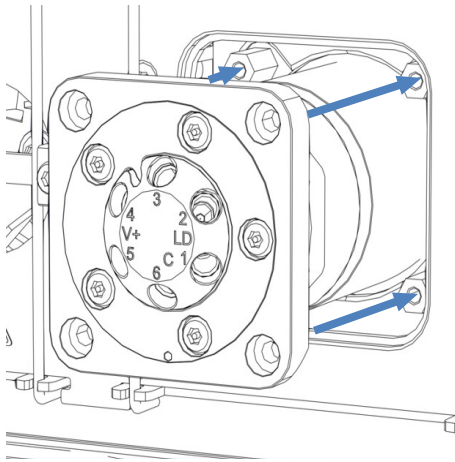
1. Place the cover plate onto the valve opening.
2. Tighten the 4 screws of the cover plate.

*Installing the Vanquish Switching Valve*

1. Connect the replacement switching valve to the cable.

*Figure 200: Connecting the cable*

2. Push the cable into the housing.
3. Carefully push the switching valve into the housing.

*Figure 201: Installing the Vanquish switching valve*

4. Check the correct orientation of the switching valve: Port 3 must point upwards.
5. With a screwdriver, tighten the 4 screws on the switching valve.
6. Remove the fitting plugs that cover the valve ports.
7. Connect the liquid lines as required by the application.
8. Turn on the power to the column compartment.

9. Inspect the valves visually for leakage.
10. For valves on the left valve position, run the script: **Test System Tightness (Subject To Test = Sampler)**. This script also tests the column switching valves for leakage.

#### 7.15.4 Replacing the VICI Switching Valve

You can only replace the VICI valve where a VICI valve drive is installed. To install the VICI valve drive, contact your local Thermo Fisher Scientific Technical Support. For an overview of the VICI switching valve, see [Column Switching Valve Overview](#) (► page 51).

##### *Prerequisite*

The VICI valve drive and the adapter frame are installed (performed by service engineer).

##### *When*

- Switching valve is defective
- To change between different valve types

##### *Parts required*

- VICI switching valve as required by the application

##### *Tools required*

- Screwdriver, Torx T10

##### *Preparations*

1. Turn off the pump flow.
2. Disconnect all liquid lines connected to the VICI switching valve.
3. Do not yet remove the fitting plugs that cover the valve ports on the replacement switching valve.
4. To remove the installed valve pod from the valve flange, screw a fitting plug into a valve port and firmly pull out the valve pod using the fitting plug.

##### *If no Valve is Installed after Replacement*

1. Loosen the 4 screws of the adapter frame.
2. Remove the adapter frame.
3. Place the cover plate onto the valve opening.
4. Tighten the 4 screws of the cover plate.

### Installing the VICI Switching Valve

1. Align the two pins on the back of the valve lock ring with the matching openings on the valve flange.

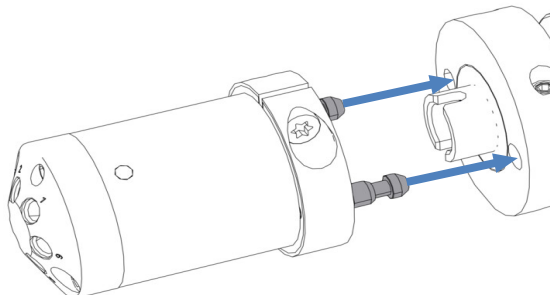


Figure 202: Aligning the lock ring with the flange

2. Press the valve pod to the valve flange.
3. To align the axis with the valve pod, press and hold the **VALVE LEFT** button or the **VALVE RIGHT** button on the keypad depending on the valve position. The catch valve function is activated and you can release the button.
4. When the axis is aligned, the valve pod snaps into the valve flange.
5. Remove the fitting plugs that cover the valve ports.
6. Connect the liquid lines as required by the application.
7. Configure the VICI switching valve in the chromatography data system.
8. Inspect the valves visually for leakage.
9. For valves on the left valve position, run the script: **Test System Tightness (Subject To Test = Sampler)**. This script also tests the column switching valves for leakage.

## 7.15.5 Replacing the VICI Switching Valve Stator and/or Rotor Seal

### When

- Switching valve is leaking due to damaged valve stator and/or rotor seal
- Rotor seal is clogged

### Parts required

- Replacement valve stator and/or rotor seal
- Viper fitting or plastic fitting plugs

*Tools required*

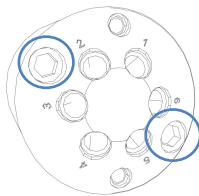
Hexagon wrench, size 9/64''

*Preparations*

1. Turn off the pump flow.
2. Disconnect all liquid lines connected to the VICI switching valve.
3. To remove the installed valve pod from the valve flange, screw a Viper fitting into the valve pod or use plastic fitting plugs.
4. Pull out the valve pod firmly using the Viper fitting or the plastic fitting plugs.

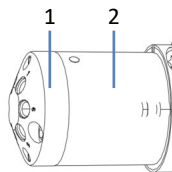
*Follow these steps*

1. Remove the 2 stator screws using the hexagon wrench. Alternately, loosen the screws in turn until you can remove them.



*Figure 203: Stator screws*

2. Remove the stator from the valve body. To avoid damage to the sealing surface, turn the stator so that it rests on its outer surface.



*Figure 204: VICI switching valve*

No.	Description
1	Stator
2	Valve body

3. Carefully remove the rotor seal with your hand.



**NOTICE**

To avoid scratches on the sealing surfaces, do not use pointed or sharp-edged tools to remove or install a seal. Even small scratches may result in poor sealing performances of the valve.

4. Inspect the sealing surfaces of the rotor seal and stator for scratches. If scratches are visible, replace the rotor seal and/or stator.
5. Insert the replacement rotor seal:
  - ◆ Observe the orientation of the seal. The sealing surface with the engraved flow passages must be facing out. The pattern is asymmetrical to prevent improper placement of the rotor seal.
  - ◆ Be careful to avoid contamination of the valve parts. Even minor particles may cause damage to the valve and result in poor sealing performance.
6. Reinstall the stator and tighten both stator screws alternately, each time approximately one-quarter turn, until they are tightened.

**TIP** Avoid overtightening. The screws hold the assembly together and do not affect the sealing force which is automatically set as the screws close the stator against the valve body.

7. Reinstall the valve pod as described in the respective section in [Replacing the VICI Switching Valve](#) (▶ page 290).
8. Inspect the valves visually for leakage.
9. For valves on the left valve position, run the script: **Test System Tightness (Subject To Test = Sampler)**. This script also tests the column switching valves for leakage.
10. If leakage is still observed, replace the valve (see [Replacing the VICI Switching Valve](#) (▶ page 290)).

## 7.15.6 Replacing the Passive Pre-Heater

### *When*

Defective passive pre-heater

### *Parts required*

Passive pre-heater

*Tools required*

Screwdriver, Torx T10

*Follow these steps*



**CAUTION—Hot surfaces**

The column compartment and pre-heater may be hot. Touching hot parts might cause burns. Allow the column compartment and the pre-heater to cool down before starting the service procedure.

1. Disconnect the outlet capillary of the passive pre-heater from the column inlet.
2. Disconnect the inlet capillary of the passive pre-heater from the autosampler or a column switching valve.
3. With the screwdriver, loosen the two screws and washers on the passive pre-heater and remove the passive pre-heater.
4. Mount the new passive pre-heater in the column chamber. See [Installing the Passive Pre-Heater](#) (▶ page 87).

## 7.16 System Controller and Display Maintenance

This section describes how to maintain the system controller and the display.

### 7.16.1 Replacing the System Controller

#### 7.16.1.1 Removing the System Controller

*Follow these steps*

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

1. To be able to shift the system base slightly on the workbench for better access to system parts, unlock the system base using the system base locking tools (see [Unlocking the System Base](#) (▶ page 70)).
2. Move the system stack into an appropriate working position.
3. Unplug the signal and power cables from the system controller.
4. Press both spring clips simultaneously and firmly pull out the system controller.

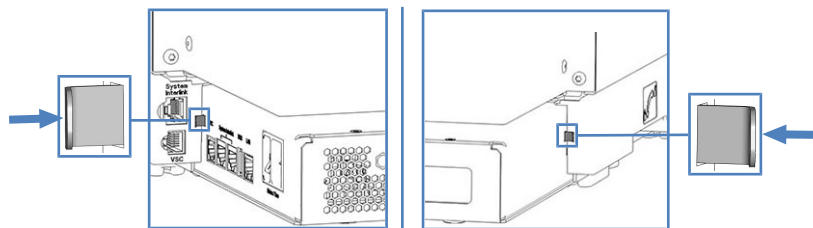


Figure 205: Pressing the spring clips on the left side and on the right side of the system controller

#### 7.16.1.2 Installing the System Controller

*Parts required*

VSC power button

*Tools required*

- Pair of pliers
- Optional: Screwdriver, Torx T10

Follow these steps

The slot for the system controller is at the rear side of the system base.

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

1. To be able to shift the system base slightly on the workbench for better access to system parts, unlock the system base using the system base locking tools (see [Unlocking the System Base](#) (▶ page 70)).
2. Move the system stack into an appropriate working position.
3. On the rear of the system stack, slightly lift the system controller and firmly push it into the system base until it clicks into place.

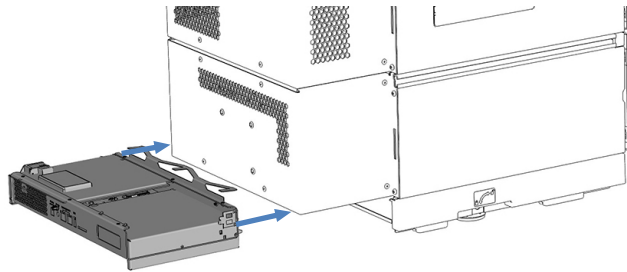


Figure 206: Inserting the system controller

4. If the system controller does not click into place even if pushed firmly: Remove the mounting bracket by loosening the 3 screws with the screwdriver.

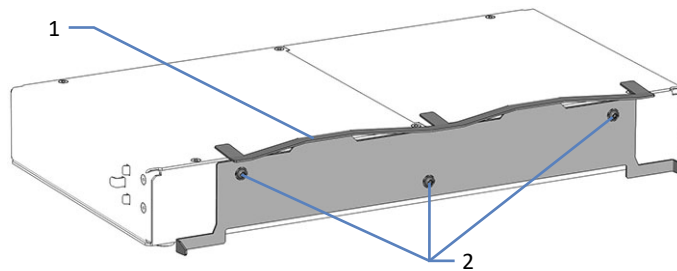


Figure 207: Removing the mounting bracket

No.	Description
1	Mounting bracket
2	Screws

**NOTICE—Damage of the system controller**

Without mounting bracket, the system controller may fall down when lifting the system. This could damage the system controller.

### 7.16.1.3 Connecting the System Controller

The following connectors are provided on the short panel of the system controller:

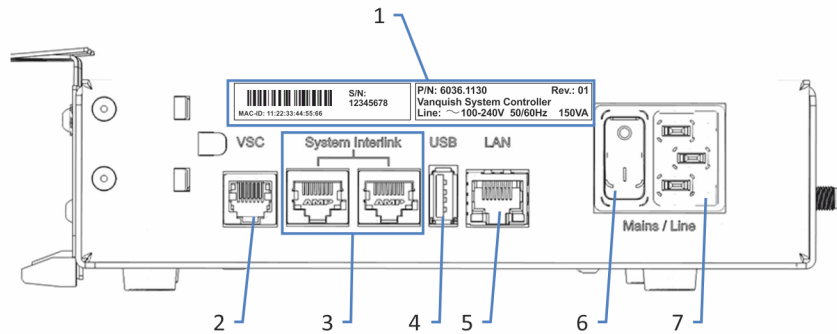


Figure 208: Connectors on the short panel

No.	Description
1	Rating plate Indicates the serial number, part number, module name, revision number, and the line rating.
2	Vanquish System Controller (VSC) connector Allows connection to the system base.
3	System Interlink port Allows connection to the system base and to a module in the HPLC system
4	Universal Serial Bus (USB) port ("A" type connector) Deactivated – Do not use
5	Local Area Network (LAN) port Allows connection to the site network.
6	Main power switch (on/off control)
7	Power inlet port

The following connectors and slots are provided on the long panel of the system controller:

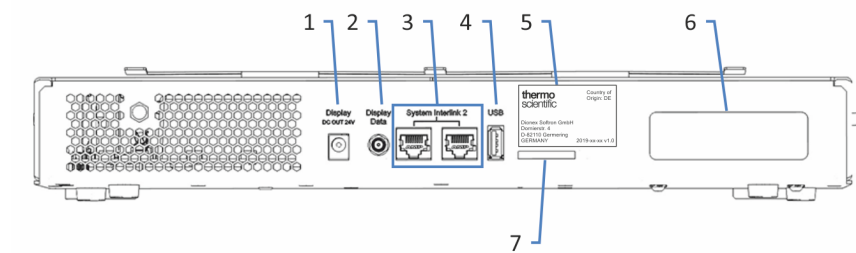


Figure 209: Connectors on the long panel

No.	Description
1	Display power outlet port
2	Display data port
3	System Interlink ports Deactivated
4	USB port ("A" type connector) Deactivated - Do not use
5	Label indicating the manufacturer's address
6	Reserved for future use.
7	Storage Device (SD) card slot

**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 system.

*Parts required*

The following parts are required and are shipped with the device:

- Power cord
- Short VSC cable (length: 8 cm)
- System interlink cable (length: 50 cm)
- If you want to access the system controller from your site network:  
LAN cable (length: 5 m)

Follow these steps

#### NOTICE

Condensation in a device can damage the electronics.

- Before connecting the devices to the power line, be sure that no condensation is present in the devices.
- If you suspect that condensation is present, allow the device to warm up to room temperature slowly. Wait until the condensation is completely gone before proceeding.

1. Verify that the power switch on the device is set to OFF.
2. Connect the power cord to the power inlet connector on the device.
3. Connect the free end of the power cord to an appropriate power source.
4. Using the short VSC cable, connect the **VSC** port of the system base to the **VSC** port of the system controller.



Figure 210: Connecting the VSC and system interlink cables

#### NOTICE—Vanquish module damage

The **System Interlink**, the **VSC** and the **LAN** ports use the same connector type. Connecting a LAN cable, for example, to a **System Interlink** port of a Vanquish module, may damage the Vanquish module and the system controller.

Only connect matching ports.

5. Using a system interlink cable, connect the System Interlink port of the system base to a System Interlink port on the short panel of the system controller.

6. Connect the other System Interlink port on the short panel of the system controller to the System Interlink port of the pump.
7. Connect a LAN cable to the LAN port of the system controller.
8. Connect the other connector of the LAN cable to the network card LAN port of the computer with the chromatography data system.
9. Move the system stack back into the operating position.
10. Lock the system base using the system base locking tools (see [Locking the System Base \(▶ page 116\)](#)).

### 7.16.2 Replacing the SD Card

**TIP** Only SD cards preformatted and preconfigured by Thermo Fisher Scientific can be used with the system controller.

#### *When*

If a message appears on the Vanquish User Interface that the SD card has to be replaced.

#### *Items required*

- New SD card
- Optional: Pen or slotted screwdriver

#### *Preparations*

1. Reboot the system controller.
2. Check whether the message appears again. If yes, proceed to the next step.
3. Turn off the system controller with the power on/off switch of the system controller.

#### *Follow these steps*

1. To be able to shift the system base slightly on the workbench for better access to system parts, unlock the system base using the system base locking tools (see [Unlocking the System Base \(▶ page 70\)](#)).
2. Move the system stack into an appropriate working position.



3. Slightly press on the SD card until the SD card is released. If necessary, use a pen or a slotted screwdriver.

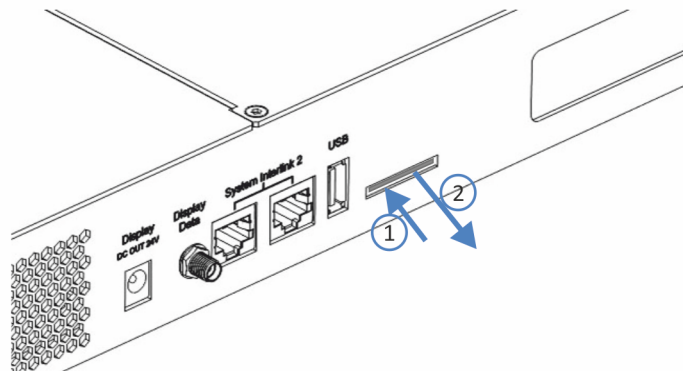


Figure 211: Removing the SD card

4. Remove the old SD card.
5. Insert a new SD card observing the following:
  - ◆ Correct orientation of the notch (see image)
  - ◆ Insert the SD card straight into the inner retainer before pushing it completely into the slot.

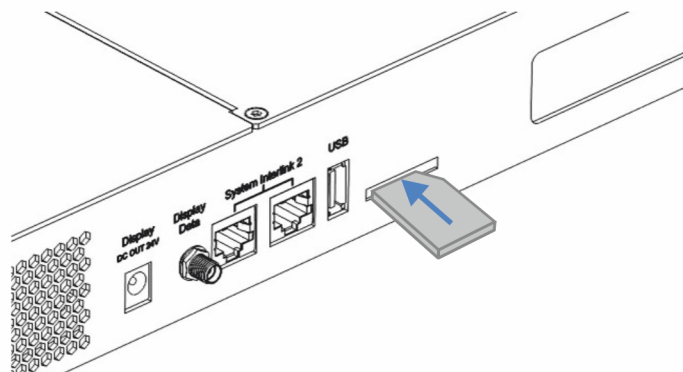


Figure 212: Installing the new SD card

6. Move the system stack back into the operating position.
7. Lock the system base using the system base locking tools (see [Locking the System Base](#) (► page 116)).

### 7.16.3 Replacing the Display

1. Unmount the old display. See [Unmounting the Display](#) (▶ page 302).
2. Mount the new display. See [Mounting the Display](#) (▶ page 96).
3. Connect the display cables. See [Connecting the Display Cables](#) (▶ page 108).

#### 7.16.3.1 Unmounting the Display

##### *Tools required*

Screwdriver, Torx T10

##### *Follow these steps*

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

1. To be able to shift the system base slightly on the workbench for better access to system parts, unlock the system base using the system base locking tools (see [Unlocking the System Base](#) (▶ page 70)).
2. Move the system stack into an appropriate working position.
3. Unplug the two display connectors from the system controller.
4. Remove the cable cover.
5. Remove the display cable from the rail and the housing cable clips.
6. Holding the fastening block with the right hand, unfasten the screw in one of the holes marked with a circle with the left hand from the outside.

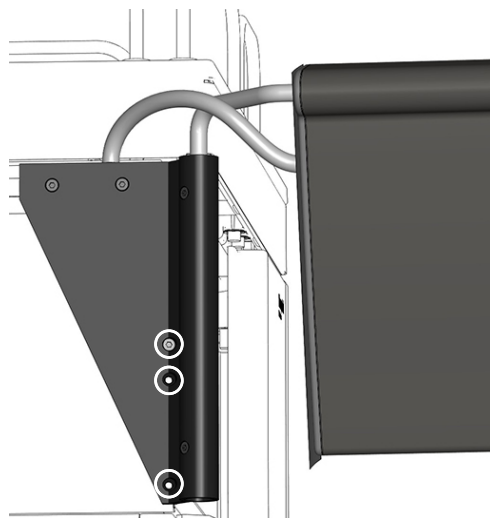
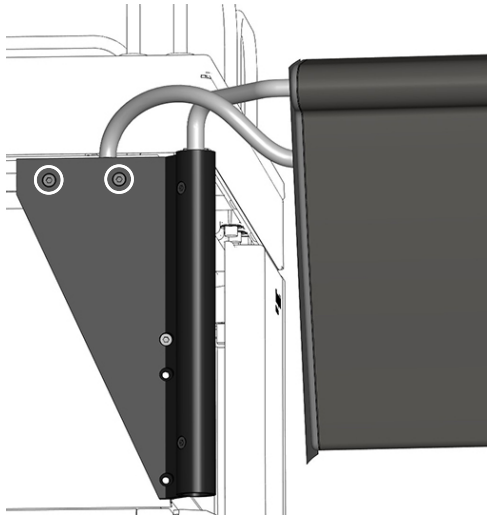


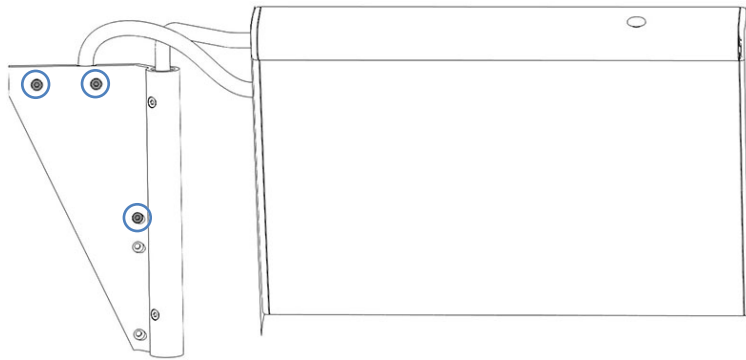
Figure 213: Unfastening the screw holding the fastening block

7. Remove the fastening block.
8. Unfasten the 2 screws in the two upper holes.



*Figure 214: Unfastening the screws*

9. Push the display assembly toward the system's rear and remove it from the stack.
10. Fasten the upper 2 screws and fasten the fastening block with a screw.



*Figure 215: Screws to be fastened on the display assembly*

## 7.17 Solvent Rack Replacement

### Preparations

1. Remove the liquid reservoirs from the solvent rack foam piece.
2. Remove the foam piece from the solvent rack (see [Removing the Foam Piece](#) (► page 305)).

### Parts required

Replacement solvent rack

### Tools required

Screwdriver, Torx T10

### Follow these steps

1. Loosen the screws that fix the mounting bracket to the system module below the solvent rack, using the screwdriver.
2. Remove the sheet metal bracket.

**TIP** Keep the bracket and the screws. You may need them for future transport.

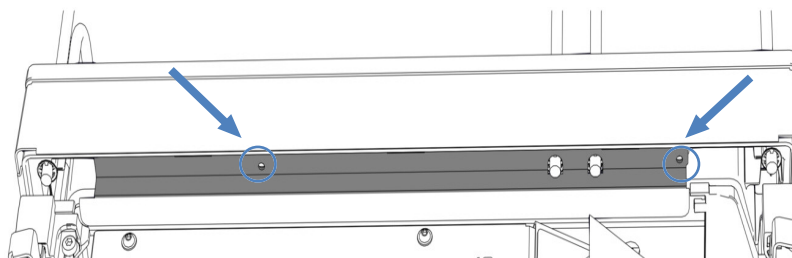


Figure 216: Removing the sheet metal bracket (here: autosampler)

3. Lift the front part of the solvent rack and remove the solvent rack by pulling it towards the front.
4. Place the new solvent rack on the topmost system module approximately 5 cm before the end of the rails. Push the solvent rack towards the rear until it clicks into place.
5. Insert the foam piece into the solvent rack (see [Inserting the Foam Piece](#) (► page 305)).
6. Place the liquid reservoirs into the solvent rack foam piece.

## 7.18 Foam Piece Replacement

### 7.18.1 Removing the Foam Piece

Firmly push the foam piece wings above the solvent rack rail and remove the foam piece.

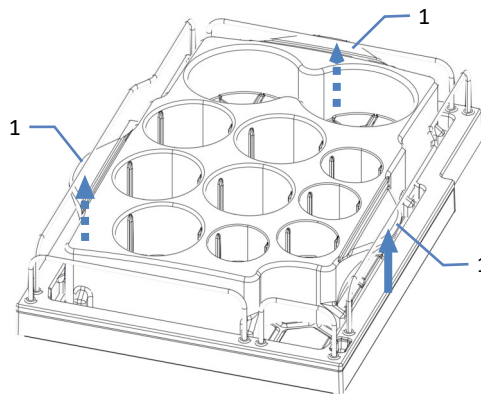


Figure 217: Removing the foam piece

No.	Description
1	Wing

### 7.18.2 Inserting the Foam Piece

1. Insert the rear and the left wing into the gap below the rails.
2. Firmly push the right wing below the rail.

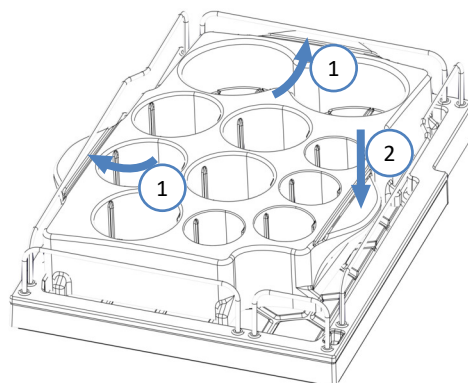


Figure 218: Inserting a foam piece

## 7.19 Main Power Fuse and Door Replacement

### 7.19.1 Replacing the Main Power Fuses

*When*

Blown fuses

*Parts required*

Fuses (2 fuses, 5 AT, 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.

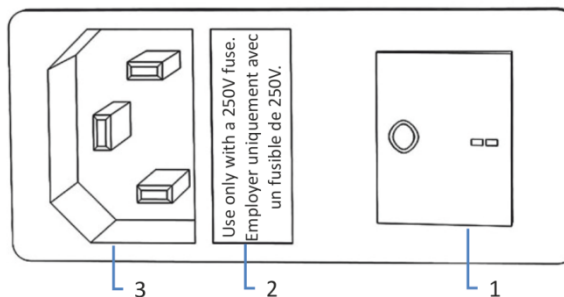


Figure 219: Fuse holder

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.
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.

## 7.19.2 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

### *Preparations*

If the door to be replaced is located directly below the solvent rack, do the following:

1. Remove all reservoirs from the solvent rack.
2. Remove the sheet metal bracket that fixes the solvent rack to the autosampler, if applicable. For instructions, see [Placing the Column Compartment in the System Stack](#) (▶ page 81).

If the display is installed next to the door to be replaced, consider loosening the fastening block of the display to push the display toward the system rear. For instructions, see [Unmounting the Display](#) (▶ page 302).

### *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. If the door is directly mounted below the solvent rack, lift the solvent rack slightly on the front edge.

2. 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.

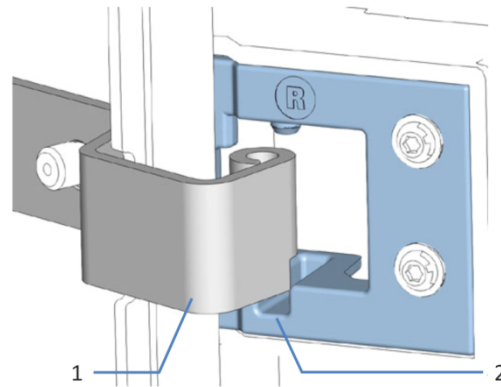


Figure 220: Unhinging a door

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

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



## 7.20 Replacing the Slide-In Module

You can remove the slide-in module from the enclosure of a module for transporting or shipping purposes. The enclosure remains in the system stack. To return a defective module to the factory, install the slide-in module in the enclosure of the replacement module.

### 7.20.1 Preparing the Pump for Removal

#### *General preparations*

1. Run the script: **Shutdown (Long-term)** with the following parameter: **Module to remove = Pump**.
2. To be able to shift the system base slightly on the workbench for better access to system parts, unlock the system base using the system base locking tools (see [Unlocking the System Base](#) (► page 70)).
3. Move the system stack into an appropriate working position.

#### *Shutdown*

1. Turn off *all* system modules with their main power switch. Pressing the system power button will not be sufficient to turn off the power to the devices completely.
2. Disconnect the power cord.
3. Disconnect all signal cables to other devices.

#### *Solvent Lines*

1. Empty the solvent lines:
  - a) Unscrew the caps of the solvent reservoirs.
  - b) Together with the caps, remove the solvent lines from the reservoirs.
  - c) Protect the solvent line filters from contamination as appropriate.

#### *Seal wash line*

1. Empty the seal wash system:
  - a) Unscrew the cap of the seal wash reservoir.
  - b) Together with the cap, remove the seal wash line from the seal wash reservoir.
  - c) To empty the seal wash line, lift up the lever of the seal wash pump. Release the lever when the line is empty.

### Needle wash lines

1. Empty the needle wash system:
  - a) Unscrew the caps of the needle wash reservoirs.
  - b) Together with the cap, remove the wash lines (labeled W and S) from the reservoirs.
  - c) Place the wash lines in a waste reservoir to empty them.

### Flow connections

1. Remove all flow connections to other system modules:
  - ◆ Seal wash pump inlet line from the peristaltic tubing on the seal wash pump
  - ◆ Needle wash lines (labeled W and S) from the degasser ports
  - ◆ Capillary to autosampler from the pump outlet port
  - ◆ Solvent lines from the pump inlet ports

#### 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.

2. Close open flow connections with appropriate plugs, for example, the plugs from the ship kit.
3. Check the leak tray and drain port. If liquid is present, absorb the liquid with a tissue.

## 7.20.2 Removing the Pump Slide-In Module

### Tools required

Screwdriver, Torx T20

### Preparations

See [Preparing the Pump for Removal](#) (▶ page 309).

Follow these steps

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

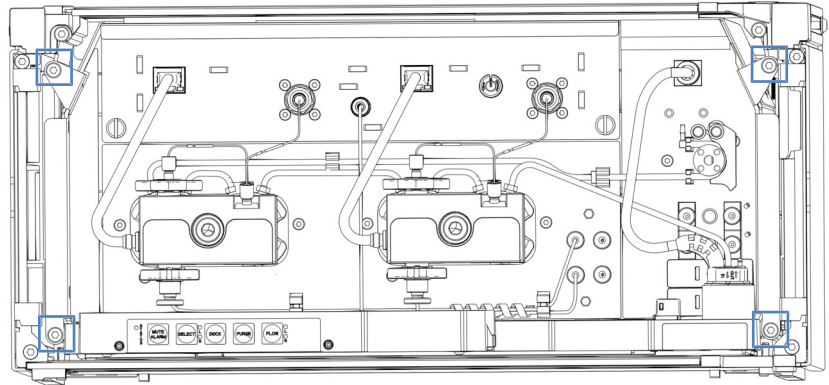


Figure 221: Captive screws on the pump slide-in module

2. Push all tubing and capillaries, which are present in the tubing chase of the Vanquish system modules, into the tubing chase.
3. Grasp the slide-in module by the leak tray, and pull the module out of the enclosure approximately 10 cm.

#### 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.

### 7.20.3 Preparing the Autosampler for Removal

#### *General preparations*

1. Remove the sample racks and sample containers from the sample compartment.
2. Run the script: **Shutdown (Long-term)** with the following parameter:  
**Module to remove = Sampler.**
3. If not already done, secure the needle unit (see [Securing the Needle Unit](#) (▶ page 238)).
4. To be able to shift the system base slightly on the workbench for better access to system parts, unlock the system base using the system base locking tools (see [Unlocking the System Base](#) (▶ page 70)).
5. Move the system stack into an appropriate working position.

#### *Shutdown*

1. Turn off *all* system modules with their main power switch. Pressing the system power button will not be sufficient to turn off the power to the devices completely.
2. Disconnect the power cord.
3. Disconnect all signal cables to other devices.

#### *Seal wash system*

1. Empty the seal wash system:
  - a) Unscrew the cap of the seal wash reservoir.
  - b) Together with the cap, remove the seal wash line from the seal wash reservoir.
  - c) To empty the seal wash line, lift up the lever of the seal wash pump. Release the lever when the line is empty.

#### *Needle wash systems*

1. Empty the needle wash systems:
  - a) Unscrew the cap of the needle wash reservoirs.
  - b) Together with the cap, remove the wash lines (labeled S, W, SWP, and WWP) from the reservoirs.
  - c) Place the wash lines in a waste reservoir to empty them.
  - d) Empty the needle wash reservoirs.

### Flow connections

1. Remove all flow connections to other system modules:
  - ◆ Seal wash reservoir line and seal wash pump inlet line
  - ◆ Needle wash lines
  - ◆ Capillary from pump
  - ◆ Capillary to column compartment, if installed

#### 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.

### Cleaning

1. If condensation or spilled samples are present in the sample compartment, clean and decontaminate the sample compartment.
2. Check the leak trays for liquid leaks. If liquid is present, absorb the liquid with a tissue.

## 7.20.4 Removing the Autosampler Slide-in Module

### Tools required

Screwdriver, Torx T20

### Preparations

See [Preparing the Autosampler for Removal](#) (▶ page 312).

### Removing the Slide-in Module

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

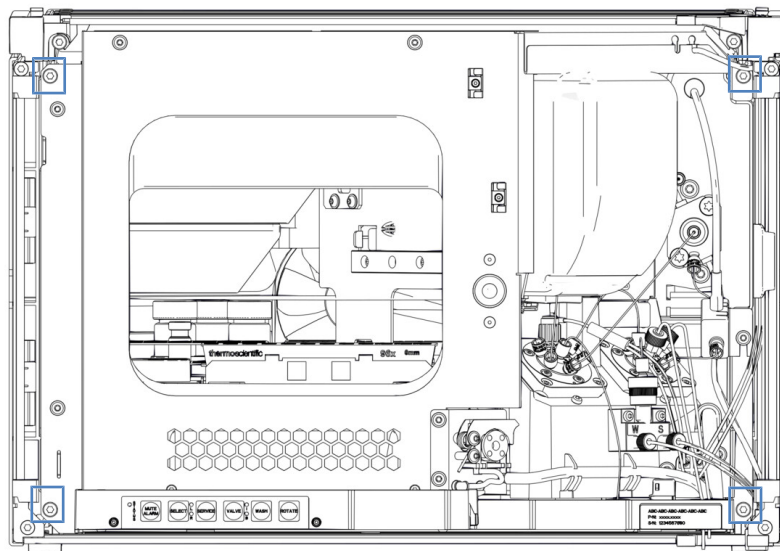


Figure 222: Captive screws on the autosampler slide-in module

2. Push all tubing and capillaries, which are present in the tubing chase of the Vanquish system modules, into the tubing chase.
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.

#### 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.

## 7.20.5 Preparing the Column Compartment for Removal

### General preparations

1. Run the script: **Shutdown (Long-term)** with the following parameter:  
**Module to remove = Oven.**
2. To be able to shift the system base slightly on the workbench for better access to system parts, unlock the system base using the system base locking tools (see [Unlocking the System Base](#) (▶ page 70)).
3. Move the system stack into an appropriate working position.

### Shutdown

1. Turn off *all* system modules with their main power switch. Pressing the system power button will not be sufficient to turn off the power to the devices completely.
2. Disconnect the power cord.
3. Disconnect all signal cables to other devices.

### Flow connections

1. Remove all flow connections to other system modules.
2. Cover open switching valve ports with fitting plugs.

#### 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.

### Optional accessories

1. Optional: Remove the switching valves (see [Replacing the Vanquish Switching Valve](#) (▶ page 287) or [Replacing the VICI Switching Valve](#) (▶ page 290)).
2. Remove the pre-heater, if installed (see [Replacing the Passive Pre-Heater](#) (▶ page 293)).
3. Remove the column following the instructions in [Installing Columns in the Column Compartment](#) (▶ page 89) in reverse order.

### Cleaning

1. Check the leak tray and drain port. If liquid is present, absorb the liquid with a tissue.

## 7.20.6 Removing the Column Compartment Slide-In Module

### Tools required

Screwdriver, Torx T20

### Preparations

See [Preparing the Column Compartment for Removal](#) (▶ page 315).

### Removing the Slide-in Module

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

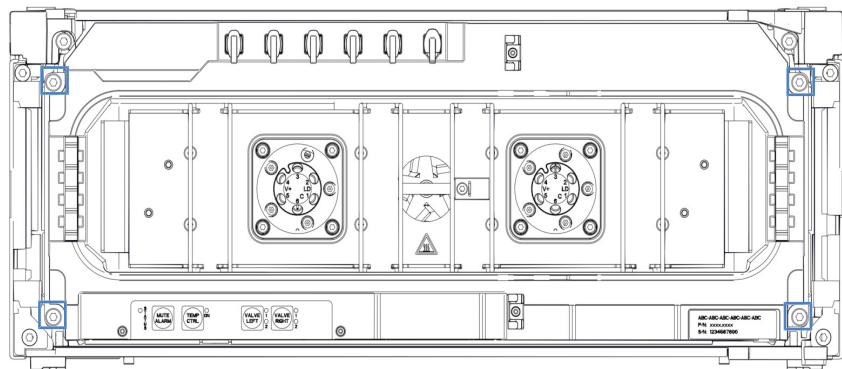


Figure 223: Captive screws on the column compartment slide-in module

2. Push all tubing and capillaries, which are present in the tubing chase of the Vanquish system modules, into the tubing chase.
3. Grasp the slide-in module by the leak tray, and pull the module out of the enclosure by approximately 10 cm.

### 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.



## 7.20.7 Returning the Slide-In Module



### 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 Health and Safety Form. Thermo Fisher Scientific refuses to accept devices for repair if the Health and Safety Form is missing, incompletely filled in, or unsigned.

#### *Preparations*

Remove the slide-in module that you want to return from the enclosure. See the related information:

[Removing the Pump Slide-In Module](#) (▶ page 310)

[Removing the Autosampler Slide-in Module](#) (▶ page 313)

[Removing the Column Compartment Slide-In Module](#) (▶ page 316)

#### *Follow these steps*

1. Install the slide-in module to the enclosure of the replacement device. Follow the steps for inserting the slide-in module in the enclosure and tightening the captive screws in [Installing the Slide-In Module](#) (▶ page 318).
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.

## 7.20.8 Installing the Slide-In Module

### Tools required

Screwdriver, Torx T20

### Preparations

1. 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. 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.
2. On the slide-in module, check that you can move the captive screws back and forth with your fingers. If you cannot, screw them in until you can.
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.
4. To facilitate tightening the slide-in module in the enclosure, pull out the module a few millimeters (approximately 2 to 5 mm).
5. With the screwdriver, move each captive screw back and forth while pressing inward until the screw slips into the thread.
6. Push the slide-in module back into the enclosure as far as it goes in.
7. 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. With a torque wrench, the recommended torque is 1.2 Nm.

8. To set up the module, follow the steps in [Installation](#) (► [page 71](#)).

## 7.21 Preparing the System for Transport

### 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.

#### General preparations

1. Run the script: **Shutdown (Long-term)** with the following parameter: **Module to remove = System**.
2. If not already done, secure the needle unit (see [Securing the Needle Unit](#) (▶ page 238)).
3. To be able to shift the system base slightly on the workbench for better access to system parts, unlock the system base using the system base locking tools (see [Unlocking the System Base](#) (▶ page 70)).
4. Move the system stack into an appropriate working position.
5. Remove the sample racks and sample containers from the sample compartment.

#### Solvent system

1. Empty the solvent lines:
  - a) Unscrew the caps of the solvent reservoirs.
  - b) Together with the caps, remove the solvent lines from the reservoirs.
  - c) Protect the solvent line filters from contamination as appropriate.

**TIP** Removing the solvent lines from the tubing guides is usually not required (not even for replacing the slide-in module). However, when you remove the solvent lines from the tubing guides in the pump and all modules above the pump in the system stack, be careful not to pull on other tubing in the guides.

2. Empty the solvent reservoirs.

### Seal wash system

1. Empty the seal wash system:
  - a) Unscrew the cap of the seal wash reservoir.
  - b) Together with the cap, remove the seal wash line from the seal wash reservoir.
  - c) To empty the seal wash line, lift up the lever of the seal wash pump. Release the lever when the line is empty.
2. Empty the seal wash reservoir.

### Needle wash systems

1. Empty the needle wash systems:
  - a) Unscrew the cap of the needle wash reservoirs.
  - b) Together with the cap, remove the wash lines (labeled S, W, SWP, and WWP) from the reservoirs.
  - c) Place the wash lines in a waste reservoir to empty them.
  - d) Empty the needle wash reservoirs.

### Shutdown

1. Turn off *all* system modules with their main power switch. Pressing the system power button will not be sufficient to turn off the power to the system modules completely.

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

2. Disconnect all power cords.
3. Disconnect all signal cables to external devices.

### Cleaning

1. If condensation or spilled samples are present in the sample compartment, clean and decontaminate the sample compartment before you proceed. Verify that the autosampler has been cleaned and/or decontaminated as appropriate.
2. Check the leak trays for liquid leaks. If liquid is present, absorb the liquid with a tissue.

### Remaining tasks

1. Pull out the system drain tubing out of the waste container.
2. Fix the carrying handles (see [Fixing the Carrying Handles](#) (► [page 321](#))) if necessary.

## 7.22 Fixing the Carrying Handles

### Parts required

- 4 handles  
Use the carrying handles that were installed when the system was shipped and that have 2 holes for screws.

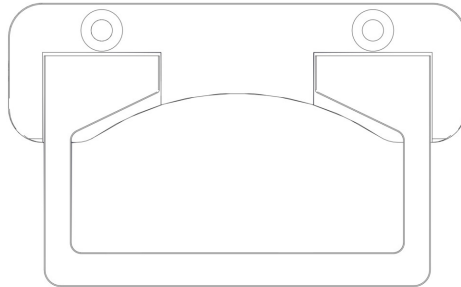


Figure 224: Carrying handle for the system stack

- 8 screws that were fixed to the handles

### Tools required

Screwdriver, Torx T30

### Follow these steps

1. Insert a carrying handle into the right and into the left rail from the rear.

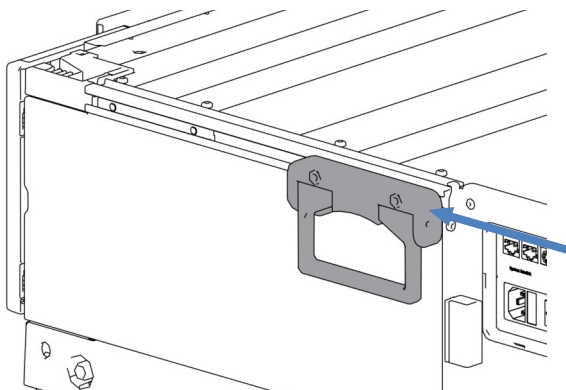


Figure 225: Sliding the carrying handle on the right rail

- Slide the handles toward the system's front until the distance between the front of the rail and the front edge of the handle is about 6 cm.

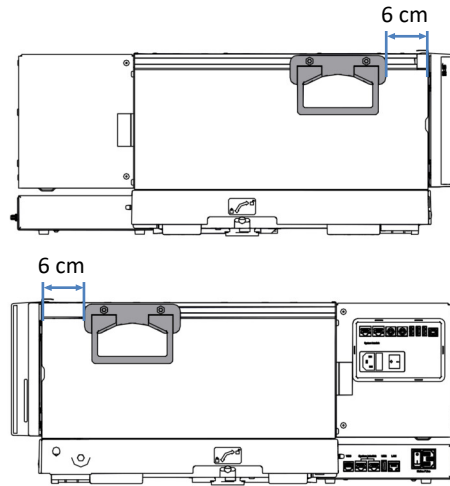


Figure 226: Positioning the front carrying handles (upper image: stack seen from the left; lower image: stack seen from the right)

- Fix the screws of the handles.
- Insert a carrying handle into the right and into the left rail from the rear.
- Slide the handles toward the system front so that the rear side of the handles flushes with the rear side of the rails.

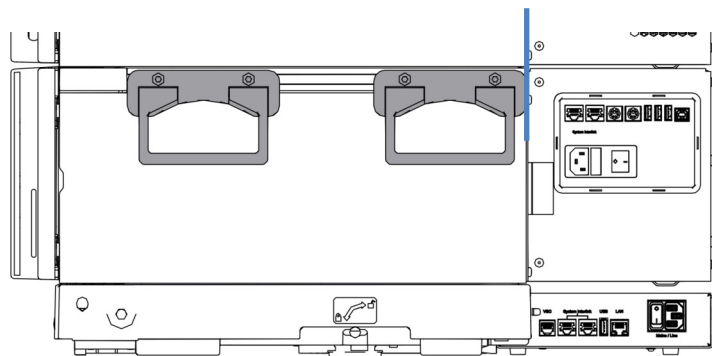


Figure 227: Correct position of the rear carrying handles

6. Fix the screws of the handles.

**CAUTION—Personal injury and system damage**

Fixing the handles to the autosampler and lifting the system could lead to personal injury and to system damage.

To avoid personal injury and system damage, fix the handles only to the pump.

**CAUTION—Risk of Injury and Module Damage**

Handles can slide off the module if the attachment screws are not fixed properly. Also, a slide-in module can fall out if not fixed properly. This could cause personal injury and damage to the module. Verify the following before lifting the system:

- The handles are fixed properly and cannot slide off the module.
- The four screws of each slide-in modules are tightened and no slide-in module can fall out (see [Replacing the Slide-In Module](#) (▶ page 309)).





# 8 Troubleshooting

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

## 8.1 General Information about Troubleshooting

The following features help you to identify that a problem occurred during operation of the system.

Indicator	Description
Status indicators	<p>The system shows the health status of the following:</p> <ul style="list-style-type: none"> <li>• Overall system: On the Vanquish User Interface on the top of the screen (see <a href="#">Overall System Health Status Icons</a> (▶ page 150)).</li> <li>• System modules If the firmware of a system module detects a problem, a message appears in the notification panel and the following status indicators of that system module are red: <ul style="list-style-type: none"> <li>◆ LED bar (see <a href="#">LED bars</a> (▶ page 148)) on the module and LED bar representation on the home panel</li> <li>◆ STATUS LED (see <a href="#">Keypads</a> (▶ page 145))</li> </ul> </li> </ul>
Leak alarms	<p>Leaks are a potential safety and chromatography issue. Therefore, if a leak sensor detects leakage, beeping starts to alert you in addition to the message in the notification panel and the status indicators changing to red. Follow the instructions in <a href="#">Testing the System for Liquid Leaks</a> (▶ page 355).</p>
Messages	<p>If a module firmware detects a problem, a message appears in the notification panel. The notification panel stores information about all warnings and errors of the system modules and all events of the system controller since the last system controller reboot.</p>

The following sections inform about messages and operating issues that might arise during the system operation and provide troubleshooting assistance.

### *Further Assistance*

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 part number and serial number of the system available when communicating with Thermo Fisher Scientific. You can find this information on the type label in the system base drawer.

## 8.2 Messages

If the firmware of a system module detects an error, a message appears on the Vanquish User Interface and in the chromatography data system. The tables in this section list the most frequently observed messages for each system modules and provide 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. To narrow down the source of a problem, additional text may accompany a specific message, for example, in the chromatography data system.

If you cannot find the code you are looking for, check the message text. The two messages "Unexpected module behavior" and "Module malfunction detected" can be assigned to different codes.

**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 us. For details, see the *Contacting Us* section at the beginning of this manual.

### 8.2.1 Common Messages

This section provides information on messages that the system modules have in common.

The table lists the most frequently observed messages for the system modules.

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. 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 33 Leak detected – eliminate within approx. xx seconds.	xx = the number of seconds within the leakage must be resolved before the sequence will be aborted Find and eliminate the source for the leakage. If leakage in the pump is not resolved after 3 minutes, the pump stops the flow. 1. 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, absorb all liquid in the leak tray and under the leak sensor.

Message and Code	Description and Remedial Action
Code 34 Leak detected.	The message appears because the leakage reported earlier with code 33 was not resolved within 3 minutes. The pump stopped and/or the running sequence was aborted because of leakage. Find and eliminate the source for the leakage (see <a href="#">Testing the System for Liquid Leaks</a> (▶ page 355)).
Code 36 Download failed.	The firmware download has not been successful. Repeat the download.
Code 37 Download firmware mismatch.	The firmware download has not been successful. Verify that the correct firmware file was selected. Repeat the download.
Code 52 Module software incomplete. Download firmware (again).	The firmware is incomplete, for example, because the communication between the chromatography data system and the module was interrupted during the firmware download. Repeat the download.
Code 79 [Device] was not found.	The message may appear for a pressure sensor in a pump head or for the system pressure sensor in the flowmeter (see identification information in <a href="#">Pump Messages</a> (▶ page 330)). <ul style="list-style-type: none"> <li>• Pump head: Verify that the pressure sensor cable of the pump head for which the message appears is properly plugged into the connection port.</li> <li>• Flowmeter: Contact Technical Support.</li> </ul>
Code 84 Could not move X to its destination position. Code 85 Could not move X to its destination position.	X = left valve or right valve The respective switching valve may be defective. Replace the switching valve, see <a href="#">Replacing the Vanquish Switching Valve</a> (▶ page 287) or <a href="#">Replacing the VICI Switching Valve</a> (▶ page 290). If the error message persists, contact Technical Support.
Code 89 Liquid leak sensor missing.	Contact Thermo Fisher Scientific Technical Support for assistance. Note that the module can be operated nevertheless, even if the leak sensor is defective or not present, if leak detection is disabled.
Code 90 Download firmware mismatch – invalid version.	You tried to download an incompatible firmware with an earlier version number than the firmware that is currently installed in the module. Downgrading the firmware may result in loss of functionality or malfunctioning of the module. If required, repeat the download with a firmware version later than the version currently installed in the module.
Code 91 Data changed during read.	All modules: <ul style="list-style-type: none"> <li>• This may be a temporary error. Turn off the module. Wait for 5 seconds and turn on the module again.</li> <li>• The firmware may be defective. Update the firmware.</li> </ul> In addition for the pump: If the message appears for a pressure sensor in a pump head or for the system pressure sensor in the flowmeter (see identification information in <a href="#">Pump Messages</a> (▶ page 330)): <ul style="list-style-type: none"> <li>• Pump head: Verify that the pressure sensor cable of the device for which the message appears is properly plugged into the connection port.</li> <li>• Flowmeter: Contact Technical Support.</li> </ul>

Message and Code	Description and Remedial Action
Code 92 Data verification failed.	<p>All modules:</p> <ul style="list-style-type: none"> <li>• This may be a temporary error. Turn off the module. Wait for 5 seconds and turn on the module again.</li> <li>• The firmware may be defective. Update the firmware.</li> </ul> <p>In addition for the pump:</p> <p>If the message appears for a pressure sensor in a pump head or for the system pressure sensor in the flowmeter (see identification information in <a href="#">Pump Messages</a> (▶ page 330)):</p> <ul style="list-style-type: none"> <li>• Pump head: Verify that the pressure sensor cable of the device for which the message appears is properly plugged into the connection port.</li> <li>• Flowmeter: Contact Technical Support.</li> </ul>
Code 118 USB Buffer Overflow.	<p>This is a software problem. The module produces data faster than the computer on which the chromatography data system is running reads the data.</p> <ol style="list-style-type: none"> <li>1. In the chromatography data system, disconnect and reconnect the module.</li> <li>2. If this does not solve the problem, update the firmware or the chromatography data system version.</li> <li>3. If the problem persists: Also, third-party software on the computer, for example, virus scanners or poor computer performance can cause the problem. Contact the onsite IT department.</li> </ol>
Code 120 System interlink request timed out.	<p>Communication with the module failed. The module did not respond in time.</p> <p>For the module for which the message appears:</p> <ol style="list-style-type: none"> <li>1. Turn on the module if it is not yet turned on.</li> <li>2. Check the system interlink cables for proper connection.</li> </ol>
Code 126 Device lost system interlink connection.	<p>A system interlink cable may be disconnected from the module or defective.</p> <ol style="list-style-type: none"> <li>1. Check the system interlink connections to the module.</li> <li>2. If the message persists, replace the system interlink cables.</li> </ol>
Code 128 System interlink data errors.	<p>A system interlink cable may be disconnected from the module or defective.</p> <ol style="list-style-type: none"> <li>1. Check the system interlink connections to the module. Verify that all system interlink cables are connected at both ends.</li> <li>2. If the message persists, replace the system interlink cables.</li> </ol>
Code 129 Device X not found on system interlink.	<p>X = serial number</p> <p>The module with the given serial number may be disconnected, turned off or a firmware update is running.</p> <ol style="list-style-type: none"> <li>1. Check the system interlink connections to the module.</li> <li>2. If the message persists, check the module operational status.</li> </ol>
Code 131 System interlink bus not operable.	<p>A system interlink cable may be disconnected from the module or defective.</p> <p>Check the system interlink connections to the module.</p>

Message and Code	Description and Remedial Action
Code 136 Lock request rejected – already locked by X.	X = lock holder ID, with USB address referring to the chromatography data system or CAN address referring to the system controller or a module  The module is already locked by another software (system controller or chromatography data system). Wait until the module is released from the locked state.
Code 137 Lock by X expired.	X = lock holder ID, with USB address referring to the chromatography data system or CAN address referring to the system controller or a module  Inform Thermo Fisher Scientific about the occurrence. No further action required.
Code 145 Lock holder X lost.	X = lock holder ID, with USB address referring to the chromatography data system or CAN address referring to the system controller or a module  The lock was released automatically since its holder disappeared from system interlink. Check the system interlink connections to the module.
Code 152 Assignment or command rejected – device locked.	Module is not ready to accept command or property assignment since locked by another software (system controller or chromatography data system).  Wait until module is released by the current software (system controller or chromatography data system).

## 8.2.2 Pump Messages

This section provides information on messages with code numbers 4000 through 4999. These messages are specific to the pump.

### *Additional Source Identification*

To narrow down the source of a problem, check the message in the chromatography data system for additional information:

Default Name in Data System	Description
PumpModule.Pump	The message relates to the entire pump module, including flowmeter (with system pressure sensor).
PumpModule.Pump Left Block (WP)	The message relates to the following: <ul style="list-style-type: none"> <li>• <i>Left</i> pump block (A)</li> <li>• Components in the <i>left</i> pump block, for example, the pump head</li> <li>• Components on the <i>left</i> side of the <i>left</i> pump head, for example, the <i>left</i> pressure sensor in the pump head or the working piston, delivering %A.</li> </ul>

Default Name in Data System	Description
PumpModule.Pump Left Block (EP)	The message relates to the following: <ul style="list-style-type: none"> <li>• <i>Left</i> pump block (<b>A</b>)</li> <li>• Components in the <i>left</i> pump block, for example, the pump head</li> <li>• Components on the <i>right</i> side of the <i>left</i> pump head, for example, the <i>right</i> pressure sensor in the pump head or the equilibration piston, delivering %A</li> </ul>
PumpModule.Pump Right Block (WP)	The message relates to the following: <ul style="list-style-type: none"> <li>• <i>Right</i> pump block (<b>B</b>)</li> <li>• Components in the <i>right</i> pump block, for example, the pump head</li> <li>• Components on the <i>left</i> side of the <i>right</i> pump head, for example, the <i>left</i> pressure sensor in the pump head or the working piston, delivering %B</li> </ul>
PumpModule.Pump Right Block (EP)	The message relates to the following: <ul style="list-style-type: none"> <li>• <i>Right</i> pump block (<b>B</b>)</li> <li>• Components in the <i>right</i> pump block, for example, the pump head</li> <li>• Components on the <i>right</i> side of the <i>right</i> pump head, for example, the <i>right</i> pressure sensor in the pump head or the equilibration piston, delivering %B</li> </ul>

### Pump Messages

The table lists the most frequently observed messages for the pump.

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. 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 4098 Upper pressure limit exceeded	Check the flow path for blockage. Run the script: <b>Test System Back Pressure.</b>

Message and Code	Description and Remedial Action
Code 4099 Pressure fallen below lower limit.	<p>Check the following causes:</p> <ul style="list-style-type: none"> <li>• One or more solvent reservoirs are empty. Run the script: <b>Change Liquids / Solvents (Refresh Only = On)</b>.</li> <li>• Air bubbles may be trapped in the solvent lines. Check the solvent line filters. Purge the pump.</li> <li>• With the applied flow, the pump cannot build up enough pressure to reach the lower pressure limit. Adapt the lower pressure limit or increase the flow.</li> <li>• Leakage may be present in the system. Run the script: <b>Test System Tightness (Subject To Test = Pump)</b>.</li> <li>• A check valve may be contaminated or defective. Clean or replace the check valves (see <a href="#">Maintaining the Pump Head Check Valves</a> (► page 213)).</li> </ul>
Code 4100 Purge pressure limit exceeded	<p>A pressure of more than 5 MPa (50 bar) built up after a purge cycle has started.</p> <ul style="list-style-type: none"> <li>• If the message appears together with a message regarding the flowmeter filter backpressure (<b>code 4533</b>), replace the filter (see <a href="#">Replacing the Flowmeter Filter</a> (► page 218)).</li> <li>• A purge valve may be defective. Contact Technical Support.</li> </ul>
Code 4101 Not ready. Please run self-test.	<p>The pump is not ready because the self-test was not successful. Repeat the self-test.</p>
Code 4112 Self-test failed because of fluctuating pressure.	<p>Changes in pressure have occurred during the self-test. Wait until the system pressure is down or depressurize the system and repeat the self-test.</p>
Code 4113 Self-test failed because pressure is out of range.	<p>The pressure has not been down to zero during the self-test. Verify that the pressure sensor cables are properly connected. Wait until the system pressure is down or depressurize the system and repeat the self-test. If the message appears again, the system pressure sensor may be defective. Contact Technical Support.</p>
Code 4114 The device is busy. Please retry after 1 minute.	<p>The pump is not ready because, for example, a self-test or recalibration procedure is running. Retry after 1 minute. If the message appears again, wait until the system pressure is down or depressurize the system and turn the pump off and on again.</p>
Code 4119 Can't start pump while alarm is on.	<p>An alarm is present, for example, because leakage has been detected. You can restart the pump flow only when the alarm is no longer present. Mute the alarm by pressing the <b>MUTE ALARM</b> button on the pump keypad. Find and eliminate the source for the alarm as suggested for the accompanying message.</p>



Message and Code	Description and Remedial Action
Code 4120 The rear seal wash system has run out of wash solution.	<p>This message alerts you only when the drop counter functionality of the seal wash detector is enabled (standard setting).</p> <ul style="list-style-type: none"> <li>• The seal wash reservoir may be empty. Provide new seal wash liquid. Observe the recommendations for the seal wash liquid in <a href="#">Filling the Seal Wash Reservoir</a> (▶ <a href="#">page 130</a>).</li> <li>• Inspect the seal wash lines across the entire flow path for indications of blockage or leakage. All lines must be properly connected and routed. Replace the seal wash lines as necessary (see <a href="#">Seal Wash System Maintenance</a> (▶ <a href="#">page 266</a>)).</li> <li>• Check whether liquid escapes from the connections of the seal wash system or under the pump heads (see <a href="#">Testing the Seal Wash System for Leakage</a> (▶ <a href="#">page 266</a>)).</li> <li>• Inspect the peristaltic tubing for indications of blockage or damage. Replace the tubing as necessary (see <a href="#">Replacing the Peristaltic Tubing in the Seal Wash Pump</a> (▶ <a href="#">page 276</a>)).</li> <li>• Verify that the peristaltic tubing is properly inserted in the seal wash pump and that the lever of the pump is not blocked.</li> <li>• Verify that the seal wash tubing is connected to the correct port on the seal wash detector (port labelled <b>in</b>; see picture in <a href="#">Testing the Seal Wash System for Leakage</a> (▶ <a href="#">page 266</a>)).</li> <li>• Inspect the electrodes of the seal wash detector for contamination or damage. Replace the seal wash detector as necessary (see <a href="#">Replacing the Seal Wash Detector</a> (▶ <a href="#">page 280</a>)).</li> </ul>
Code 4121 Piston seal leakage has exceeded the recommended limit.	<p>This message alerts you only when the drop counter functionality of the seal wash detector is enabled (standard setting).</p> <p>Test the pump for leakage. Run the script: <b>Test System Tightness (Subject To Test = Pump)</b>. When the piston seals are leaky, replace the seals (see <a href="#">Replacing the Piston Seal</a> (▶ <a href="#">page 197</a>)).</p>
Code 4122 The rear seal leak sensor detects drops constantly.	<p>This message alerts you only when the drop counter functionality of the seal wash detector is enabled (standard setting).</p> <ul style="list-style-type: none"> <li>• Verify that the liquid flows off properly into the drain system, through the drain port at the bottom right of the leak tray.</li> <li>• Inspect the bottom side of the seal wash detector: Remove the seal wash detector assembly from the pump and disconnect the detector from the funnel. Dry the bottom side with a cloth or tissue. Inspect the detector electrodes. If they are clean and undamaged, reassemble the detector and the funnel and reinstall the assembly in the pump (see <a href="#">Replacing the Seal Wash Detector</a> (▶ <a href="#">page 280</a>)).</li> <li>• If the message appears again, the seal wash detector may be defective. Replace the seal wash detector (see <a href="#">Replacing the Seal Wash Detector</a> (▶ <a href="#">page 280</a>)).</li> </ul>

Message and Code	Description and Remedial Action
Code 4127 The pump drive is still in undock position. Please execute a dock command.	<p>This message alerts you during pump maintenance (for example, when replacing the piston seals or pistons) when you try to start the pump while the pump head is not yet in the position for operation.</p> <p>Return the pump head into the position for operation: On the keypad, the LEDs next to the <b>FLOW</b> button indicate which pump head is in the position for maintenance (LED is flashing green). Verify that this pump head is selected (LED next to the <b>SELECT</b> button is green) and press the <b>DOCK</b> button. When the pump is in the position for operation, the LED next to the <b>FLOW</b> button stops flashing.</p>
Code 4148 Can't perform this command while the flow is on.	You tried to run a self-test while the flow rate was not yet down to zero. Turn off the flow and repeat the command.
Code 4152 Pressure sensor malfunction. Check cable connection and retry.	<p>Verify that the cable of the pressure sensor for which the message appears is properly plugged into the connection port. Restart the flow.</p> <p>If the message appears again, the pressure sensor may be defective:</p> <ul style="list-style-type: none"> <li>• If the message appears for the pressure sensor of a pump head, replace the pump head.</li> <li>• If the message appears for the system pressure sensor, contact Technical Support.</li> </ul>
Code 4158 Out of eluent X.	This message alerts you only if you are monitoring the solvent consumption. The message indicates for which solvent the reservoir is empty. Provide new solvent. Run the script: <b>Change Liquids / Solvents</b> .
Code 4161 Pressure recalibration deviates by xx bar.	The pump pressure was not down to zero during the self-test. Wait until the pressure is down and repeat the test.
Code 4208 System pressure too high. Please relieve pressure and retry.	<p>Follow these steps:</p> <ol style="list-style-type: none"> <li>1. Verify that the pressure sensor cables are properly connected. Reconnect the cables if necessary.</li> <li>2. Check the flow path for blockage. Run the script: <b>Test System Back Pressure</b>.</li> <li>3. Run a self-test.</li> </ol> <p>If the message persists, the system pressure sensor may be defective. Contact Technical Support.</p>
Code 4209 Could not build up enough pressure. Please check the fitting plug.	<p>The pump could not build up enough pressure during pressure sensor calibration. This may be caused by the following:</p> <ul style="list-style-type: none"> <li>• Air may be trapped in the system. Purge the pump. Run the script: <b>Purge Pump</b>.</li> <li>• Leakage may be present. Run the script: <b>Test System Tightness (Subject To Test = Pump)</b>.</li> </ul>
Code 4213 Head pressure does not match system pressure. Execute the self-test or perform pressure recalibration.	<ol style="list-style-type: none"> <li>1. Run a self-test.</li> <li>2. If the message appears again, perform pressure recalibration. Run the script: <b>Adjust System Pressure Sensors</b>.</li> </ol>

Message and Code	Description and Remedial Action
Code 4220 Pump head not recognized. Please plug in the pressure sensor cable.	<ol style="list-style-type: none"> <li>1. Connect the pressure sensor cable from the pump head to the <b>Pressure</b> connector. If the cable is connected, verify that it is properly seated.</li> <li>2. If the problem persists, the pump head may be defective. Contact Technical Support or replace the pump head (see <a href="#">Replacing the Pump Head</a> (▶ page 185)).</li> </ol>
Code 4231 Pressure sensor not recognized. Please plug in the sensor cable.	<p>Verify that the cable of the pressure sensor for which the message appears is properly plugged into the connection port. Restart the flow.</p> <p>If the message appears again, the pressure sensor may be defective:</p> <ul style="list-style-type: none"> <li>• If the message appears for the pressure sensor of a pump head, replace the pump head (see <a href="#">Replacing the Pump Head</a> (▶ page 185)).</li> <li>• If the message appears for the system pressure sensor, the system pressure sensor may be defective. Contact Technical Support.</li> </ul>
Code 4232 The identification number of the XX has changed.	<p>XX is the left pump head or right pump head</p> <p>The message appears when a pump head has been replaced or when the left and right pump heads have been interchanged, for example, accidentally during maintenance/service. The message is for informational purposes only. No action is required.</p>
Code 4234 The flow was stopped due to a request from another module.	The pump flow was stopped because of a problem with another module. Check the messages from other modules.
Code 4238 Mainboard initialization failed.	<p>Main board initialization has not been successful.</p> <ol style="list-style-type: none"> <li>1. This may be a temporary error. Turn off the module. Wait for 5 seconds and turn on the module again.</li> <li>2. If the message appears again, update the firmware.</li> <li>3. If the message persists, the main board may be defective. Contact Technical Support.</li> </ol>
Code 4502 Cannot regulate flow. Run a leak test.	<p>The pump cannot deliver the selected flow rate.</p> <ul style="list-style-type: none"> <li>• Message is accompanied by message codes <b>4512</b> or <b>4532</b>: Follow the remedial actions suggested for the accompanying message. If this does not remedy the situation, there may be leakage in the system. Find and eliminate the source for the leakage (see <a href="#">Testing the System for Liquid Leaks</a> (▶ page 355)).</li> <li>• Message appears alone: There may be leakage in the system. Find and eliminate the source for the leakage (see <a href="#">Testing the System for Liquid Leaks</a> (▶ page 355)).</li> </ul>
Code 4503 The pressure exceeded the absolute limit.	Test the flow path for blockage. Run the script: <b>Test System Back Pressure</b> .
Code 4504 NC drive initialization error.	Repeat the self-test.
Code 4508 Piston drive home sensor remains dark.	Repeat the self-test.

Message and Code	Description and Remedial Action
Code 4512 Cannot pressurize due to inlet valve failure or air in system.	<p>A compression phase had to be repeated as the expected pressure was not reached. This can be due to air in the system or because the inlet check valve needs cleaning. However, the pump delivers the correct flow as the following compression phase was successful.</p> <p>If the message is rare and not accompanied by other messages, for example <b>code 4532</b>, you can tolerate the message. Otherwise:</p> <ul style="list-style-type: none"> <li>• Purge the pump. Run the script: <b>Purge Pump</b>.</li> <li>• If the message appears again after purging, clean the inlet check valve (see <a href="#">Cleaning the Check Valves (Pump Head)</a> (▶ page 216)).</li> <li>• Only use the genuine solvent lines authorized by Thermo Fisher Scientific for this pump.</li> </ul>
Code 4513 Home position deviation XX. Please execute self-test.	<p>XX is the value for the deviation.</p> <p>Make sure that you use the recommended seal wash liquid (see <a href="#">Filling the Seal Wash Reservoir</a> (▶ page 130)) and run a self-test.</p>
Code 4514 The user defined calibration data of the flow sensor is invalid.	<p>The calibration data for the selected solvent is incomplete. For example, because the calibration procedure has been interrupted unexpectedly.</p> <p>Repeat the calibration for the selected solvent (see <a href="#">Adding Custom Solvents to the Calibration Table</a> (▶ page 160)).</p>
Code 4517 Residual pressure too high for flow autozero.	Stop the flow and wait until the pressure has dropped.
Code 4519 Calibration table full.	In the calibration script, delete a solvent from the solvent calibration table to free up space.
Code 4520 Flowmeter memory unavailable.	Check that the flowmeter is correctly inserted.
Code 4522 Unknown solvent.	<p>The solvent you selected is not available in the solvent calibration table. Possible reasons are: The solvent was removed from the calibration table. The flowmeter was replaced, and a solvent (with the same name) has not been calibrated and added to the configuration of the new flowmeter.</p> <p>Select a solvent from the solvent calibration table or add the solvent to calibration table (see <a href="#">Adding Custom Solvents to the Calibration Table</a> (▶ page 160)).</p>
Code 4523 Drift rate too high for flow autozero.	<p>The flow is not stable.</p> <ol style="list-style-type: none"> <li>1. Wait until the system pressure is down to zero.</li> <li>2. Purge the pump to remove residual air.</li> <li>3. When the pump has been powered on for at least 6 hours, repeat autozero.</li> </ol>
Code 4526 Command sequence error.	The commands were executed in a wrong or unexpected order. Check the command script in your method for errors.
Code 4527 Maximum compression rate limit exceeded.	The specified method causes too high compression rates for the selected column. Decrease the compression rate where specified in the method and/or decrease the value for the flow acceleration (maximum flow ramp up).

Message and Code	Description and Remedial Action
Code 4529 The pump capillary connections are setup for solvent calibration. Normal operation is not possible.	A calibration attempt has been interrupted. Use the solvent calibration scripts to either complete the calibration or return the pump to the original capillary configuration as required by the application.
Code 4531 Cannot deliver flow at this pressure.	The pump cannot deliver the requested flow rate at the resulting pressure. Adapt the application setup. For example, reduce the flow rate. See <a href="#">Dependency of Column Pressure and Flow Rate</a> (▶ page 159).
Code 4532 Cannot regulate flow due to air in system or inlet valve failure.	One or more compression phases were unsuccessful. The pump could not deliver the correct flow. This can be due to air in the system or because the inlet check valve needs cleaning. The message appears together with other messages, for example <b>code 4502</b> and <b>code 4512</b> . <ul style="list-style-type: none"> <li>• Check the liquid level in the solvent reservoir.</li> <li>• Purge the pump. Run the script: <b>Purge Pump</b>.</li> <li>• If the message appears again after purging, clean the inlet check valve (see <a href="#">Cleaning the Check Valves (Pump Head)</a> (▶ page 216)).</li> <li>• Only use the genuine solvent lines authorized by Thermo Fisher Scientific for this pump.</li> </ul>
Code 4533 Elevated filter backpressure. Consider replacing the flowmeter filter soon.	The message appears to inform you before an actual problem occurs. The message indicates that there may be a problem with the solvents, for example, algae growth. Consider replacing the flowmeter filter (see <a href="#">Replacing the Flowmeter Filter</a> (▶ page 218)). Observe the recommendations in <a href="#">Use of Solvents and Additives</a> (▶ page 141).
Code 4534 System pressure exceeded maximum pressure during purge.	<ol style="list-style-type: none"> <li>1. On the flowmeter outlet, remove the capillary to the autosampler and retry.</li> <li>2. Depends as follows: <ul style="list-style-type: none"> <li>• The error is no longer present: The autosampler fluidics or the capillary to the autosampler may be clogged. As applicable, eliminate the source for the clogging and/or replace the capillary from the flowmeter to the autosampler.</li> <li>• The error persists: In the flowmeter, the T-piece or the restrictor capillaries may be clogged. Contact Technical Support.</li> </ul> </li> </ol>

### 8.2.3 Autosampler Messages

This section provides information on messages with code numbers 5000 through 5999. These messages are specific to the autosampler.

The table lists the most frequently observed messages for the autosampler.

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. If the message appears again, contact Technical Support.
Code 5002 Command rejected – module is in error state.	An internal error has occurred. Perform a self-test.
Code 5010 Horizontal needle drive blocked. Loosen transport lock completely.	Loosen the shipping lock screw above the needle unit. See <a href="#">Unlocking the Needle Unit</a> (▶ page 239). Check that the horizontal needle drive can be shifted easily. If obstacles are present in the way of the needle drive, remove the obstacles.
Code 5011 Vertical needle drive blocked. Check for correct installation of sample loop.	Check that the sample loop is installed correctly. See the steps for installation of the sample loop in <a href="#">Sample Loop Maintenance</a> (▶ page 232).
Code 5012 Selftest failed.	The autosampler failed the self-test. Contact Thermo Fisher Scientific Technical Support for assistance.
Code 5013 Carousel blocked. Check for obstructions with racks or sample containers.	Rotate the carousel and check that it can be moved easily. If obstacles are present in the way of the carousel, remove the obstacles.
Code 5014 Rack not found. Check for correct rack position in the carousel and sample sequence.	Check if a sample rack or well plate is installed in this segment in the carousel. Check that it is placed correctly (see <a href="#">Loading the Carousel</a> (▶ page 156)) and correct the position, if required.
Code 5015 Vial not found. Check for correct vial position in the rack and sample sequence.	Check if a vial or well plate is present at the specified position. Place a sample container at the specified position (see <a href="#">Loading the Carousel</a> (▶ page 156)). Check the sample positions defined in the sample sequence. Specify a different position, if necessary.
Code 5016 Needle seat not found. Install needle seat.	Verify that the needle seat is installed. Install or replace the needle seat and needle unit, if necessary (see <a href="#">Replacing Needle Seat and Needle Unit</a> (▶ page 241)).
Code 5017 Needle hit an unexpected object due to incorrect sample rack or well plate configuration.	Check if the correct sample rack or well plate is configured and the correct sample position is defined in the sequence. Consider the number of positions of the configured sample rack or well plate as well as the respective well plate height.
Code 5018 Vial pusher hit an object that is higher than expected. Check the rack and/or well plate configuration.	The vial pusher encountered an object that is higher than expected. Check the sample rack or well plate configuration. Consider the height of the sample rack or well plate.
Code 5019 Inject process refused. Pressure too high for installed components. Reduce pressure to value specified in manual.	The operating pressure is above the specified pressure range for the autosampler. Reduce the operating pressure and restart the run. Observe the pressure specifications in Performance Specifications.

Message and Code	Description and Remedial Action
Code 5020 Septum too strong/tight for bottom detection. Check documentation for supported consumables.	The needle cannot puncture the used septa or well plate cover. For supported vial caps and well plate covers, see <a href="#">Recommendations on Vial Caps and Well Plate Covers</a> (▶ page 158).
Code 5021 Loop cover removed while temperature control is on. Replace cover or temperature control will shut down in X.X minutes.	With X.X = the number of minutes With autosamplers that come with an insulation (loop) cover, the cover must be installed to use sample thermostating. If the cover is not installed properly, thermostating cannot be enabled or will be turned off automatically to protect the interior components from high humidity and extensive condensation when thermostating the sample compartment.
Code 5022 Temperature control shut down due to missing loop cover.	With autosamplers that come with an insulation (loop) cover, the cover must be installed to use sample thermostating. If the cover is not installed properly, thermostating cannot be enabled or will be turned off automatically to protect the interior components from high humidity and extensive condensation when thermostating the sample compartment.
Code 5023 Insulation Loop Cover Bracket removed while temperature control is on. Replace frame or temperature control will shut down in X.X minutes.	With X.X = the number of minutes The insulation cover mounting bracket has been removed while the temperature control was turned on. The insulation cover must be installed to use sample thermostating. Reinstall or replace the insulation cover mounting bracket as described in <a href="#">Replacing Needle Seat and Needle Unit</a> (▶ page 241) and install the insulation cover as described in <a href="#">Installing the Insulation Cover</a> (▶ page 95).
Code 5024 Insulation Loop Cover Bracket missing.	The insulation cover mounting bracket has been removed while the temperature control was turned on. Reinstall or replace the insulation cover mounting bracket as described in <a href="#">Replacing Needle Seat and Needle Unit</a> (▶ page 241) and install the insulation cover as described in <a href="#">Installing the Insulation Cover</a> (▶ page 95).
Code 5029 Carousel home sensor failure.	When the message appears, write down the message code and turn off the module. Wait for 5 seconds and turn on the module again. If the message appears again, contact Technical Support.
Code 5030 Carousel motor failure or blockade.	When the message appears, write down the message code and turn off the module. Wait for 5 seconds and turn on the module again. If the message appears again, contact Technical Support.
Code 5032 Both doors not closed while temperature control is on. Close both doors or temperature control will shut down in xx minutes.	xx = the number of seconds before autosampler is shut down Keep both autosampler doors closed when temperature control is on.
Code 5032 Both doors not closed while temperature control is on. Close both doors or temperature control will shut down in xx minutes.	xx = the number of seconds before autosampler is shut down Keep both autosampler doors closed when temperature control is on.
Code 5033 Temperature control shut down due to open door.	Close both autosampler doors and restart temperature control.
Code 5035 Temperature control shut down due to xx fan failure.	When the message appears, write down the message code and turn off the module. Wait for 5 seconds and turn on the module again. If the message appears again, contact Technical Support.

Message and Code	Description and Remedial Action
Code 5037 Backup memory error. Module not operational.	When the message appears, write down the message code and turn off the module. Wait for 5 seconds and turn on the module again. If the message appears again, contact Technical Support.
Code 5039 Calibration process refused, pressure below 100 bar.	Pressure sensor calibration is not possible because system pressure is too low. Check for leakage or air in the system. Repeat pressure sensor calibration.
Code 5040 Model – Firmware Mismatch! This firmware only supports VN-A10 models! Download appropriate firmware!	You tried to download the wrong firmware. Select a Vanquish Neo autosampler firmware file for download.
Code 5042 Vanquish Neo sampler detected unknown inject valve bypass position. Set correct position and run self-test command.	The autosampler was interrupted during a script, such as <b>Change Fluidics / Workflow</b> . Repeat the script.
Code 5043 Vanquish Neo Pump not found on system interlink. Cannot receive pressure from pump SN xx.	With xx = the serial number of the pump Check that all System Interlink cables on the Vanquish system are properly connected.
Code 5045 Could not pressurize while delivering solvent. Check for air or leakages in system.	Run the following script and follow the instructions: <b>Test System Tightness</b> .
Code 5099 The device is busy.	The autosampler is not ready because, for example, a self-test is running or the autosampler is still busy processing a previous command. Retry when the autosampler is ready.



## 8.2.4 Column Compartment Messages

This section provides information on messages with code numbers 2000 through 2999. These messages are specific to the column compartment.

The table lists the most frequently observed messages for the column compartment.

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. 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 2095 Wrong right valve pod installed.	Verify that the configured valve pod and the installed valve pod match.
Code 2096 Wrong left valve pod installed.	Verify that the configured valve pod and the installed valve pod match.
Code 2097 Right valve position error.	<ol style="list-style-type: none"> <li>1. Verify that the configured valve pod and the installed valve pod match.</li> <li>2. Verify that the valve pod is correctly installed.</li> <li>3. Start the catch valve function by pressing and holding the <b>VALVE RIGHT</b> button on the keypad.</li> </ol>
Code 2098 Left valve position error.	<ol style="list-style-type: none"> <li>1. Verify that the configured valve pod and the installed valve pod match.</li> <li>2. Verify that the valve pod is correctly installed.</li> <li>3. Start the catch valve function by pressing and holding the <b>VALVE LEFT</b> button on the keypad.</li> </ol>

## 8.3 System Troubleshooting

This section is a guide to troubleshooting issues that may arise during operation of the Vanquish system. Locate the table for the type of symptom you have, find the possible cause, and use the description of the solution to help you solve your problem quickly.

This section provides information on symptoms and causes directly related to the LC system modules and connections between the modules. For information on general chromatography and application troubleshooting, refer to the technical literature.

The Vanquish User Interface provides some scripts for troubleshooting the system.

Problem	Script
<ul style="list-style-type: none"> <li>• High column backpressure</li> <li>• Overpressure shutdown</li> <li>• Poor peak area precision</li> <li>• Continuously rising pressure</li> <li>• No flow or the pump issued a message indicating that it could not regulate the flow</li> </ul>	<b>Test System Back Pressure</b>
<ul style="list-style-type: none"> <li>• Low column pressure</li> <li>• Retention time variations</li> <li>• Poor peak area precision</li> <li>• No flow or the pump issued a message indicating that it could not regulate the flow</li> </ul>	<b>Test System Tightness</b>
System settings do not match	To set the system or single system modules to factory default values, run the script: <b>Reset to Factory Defaults</b> .
System settings could not be retrieved, and the system could not be initialized properly	Run the script with the parameters appropriate for your configuration and workflow: <b>Init System Setup</b> .
Injection was aborted	Run the script: <b>Clean Up System</b> .

### 8.3.1 Peaks

#### No peaks

Possible Cause	Remedial Action
Pre-heater used in nano or capillary LC applications	Remove the pre-heater (see <a href="#">Replacing the Passive Pre-Heater</a> (▶ page 293)).
Wrong capillaries used between column and detector or between autosampler and column	Use the correct capillaries for your application (to change the workflow and the flow connections, run the script: <b>Change Fluidics / Workflow</b> or refer to the <i>Flow Scheme</i> ).
Air bubbles in sample loop, needle, or metering device	Purge the autosampler.
Vial empty	Check the sample level in the vial. If the sample level is too low, replace the vial with a filled one.
Solvent in solvent reservoir does not match the solvent setting	Change the solvent in the solvent reservoir or change the solvent setting.

#### Peak drift

Possible Cause	Remedial Action
Solvent degasser for micro LC applications used in nano LC applications	Connect the solvent lines from the reservoirs to the pump shut-off valves (see <a href="#">Replacing Solvent Lines from Reservoir to Pump</a> (▶ page 222)).
Temperature of column compartment not stable	<ol style="list-style-type: none"> <li>1. Check the temperature of the column compartment.</li> <li>2. Wait until the temperature has stabilized.</li> </ol>
After changing the solvent type, the previous solvent has not been removed completely from the autosampler or system	<ol style="list-style-type: none"> <li>1. If the script (<b>Change Liquids / Solvents</b>) did not fully remove the previous solvent, check whether the correct parameter was set: <b>Refresh Only = Off</b>.</li> <li>2. Run the script again: <b>Change Liquids / Solvents</b> with the parameter: <b>Refresh Only = Off</b>.</li> </ol>

### 8.3.1.1 Peak Shape

#### Peak tailing

Possible Cause	Remedial Action
Extra column volume too large	<ul style="list-style-type: none"> <li>• Use short capillary connections with a suitable inner diameter.</li> <li>• Use the Viper capillaries appropriate for your application (refer to the script: <b>Change Fluidics / Workflow</b>).</li> </ul>
Improper capillary connections	<ol style="list-style-type: none"> <li>1. Check fittings for correct placement.</li> <li>2. Loosen and retighten Viper fittings (see <a href="#">Connecting NanoViper Capillaries</a> (▶ page 119)).</li> <li>3. Use the Viper capillaries appropriate for your application (refer to the script: <b>Change Fluidics / Workflow</b>).</li> <li>4. Replace the capillary.</li> </ol>
Dead volumes in capillary connections	<ol style="list-style-type: none"> <li>1. Run the script: <b>Test System Tightness (Subject To Test = Sampler)</b>.</li> <li>2. Inspect the capillary and replace the capillary, if necessary.</li> </ol>

#### Peak broadening

Possible Cause	Remedial Action
Extra-column volume too large	<ul style="list-style-type: none"> <li>• If early peaks are broader than later eluting ones, check the capillary I.D. and the capillary length, for example.</li> <li>• Use a capillary with a smaller volume for the connection between column compartment and downstream detecting device.</li> </ul>
Temperature gradient in column	<ul style="list-style-type: none"> <li>• If using flow rates &gt; 50 µL/min, in particular with 1-mm ID columns in the flow range of 50-100 µL/min, use a pre-heater.</li> <li>• If a pre-heater is already installed, check the pre-heater for correct installation. If necessary, reinstall the pre-heater (see <a href="#">Replacing the Passive Pre-Heater</a> (▶ page 293)).</li> </ul>
Capillaries partly clogged	<ol style="list-style-type: none"> <li>1. Run the script: <b>Test System Back Pressure</b>.</li> <li>2. Replace the capillaries.</li> </ol>
Sample loop partly clogged	Run the script: <b>Test System Back Pressure</b> .
Dead volumes in capillary connections	<ol style="list-style-type: none"> <li>1. Run the script: <b>Test System Tightness (Subject To Test = Sampler)</b>.</li> <li>2. Properly install the capillary connections.</li> <li>3. Tighten the capillary connections.</li> <li>4. Replace the capillary.</li> </ol>

*Peak broadening, increased dead time*

Possible Cause	Remedial Action
After-column volume high	<ul style="list-style-type: none"> <li>• Use a capillary with an appropriate: <ul style="list-style-type: none"> <li>◆ Inner diameter</li> <li>◆ Length</li> </ul> </li> <li>• Inspect the capillary. If it is defective, replace the capillary.</li> </ul>
Needle seat filter clogged	<ol style="list-style-type: none"> <li>1. Run the script: <b>Test System Back Pressure</b>.</li> <li>2. Replace the needle seat, if necessary.</li> </ol>

*Triangular peaks*

Possible Cause	Remedial Action
Column overloaded (sample concentration too high)	Dilute the sample.

**8.3.1.2 Ghost Peaks, Negative Peaks and Spikes***Ghost peaks*

Possible Cause	Remedial Action
Contamination (typically injector or column)	Flush the system including the column using an appropriate solvent (see <a href="#">Flushing the Pump with Persistent Contamination Only</a> (▶ page 179)).
Eluents are degraded, dirty or of poor purity/quality	<ul style="list-style-type: none"> <li>• Use fresh and appropriate solvents, for example, MS-grade.</li> <li>• Replace the solvent reservoirs using fresh and appropriate solvents (MS-grade) (run the script: <b>Change Liquids / Solvents</b>).</li> </ul>

*Negative peaks*

Possible Cause	Remedial Action
Different composition of sample solvent and mobile phase	Dissolve the sample in the mobile phase.
Air injected/vial empty	Check whether the vial is empty. Replace the vial with a filled one.

*Spikes*

Possible Cause	Remedial Action
Electrical interferences from other system modules	<ul style="list-style-type: none"> <li>• Avoid operation of equipment generating strong electric or magnetic fields in close proximity.</li> <li>• Do not connect equipment that may cause power disturbances to the same power network used to supply the system.</li> </ul>
Column temperature significantly above boiling point of mobile phase	When developing methods, prevent the column temperature from getting significantly above the boiling point of the mobile phase.
Solvent insufficiently degassed	Degas solvents in an ultrasonic bath.

**8.3.1.3 Peak Area Precision***Poor peak area precision/peak areas too small*

Possible Cause	Remedial Action
Air bubbles in sample loop, needle, or metering device	Purge the autosampler.
Vial empty	Check the sample level in the vial. If the sample level is too low, replace the vial with a filled one.

*Contamination or carry-over*

Possible Cause	Remedial Action
Contamination in the system	Flush the system using an appropriate solvent. If you use water as solvent in pump channel A, flush it with 80% acetonitrile.
Autosampler carry-over due to contaminated needle	<ol style="list-style-type: none"> <li>1. Check whether one of the needle wash lines (labeled SWP and WWP) is squeezed.</li> <li>2. Check whether one of the needle wash reservoirs is empty. If one of the reservoirs is empty, replace it by running the script: <b>Change Liquids / Solvents</b>. Use an appropriate needle wash liquid (see <a href="#">Filling the Needle Wash Reservoirs</a> (▶ page 127)).</li> <li>3. Check whether the needle wash is deactivated in the chromatography data system. If yes, activate the needle wash.</li> <li>4. To wash the needle and needle seat, run the script: <b>Clean Up System</b>.</li> <li>5. If carry-over persists, replace the needle unit and the needle seat (see <a href="#">Replacing Needle Seat and Needle Unit</a> (▶ page 241)).</li> </ol>
Autosampler carry-over due to worn or damaged needle seat	Replace the needle seat (see <a href="#">Replacing Needle Seat and Needle Unit</a> (▶ page 241)).

*Instable analysis or poor reproducibility*

Possible Cause	Remedial Action
Unstable environmental conditions	<ul style="list-style-type: none"> <li>• Make sure that the temperature and air humidity are constant. For information on the specified environmental conditions, refer to the operating manual of the detection device.</li> <li>• Use column thermostating.</li> <li>• If the sample allows cooling, cool the sample in the autosampler.</li> <li>• Avoid draft.</li> </ul>
Irreproducible gradient	<ul style="list-style-type: none"> <li>• Check the value for %B. If it is outside the range 1-99, correct it.</li> <li>• The system is not properly equilibrated. Let the system equilibrate for 5 hours.</li> <li>• Purge the pump.</li> </ul>

*Leakage*

Possible Cause	Remedial Action
Capillary connections not installed properly or not tight	<ul style="list-style-type: none"> <li>• Run the script: <b>Test System Tightness (Subject To Test = System)</b>.</li> <li>• Inspect the capillary and replace it if necessary.</li> </ul>

*Sample problems*

Possible Cause	Remedial Action
Sample is unstable and decomposes	<ul style="list-style-type: none"> <li>• Cool the sample in the autosampler.</li> <li>• Use a new sample.</li> <li>• Change the environmental conditions.</li> </ul>

*Injection volume variation*

Possible Cause	Remedial Action
Autosampler draws air from vial	<p>There is not enough sample in the vial or the needle height setting is incorrect.</p> <ul style="list-style-type: none"> <li>• Check the sample level in the vial. If the sample level is too low, replace the vial with a filled one.</li> <li>• To check whether the needle is clogged, run the script: <b>Test System Back Pressure</b>. Follow the instructions.</li> </ul>
Air trapped in autosampler flow path	Purge the autosampler.
Gas content of sample too high or saturated	Degas the sample if possible.
Injector needle clogged or needle tip deformed	Run the script: <b>Test System Back Pressure</b> . Follow the instructions.
Piston seals in autosampler metering device leaking	Run the script: <b>Test System Tightness (Subject To Test = Sampler)</b> . Follow the instructions.
Injection valve or other autosampler components leaking	Run the script: <b>Test System Tightness (Subject To Test = Sampler)</b> . Follow the instructions.

Possible Cause	Remedial Action
Needle seat worn out	Run the script: <b>Test System Tightness (Subject To Test = Sampler)</b> . Follow the instructions.

### 8.3.2 Pressure

#### *Pressure pulsation or inconstant pressure*

Possible Cause	Remedial Action
System clogged with particles	<p>Samples and insufficient solvent purity are frequently the source for particles clogging the system. In nano LC and capillary LC applications, the capillaries with even smaller inner diameters need an even higher level of solvent and sample purity.</p> <ul style="list-style-type: none"> <li>• Nano LC and capillary LC applications: To avoid contaminating the sample, do the following: <ul style="list-style-type: none"> <li>◆ Use the vials with particle-free septa from the ship kit or those listed in <a href="#">Recommendations on Vial Caps and Well Plate Covers</a> (► page 158).</li> <li>◆ Reduce the number of replicates from one capped vial to &lt;10.</li> <li>◆ Wash the needle and/or intensify the needle wash in the chromatography data system.</li> </ul> </li> <li>• Run the script: <b>Test System Back Pressure</b>. Follow the instructions.</li> </ul>
Solvent is degraded	Use fresh solvent.

#### *High backpressure*

Possible Cause	Remedial Action
One or more capillaries in the system clogged or damaged by bending	Run the script: <b>Test System Back Pressure</b> . Follow the instructions.
Column contaminated or clogged	<ol style="list-style-type: none"> <li>1. Run the script: <b>Test System Back Pressure</b>. Follow the instructions.</li> <li>2. If the test succeeds, the column or the capillary to the down-stream device is clogged.</li> <li>3. Replace the column or the capillary to the downstream device.</li> </ol>
Column switching valve clogged	<ol style="list-style-type: none"> <li>1. Check the valve for indications of blockage.</li> <li>2. Replace the valve if necessary (see <a href="#">Replacing the Vanquish Switching Valve</a> (► page 287) or <a href="#">Replacing the VICI Switching Valve</a> (► page 290)).</li> </ol>
Pre-heater clogged	Replace the pre-heater (see <a href="#">Replacing the Passive Pre-Heater</a> (► page 293)).
Contamination in the system	Flush the system by purging the pump and the autosampler with an appropriate solvent.
Solvent in solvent reservoir does not match the solvent setting	Change the solvent in the solvent reservoir or change the solvent setting.



*Low backpressure*

Possible Cause	Remedial Action
Leak in system	Run the script: <b>Test System Tightness (Subject To Test = System)</b> . Follow the instructions.
Air trapped in the autosampler	Run the script: Purge Sampler.
Solvent in solvent reservoir does not match the solvent setting	Change the solvent in the solvent reservoir or change the solvent setting.

**8.3.3 Retention Time Variation***Decreasing retention times*

Possible Cause	Remedial Action
Improper solvent composition	<ul style="list-style-type: none"> <li>• Check the premixed solvent for age.</li> <li>• Purge the pump.</li> <li>• When preparing the system for operation, let it equilibrate for 5-24 hours.</li> <li>• Run the script: <b>Adjust Pump Flow Sensor Offsets</b>.</li> </ul>

*Increasing retention times*

Possible Cause	Remedial Action
Improper solvent composition	<ul style="list-style-type: none"> <li>• Check the premixed solvent for age.</li> <li>• Purge the pump.</li> <li>• When preparing the system for operation, let it equilibrate for 5-24 hours.</li> <li>• Run the script: <b>Adjust Pump Flow Sensor Offsets</b>.</li> </ul>
Decreasing flow rate	<ol style="list-style-type: none"> <li>1. Run the script: <b>Test System Tightness (Subject To Test = System)</b>. Follow the instructions.</li> <li>2. Check flow rate settings.</li> </ol>

*Scattering retention times*

Possible Cause	Remedial Action
Pressure fluctuations from pump	Run the script: <b>Test System Tightness (Subject To Test = System)</b> .
Air trapped in the autosampler	Run the script: <b>Purge Sampler</b> with the parameter: <b>Inner Needle Wash Weak Liquid</b> .

*Shifts in retention time for a longer period*

Possible Cause	Remedial Action
After changing the solvents, the previous solvent has not been removed completely from the pump.	Purge the pump.
Column temperature, sample temperature or solvent temperature is instable	Wait until the column temperature, sample temperature or solvent temperature is fully equilibrated.

*Retention time outside the expected range*

Possible Cause	Remedial Action
The thermal flow sensors may have a small drift or a shift.	Run the script: <b>Adjust Pump Flow Sensor Offsets</b> .
Pre-mixed solvents are too old.	<ul style="list-style-type: none"> <li>• Use fresh eluent.</li> <li>• Use fresh and appropriate solvents (for example, MS-grade).</li> <li>• Purge the pump.</li> </ul>
Pre-heater used in nano LC applications	Remove the pre-heater (see <a href="#">Replacing the Passive Pre-Heater</a> (► page 293)).
Wrong volume after the column	Check the volume of the capillary connected to the OUT port of the column.
Sample loop variant does not match the set variant	Check whether the setting for the sample loop matches the installed one and correct it if necessary.
Solvent in solvent reservoir does not match the solvent setting	Change the solvent in the solvent reservoir or change the solvent setting.

**8.3.4 Baseline***High baseline drift*

Possible Cause	Remedial Action
System not sufficiently equilibrated	<ol style="list-style-type: none"> <li>1. Flush the system until equilibration. Usually, a volume of 5–10 times the column volume will be sufficient.</li> <li>2. If flushing the system does not solve the problem, purge the pump and let the system equilibrate for at least 5 hours.</li> </ol>
Unstable environmental conditions	Make sure that the temperature and the humidity are constant.

Possible Cause	Remedial Action
Absorption of eluent changes when gradient is run	Absorbing additives may change the absorption spectrum, depending on the solvent. Consider varying additive concentrations to level the drift.
Autosampler contaminated	Run the script: <b>Clean Up System</b> .
Column contaminated	Clean or replace the column.
Old solvent present in metering device head or sample loop	To purge the metering device or sample loop, run the script: <b>Purge Sampler</b> with the parameter <b>Inner Needle Wash Strong Liquid</b> . In general, when replacing the solvent reservoirs, run the script: <b>Change Liquids / Solvents</b> .
Solvents degraded or inhomogeneous	<ul style="list-style-type: none"> <li>• Before starting an analysis, make sure that the solvents are already homogenized in the reservoirs.</li> <li>• In aqueous solvents, microorganisms can grow and degrade the solvent. To replace the solvent with a new solvent reservoir containing fresh solvent, run the script: <b>Change Liquids / Solvents</b>. Follow the instructions.</li> </ul>

#### *Non-periodic baseline fluctuation, high noise*

Possible Cause	Remedial Action
Air trapped in the system	Purge the pump and the autosampler.
Solvent is degraded or of poor quality	<ul style="list-style-type: none"> <li>• Use fresh eluent.</li> <li>• Use appropriate solvents (MS-grade).</li> <li>• To change the solvent, run the script: <b>Change Liquids / Solvents</b>.</li> </ul>

#### *Periodic baseline fluctuation, pulsation*

Possible Cause	Remedial Action
Pressure fluctuations from pump	<ul style="list-style-type: none"> <li>• Purge the pump.</li> <li>• Run the script: <b>Test System Back Pressure</b>.</li> </ul>
Air trapped in the system	Purge the pump.

## 8.3.5 Temperature Control

### 8.3.5.1 Column Compartment Temperature Control Problems

*Column compartment temperature does not change although the set point has not been reached*

Possible Cause	Remedial Action
Ambient temperature too high or setpoint lower than the specified difference to the ambient temperature	<ul style="list-style-type: none"> <li>• Reduce the ambient temperature (for example, by air-conditioning the room).</li> <li>• Select a higher temperature setpoint.</li> </ul>
Temperature control turned off	Turn on the temperature control.
Ventilation opening obstructed	<ol style="list-style-type: none"> <li>1. Open the doors of the column compartment and wait until the fans have stopped.</li> <li>2. Inspect the ventilation openings of the column compartment for obstructions.</li> <li>3. Remove any obstructing particles from the ventilation openings.</li> </ol>
Ambient air enters column chamber	<p>Improper sealing of the column chamber may impair the heating performance of the column compartment.</p> <ol style="list-style-type: none"> <li>1. Check whether the front doors close properly.</li> <li>2. Check whether the doors seal properly.</li> <li>3. Check the door seal for damage. If the door seal is damaged, replace the door (see <a href="#">Replacing the Doors</a> (► page 307)).</li> </ol>
Column compartment defective	Contact Technical Support.

### 8.3.5.2 Autosampler Temperature Control Problems

*Autosampler does not reach set temperature*

Possible Cause	Remedial Action
Ambient temperature or humidity too high	<ol style="list-style-type: none"> <li>1. Check that the insulation cover is installed.</li> <li>2. Reduce the ambient temperature (for example, by ventilating the room), and/or ambient humidity.</li> </ol>

### 8.3.6 Power and Communication

*Entire system has no power (all LED status bars off)*

Possible Cause	Remedial Action
System power button turned off	Turn on the system with the lower power button on the front left of the system base.

*System controller has no power*

Possible Cause	Remedial Action
Power button of the system controller turned off	Turn on the system controller with the upper power button on the front left of the system base.
Main power switch of the system controller turned off	Turn on the system controller with its main power switch.
Module not connected to the mains	Connect the power cord.
Error in electronic system	Contact Technical Support.

*System module has no power (LED status bar off)*

Possible Cause	Remedial Action
Module power turned off	Turn on the module with its main power switch.
Module not connected to the mains	Connect the power cord.
Fuse has blown	Replace the fuse (see <a href="#">Replacing the Main Power Fuses</a> (▶ page 306)).
Error in electronic system	Contact Technical Support.

*One or more modules cannot be turned off from the power button on the system base*

Possible Cause	Remedial Action
System interlink cables missing or defective	Check the system interlink connections between the system base and the system modules, see <a href="#">Connecting System Interlink Cables</a> (▶ page 110).

*Module cannot be operated from the chromatography data system*

Possible Cause	Remedial Action
No connection between module and computer	<ul style="list-style-type: none"> <li>• Check the USB connections from the system to the computer, see <a href="#">Connecting USB Cables</a> (▶ page 105). If the module uses a USB hub on another module, make sure that the module that provides the hub is turned on.</li> <li>• Check the USB port on the computer. USB standard 2.0 is required.</li> </ul>

### 8.3.7 User Interface related Problems

Symptom	Possible cause	Remedial actions
Display flickering	Display not properly connected	Check whether the display cable connector is fastened hand-tight to the <b>Display Data</b> port of the system controller.
Display not working	Display not connected to system controller	<ol style="list-style-type: none"> <li>1. Check whether the display is connected to the system controller. If not, proceed with the next step.</li> <li>2. Turn off the system controller.</li> <li>3. Connect the display to the system controller (see <a href="#">Connecting the Display Cables</a> (▶ page 108)).</li> <li>4. Turn on the system controller.</li> </ol>
System controller cannot be turned off with its power push button	The short VSC cable is not connected	Make sure that the short VSC cable connects the VSC port of the system base to the VSC port of the system controller.
System controller cannot be turned on although its main power switch is turned on		
System module not shown or scripts missing in the Vanquish User Interface	System module not connected to system interlink interface	<ol style="list-style-type: none"> <li>1. Check whether the system interlink port of the system module is connected to the system interlink port of the system controller (see <a href="#">Connecting System Interlink Cables</a> (▶ page 110)).</li> <li>2. Check whether the system module is turned on with its main power switch.</li> <li>3. Replace the system interlink cable.</li> </ol>
	System module not connected to the correct port of the system controller	Check whether the system interlink port of the system module is connected to the correct system interlink port of the system controller (see <a href="#">Connecting System Interlink Cables</a> (▶ page 110)).

## 8.4 Testing the System for Liquid Leaks

Regularly test the system for leaks for the following liquids:

Liquid	Follow the instructions in...
Solvent	This section
Seal wash liquid	Testing the Seal Wash System for Leakage (▶ page 266)
Solvent and needle wash liquid from the autosampler valves	Inspecting the Autosampler Valves for Leakage (▶ page 283)
Condensing water from the autosampler	Testing the Drain Pump Tubing (▶ page 253)

### When

- Regularly (as part of the maintenance plan):
  - ◆ After replacing the solvent reservoirs
  - ◆ After changing the workflow
- The leak sensor is wet. A leak sensor reports leakage.
- Chromatography problems:
  - ◆ Peaks are too small
  - ◆ Variations in retention time

### Parts and additional items required

- Replacement part as 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 169](#)).

### *Follow these steps*

1. Run the script: **Test System Tightness (Subject To Test = System)** with the parameter: **Trap Column In-Line = Yes**, if available.
2. *If column switching valves are installed in the column compartment:* While the script is running that also checks the column switching valves in the left position, visually check the column switching valves in the right position (see [Inspecting the Column Switching Valves for Leakage](#) (▶ [page 286](#))).
3. Check whether the script has found a leakage. If a leakage was found, resolve the leakage following the instructions on the screen.
4. To verify that the leakage has been fully resolved, run the script again and check the result.



# 9 Specifications

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

## 9.1 Physical Specifications

### 9.1.1 Environmental Specifications

The environmental conditions are specified as follows:

Type	Specification
Range of use	Indoor use only
Ambient operating temperature	5 °C - 35 °C
Ambient storage temperature	-20 °C - 45 °C
Ambient operating humidity	20% - 80% relative humidity (non-condensing)
Ambient storage humidity	Maximum 60% relative humidity (non-condensing)
Operating altitude	Maximum 2000 m above sea level
Pollution degree	2
Overvoltage category	II

### 9.1.2 Power Requirements

The power requirements are specified as follows:

Product	Power requirements
Pump	100 – 240 VAC, ± 10 %; 50/60 Hz, max. 525 W / 550 VA
Autosampler	100 – 240 V AC, ± 10 %; 50/60 Hz; max. 525 W / 550 VA
Column compartment	100 – 240 V AC, ± 10 %; 50/60 Hz; max. 525 W / 550 VA
System controller	100 – 240 VAC, ± 10 %; 50/60 Hz, max. 50 W / 150 VA

### 9.1.3 Dimensions

The dimensions of the system and system modules are specified as follows:

Product	Dimension (height x width x depth)	
System	Basic configuration <sup>1</sup> : 74 x 45 x 65 cm <sup>2</sup>	Basic configuration and column compartment: 82 x 45 x 65 cm <sup>3</sup>
Pump	19.2 x 42 x 62 cm	
Autosampler	29 x 42 x 62 cm	
Column compartment	Outer dimension	15.9 x 42 x 62 cm
	Column chamber	7.8 x 34.3 x 3.7 cm
<sup>1</sup> : The basic configuration includes the system base with system controller, pump, autosampler and display		
<sup>2</sup> : Display mounted to the autosampler and positioned in front of the solvent rack		
<sup>3</sup> : Display mounted to the autosampler and positioned in front of the column compartment		

### 9.1.4 Emission Sound Pressure Level

The emission sound pressure levels are specified as follows:

Product	Emission sound pressure level
System	< 75 dB(A), typically < 55 dB(A)
Pump	< 70 dB(A), typically < 50 dB(A)
Autosampler	< 70 dB(A), typically < 50 dB(A)
Column compartment	< 42 dB(A), typically < 40 dB(A)

### 9.1.5 Weight

The weight of the system and system modules are specified as follows:

Product	Weight	
System	Basic configuration <sup>1</sup> : Approx. 66 kg	Basic configuration and column compartment: Approx. 79 kg
Pump	26 kg	
Autosampler	26 kg	
Column compartment	Without valves: 10.7 kg; with 2 Vanquish valves: 11.6 kg; with 2 VICI valves: 13.1 kg	
<sup>1</sup> : The basic configuration includes the system base with system controller, pump, autosampler and display		

## 9.2 Performance Specifications

### 9.2.1 System Performance Specifications

The system performance is specified as follows:

Type	Specification
Communication	The system base provides the following ports: 1 System Interlink port (RJ45-8 connector) 1 VSC port (RJ-12 connector) For ports on the system modules, see the performance specification sections for the system modules.
Control	Vanquish User Interface Keypad with buttons for performing certain functions directly from the system module. The system can be operated with a chromatography data system. For details, contact the Thermo Fisher Scientific sales organization.
Materials in the flow path	For materials in the flow path, refer to the performance specification sections for the pump, autosampler, and the column compartment.
Solvent and additive information	See <a href="#">Use of Solvents and Additives</a> (▶ page 141).
Biocompatibility	Yes
Safety features	Leak detection and safe leak handling, excessive pressure monitoring
Good Laboratory Practice (GLP) features	Predictive Performance functions for scheduling maintenance procedures based on the actual operating and usage conditions of the system modules. All system parameters logged on the notification panel.

### 9.2.2 Pump Performance Specifications

The pump performance is specified as follows:

Type	Specification
Operating principle	Serial dual-piston pump with independent piston drives
Compressibility compensation	Fully automated, independent of the composition of the mobile phase
Flow range (settable)	0 – 100 µL in 1nL/min increments
Flow accuracy	Typically: ± 3% Conditions: 0.1 - 100 µL/min any of 4 pre-calibrated solvents, measured at 20 MPa system pressure
Inter-module deviation	< 5% for flow rates > 300 nL/min – 10 µL/min Conditions: Measured by retention time differences of TQAPGFSYTDANK Cytochrome C protein digest peptide and 30 min gradient.

Type	Specification
Retention time precision	<p>≤ 0.2% RSD or ≤ 0.1 SD min, whichever is greater</p> <p>Conditions: For TGQAPGFSYTDANK Cytochrome C protein digest peptide for gradients 30 – 90 min.</p>
Pressure range	<p>Column pressure: 2 – 150 MPa (20 – 1500 bar, 300 – 21750 psi)</p> <p>150 MPa column pressure up to 1 μL/min. With a flow rate above 1 μL/min, the maximum pressure is solvent dependent and decreases linearly down to 70 MPa at 100 μL/min for acetonitrile 80% in channel B.</p>
Number of solvent channels	2
Maximum stroke volume	96 μL
Dwell volume (contribution of the pump to the system gradient delay volume)	25 nL
Degassing	<p>2 channels for autosampler wash liquids</p> <p>2 additional channels available for solvent degassing as an option for micro LC applications only</p>
Communication	<p><i>USB:</i></p> <p>1 USB port (USB 2.0, "B" type connector)</p> <p>1 USB hub with 3 ports (USB 2.0, "A" type connectors)</p> <p><i>I/O Interface:</i></p> <p>2 Dig I/O ports (mini-DIN), each providing one input and one relay output</p> <p><i>System Interlink:</i></p> <p>2 System Interlink ports (RJ45-8 connectors)</p>
Materials in the analytical flow path	<p>Ceramics, DLC (diamond like carbon), fluoropolymers, MP35N, PEEK, titanium, UHMW PE</p> <p>For information on the chemical resistance of materials, refer to the technical literature.</p>

### 9.2.3 Autosampler Performance Specifications

The autosampler performance is specified as follows:

Type	Specification	
Injection method	Split-loop, direct injection or trap-and-elute	
Number of injection units	1	
Pressure range	5 - 151 MPa (50 - 1517 bar, 700 - 22002 psi)	
Injection volume range	25 µL sample loop (standard)	0.01 µL - 25 µL, settable in steps of min 0.01 µL
	100 µL sample loop (extended)	0.01 µL - 100 µL, settable in steps of min 0.01 µL High-volume trapping by multiple draw cycles and trap cycles: up to 500 µL
Injection volume accuracy	Typically, ± 0.5% with an injection volume of 5 µL and water	
Injection volume precision	0.05 – 0.20 µL	<5.0%
	0.20 – 0.50 µL	<1.5%
	0.50 – 2.00 µL	<0.5%
	Above 2 µL	<0.25%
Low sample loss features	2.5 µL out of 3 µL with adequate vials (see <a href="#">Recommendations on Vial Caps and Well Plate Covers</a> (▶ page 158))	
Linearity	r > 0.9999 (caffeine in water)	
Needle wash	Dip rinse and continuous rinse of external needle surface with 2 independent wash liquids. Rinse of sample loop and internal needle surface with strong wash liquid from the wash port (SWP). Afterward, rinse of sample loop and internal needle surface with weak wash liquid from the metering device (W).	
Number of needle wash liquids	2	
Dwell volume (contribution of the autosampler to the system gradient delay volume)	With sample loop volume of 25 µL:	
	In inject position	55 µL
	In bypass position	51 nL
Carry over	<0.002% with caffeine	
Barcode reader	Yes	
Automation Features Barcode Reading	Barcode reading: <ul style="list-style-type: none"> <li>• Empty segment detection</li> <li>• Rack/well plate verification</li> <li>• Inventory management</li> </ul>	
Sample compartment thermostating: Temperature range	4 - 40 °C, cooling ≥ 23 K below ambient at < 80% relative humidity	
Temperature accuracy	-2 °C and +4 °C	
Temperature stability	± 1 °C	

Type	Specification
Sample capacity	4 segments useable for sample racks or well plates with SBS footprint format; plus support of vial holders with a capacity of (number of vials x O.D.): 12 x 22.5 mm
Vial capacity	<ul style="list-style-type: none"> <li>• 54 x 12 mm O.D. vials</li> <li>• 96 x 6 mm O.D. vials</li> <li>• 96 x 7 mm O.D. vials</li> <li>• 96 x 8 mm O.D. vials</li> <li>• 16 x 15 mm O.D. vials</li> <li>• 9 x 22.5 mm O.D. vials</li> </ul>
Well plate capacity	96- and 384-position well plates with SBS footprint
Minimum sample required	2 µL at 1 µL injection volume
USB Communication	1 USB port (USB 2.0, "B" type connector) 1 USB hub with 3 ports (USB 2.0, "A" type connectors)
I/O Interface	2 digital I/O ports (mini DIN), each providing one digital input, and one relay output
System Interlink	2 system interlink ports (RJ45-8 connectors)
Materials in the analytical flow path	Titanium, ceramics, PEEK, MP35N, DLC, sapphire, fluoropolymers Note: For information about the seal wash liquid to be used, see <a href="#">Filling the Seal Wash Reservoir</a> (► page 130). For information about the chemical resistance of materials, refer to the technical literature.
Materials in the needle wash flow path	PP (polypropylene), PE, FFPM (perfluoro-elastomer), FFKM, PEEK, PA (polyamide), PK (polyketone), TPE (thermoplastic elastomer)
Materials in the seal wash flow path	Titanium, ceramics, PEEK, UHMW PE, PP, PTFE, silicone

## 9.2.4 System Controller Performance Specifications

The system controller performance is specified as follows:

Type	Specification
I/O interfaces	1 LAN port 2 USB ports (deactivated) 4 System Interlink ports (2 are deactivated)
System interlink	2 System Interlink ports (1 pair, RJ45-8 connectors)

## 9.2.5 Column Compartment Performance Specifications

The column compartment performance is specified as follows:

Type	Specification
Pressure range	Vanquish valve: 50-1500 bar VICI valve C82: 50-1034 bar VICI valve C2, C2N: 50-345 bar
Temperature range	+5 °C to 80 °C without valves +5 °C to 60 °C with Vanquish valves +5 °C to 50 °C with VICI valves
Temperature accuracy	±0.5 °C
Temperature stability	±0.05 °C
Temperature precision	±0.1 °C
Heat up time	From 35 °C to 65 °C ±1 °C in less than 12 minutes
Column switching valves	Up to two valves: 2-position 6-port Vanquish valve, 1500 bar 2-position 6-port C82 VICI valve, 1034 bar 2-position 6-port C2 VICI valve, 345 bar 2-position 6-port C2N VICI valve, 345 bar For further information on available column switching valves, see <a href="#">Optional Accessories</a> (▶ page 371).
USB communication	1 USB port (USB 2.0, "B" type connector) 1 USB hub with 3 ports (USB 2.0, "A" type connectors)
I / O Interface	2 Dig I/O ports (mini DIN), each providing one digital input, and one relay output
System Interlink	2 System Interlink ports (RJ45-8 connectors)
Materials in the flow path	Vanquish valve: ceramic, DLC, titanium VICI valve C82: stainless steel with inert coating, PAEK composit VICI valve C2, C2N: PAEK, PAEK composit Capillaries: MP35N (for details, see the pre-heater specifications) For information about the chemical resistance of materials refer to the technical literature.

### Passive pre-heater

Type	Specification
Temperature range	Same as column chamber
Wetted parts	MP35N
Biocompatible	Yes
Heated volume	1 µL
Total volume	6 µL



# 10 Accessories, Consumables and Replacement Parts

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

## 10.1 General Information

The system 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.

## 10.2 Ship Kit

This section lists the content of the ship kit. 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 system is shipped.

For reordering information, see [Consumables and Replacement Parts](#) (▶ page 373).

### 10.2.1 System

#### Capillaries

For detailed information on the usage of the capillaries, refer to the flow scheme from the ship kit.

Item	Quantity in shipment
Capillary, nanoViper, fused silica-/PEEK-sheathed, 1/32", I.D. x O.D. x length 20 µm x 360 µm x 550 mm, for nano LC applications	2
Capillary column-detector, nanoViper, fused silica-/PEEK-sheathed, 1/32", I.D. x O.D. x length 20 µm x 280 µm x 1 m, for nano LC applications	1
Capillary column-detector, nanoViper, fused silica-/PEEK-sheathed, 1/32", I.D. x O.D. x length 50 µm x 360 µm x 550 mm, for capillary and micro LC applications	4
Capillary pump-autosampler, nanoViper, fused silica-/PEEK-sheathed, 1/32", I.D. x O.D. x length 50 µm x 360 µm x 350 mm, for capillary and micro LC applications	1
Capillary autosampler-column/column compartment, nanoViper, fused silica-/PEEK-sheathed, 1/32", I.D. x O.D. x length 50 µm x 280 µm x 1 m, for capillary and micro LC applications	1
Capillary column-detector, fused silica, I.D. x O.D. x length 20 µm x 280 µm x 1.5 m, for nano LC applications	1
Capillary column-detector, fused silica, I.D. x O.D. x length 50 µm x 280 µm x 1.5 m, for capillary and micro LC applications	1

*Capillary Accessories*

Item	Quantity in shipment
Viper union	1
Fitting plug, Viper, titanium	2
Knurl for nanoViper fittings	2

*Wash System Accessories*

Item	Quantity in shipment
Tubing, silicone	3m
Tubing connector, straight (pack of 5)	1

*Liquid Reservoir Accessories*

Item	Quantity in shipment
Reservoir cap	10
Retaining guide (diameter 1.6 mm) to keep the following lines in the reservoir caps: <ul style="list-style-type: none"> <li>• Solvent lines (reservoir to pump)</li> <li>• Needle wash liquid lines (reservoir to wash liquid degasser in pump and reservoir to autosampler wash pump)</li> </ul>	10
Retaining guide (diameter 3.0 mm) to keep the seal wash line in the reservoir caps	10
Cap plug to close open holes in the reservoir cap (pack of 20)	2
Solvent line filter, filter holder (no filter frit or solvent line adapters included)	6
Solvent line adapter	6
Solvent line filter, filter frit, 10 µm	10

*Tools*

Item	Quantity in shipment
Hexagon wrench, size 6	1
Screwdriver, Torx T30	1
Screwdriver, Torx T10, L-shape	1
Screwdriver, Torx T20, L-shape	1
Seal-handling tool	1
Syringe, plastic, 12 mL	2
Torque screwdriver, Viper, base part with extension adapter and bits for tightening nanoViper capillaries and the autosampler needle seat	1
Tubing cutter for PEEK tubing	1
Tubing cutter for fused silica tubing	1

*Cables*

Item	Quantity in shipment
Digital I/O signaling cable, 5 m	1
LAN cable, (RJ45), 5 m	1
USB cable, type A to type B, high-speed, USB 2.0, length 0.5 m To connect the pump to the autosampler.	1
USB cable, type A to type B, high-speed, USB 2.0, length 5 m To connect the pump to the computer.	1

*Autosampler-specific parts*

Item	Quantity in shipment
Needle seat	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
Sample container kit including well plates, mats, sealing tape, vials, and caps with pre-assembled septa	1

*Miscellaneous*

Item	Quantity in shipment
Drainage kit, Vanquish system, including: <ul style="list-style-type: none"> <li>• L piece (elbow, pack of 4, different sizes)</li> <li>• Drain tubing, 11.4 m length</li> <li>• Clip (set of 2)</li> </ul>	1
Fuses kit, Vanquish system The kit includes the 5AT fuses for the pump, autosampler and the column compartment (optional).	1
Flow scheme	1
Cytochrome test sample	1
Paper label for magnetic label holder	1
Spiral tubing to wrap liquid lines or cables	1
Trap column cartridge holder	1
Acclaim™ PepMap™ 100 C18 HPLC column (set of 3)	1
Cap to close open ends of solvent lines (when disconnected from the pump)	6
Plug to close open connection ports in the pump (when no solvent lines are connected)	6

**10.2.2 Column Compartment**

The following parts are included in the ship kit for the column compartment.

Item	Quantity in shipment
Column clips (pack of 6)	1
Column ID tags (pack of 2)	1
System interlink cable, length 0.5 m To connect the column compartment to the autosampler.	1
USB cable, type A to type B, high-speed, USB 2.0, length 1 m To connect the pump to the column compartment.	1

## 10.3 Optional Accessories

### Sample Loops

Description	Part No.
Sample loop, biocompatible, MP35N, volume: 10 µL	6252.1960
Sample loop, biocompatible, MP35N, volume: 25 µL	6252.1940
Sample loop, biocompatible, MP35N, volume: 100 µL	6252.1950

### Sample Racks and Well Plates

Description	Part No.
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
Sample rack, for 16 x 15 mm O.D. vials With 2D barcode for Vanquish rack type identification	6851.1030
Sample rack, for 9 x 22.5 mm O.D. vials With 2D barcode for Vanquish rack type identification	6851.1020
For well plates and additional sample racks, refer to the ordering information that is included in the ship kit.	

### Column Compartment Valves and Accessories

Item	Part No.
Column ID tags (pack of 2)	6732.0610
Passive pre-heater, 0.1 mm x 680 mm, MP35N	6732.0184
Valve 2p-6p, Low-Disp, 150 MPa, biocompatible	6250.1520
Valve, 2p-6p, Low-Disp, VICI, C82	6041.0004B
Valve, 2p-6p, Low-Disp, 1/16", 0,25 mm, PAEK	6821.5120
Valve, 2p-6p, Low-Disp, 1/32", 0.1 mm, PAEK	6820.6232
Fitting plug for valve, 2p-6p, Low-Disp, 1/32", 0.1 mm, PAEK (pack of 6)	6820.1320
VICI valve lock ring	6253.1651

*Vacuum Degasser*

Item	Part No.
<p>Degasser kit to retrofit the pump with 2 degas chambers for solvent degassing with micro LC applications (if the solvents in use cannot be replaced once a week and degassed properly)</p> <ul style="list-style-type: none"> <li>• Recommended flow range for use: 70 – 100 <math>\mu\text{L}/\text{min}</math></li> <li>• Using the degasser with flow rates lower than 70 <math>\mu\text{L}/\text{min}</math> and premixed solvents may affect the mixing ratio of the solvents in the degasser, resulting in varying retention times. For stable retention times, it may take up to 3 injections in a sequence.</li> <li>• Only service personnel certified by Thermo Fisher Scientific are permitted to install the degas chambers.</li> </ul>	Contact Sales

*USB Isolator*

Item	Part No.
<p>USB isolator</p> <p>The USB Isolator improves the reliability of the USB connection between the USB port of an HPLC system module and the data system computer.</p>	6287.0540

*System Workbenches and Stabilizers*

Item	Part No.
IonBench including stack mounting kit	6036.1720
Stack stabilizer kit	6036.1710



## 10.4 Consumables and Replacement Parts

### 10.4.1 System Capillaries and Drainage

#### Capillaries

Description	Part No.
Capillary pump-autosampler, nanoViper, fused silica, I.D. x length 20 µm x 350 mm	6250.5240
Capillary column-detector, nanoViper, fused silica-/PEEK-sheathed, 1/32", I.D. x O.D. x length 20 µm x 280 µm x 1 m, for nano LC applications	6041.5292
Capillary column-detector, nanoViper, fused silica-/PEEK-sheathed, 1/32", I.D. x O.D. x length 20 µm x 360 µm x 1 m, for nano LC applications	6041.5293
Capillary column-detector, nanoViper, fused silica-/PEEK-sheathed, 1/32", I.D. x O.D. x length 50 µm x 280 µm x 1 m, for nano LC applications	6041.5294
Capillary column-detector, nanoViper, fused silica-/PEEK-sheathed, 1/32", I.D. x O.D. x length 50 µm x 360 µm x 1 m, for nano LC applications	6041.5295

#### Capillary accessories

Description	Part No.
Fitting plug, Viper, biocompatible	6040.2303
Viper union	6040.2304

#### Capillary tools

Description	Part No.
Tubing cutter for fused silica tubing	6720.0016
Tubing cutter for PEEK tubing	6300.0401
Torque screwdriver, Viper, base part with extension adapter and bits for tightening nanoViper capillaries and the autosampler needle seat	6250.2110

#### Drainage kit

Description	Part No.
Drainage kit, Vanquish system, including: <ul style="list-style-type: none"> <li>• L piece (elbow, pack of 4, different sizes)</li> <li>• Drain tubing, 6.25 m length</li> <li>• Drain tubing clips (pack of 2)</li> </ul>	6036.1120

## 10.4.2 System Replacement Parts and Tools

### System replacement parts

Description	Part No.
Solvent rack (without foam piece)	6036.1350
Foam piece for solvent rack	6036.1371
Vanquish Display	6036.1180
Vanquish System Controller	6036.1130

### Tools

Description	Part No.
System base locking tool	6036.1160
Torque screwdriver, Viper, base part with extension adapter and bits for tightening nanoViper capillaries and the autosampler needle seat	6250.2110
Tool kit, VN, including: <ul style="list-style-type: none"> <li>• Screwdriver Torx T30</li> <li>• Screwdriver, Torx T10</li> <li>• Screwdriver, Torx T20</li> <li>• Hexagon wrench, size 6</li> <li>• Seal-handling tool (pump)</li> <li>• Torque screwdriver, Viper, base part with extension adapter and bits for tightening nanoViper connections and the autosampler needle seat</li> <li>• Tubing cutter for PEEK capillaries</li> <li>• Tubing cutter for fused-silica capillaries</li> </ul>	6250.2100

### 10.4.3 Solvents and Wash Systems

#### *Reservoirs and reservoir parts*

Description	Part No.
Reservoir, 1 L, including cap	2270.0012
Reservoir, 0.25 L, including cap	2270.0026
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
Retaining guide (diameter 1.6 mm) to keep the following lines in the reservoir caps (pack of 5): <ul style="list-style-type: none"> <li>• Solvent lines (reservoir to pump)</li> <li>• Wash lines (reservoir to degasser in pump and reservoir to autosampler wash pump)</li> </ul>	6261.0216
Retaining guide (diameter 3 mm) to keep the seal wash line in the reservoir caps (pack of 5)	6000.0042
Plugs and retaining guides (diameter 1.6 mm) for seal wash reservoir caps, kit including <ul style="list-style-type: none"> <li>• Cap plug to close open holes in the reservoir cap (pack of 10)</li> <li>• Retaining guide for seal wash reservoir line, to keep the seal wash line in place in the reservoir cap (pack of 5)</li> </ul>	6030.9101

#### *Solvent lines, wash reservoir lines, and solvent line filters*

Description	Part No.
Solvent and wash lines kit for inner and outer needle wash, including reservoir lines and labels for solvents	6250.2305
Solvent lines (A, B) from solvent reservoirs to pump inlet	6251.0096
The Low-Pressure Tubing Kit for the pump also includes solvent lines. See <a href="#">Pump Replacement Parts</a> (▶ page 377).	
Solvent line filter, filter holder (pack of 6) (no filter frits or solvent line adapter included)	6268.0115
Solvent line adapter (1/8-1/16) (pack of 6)	6850.1056
Solvent line filter, filter frit, biocompatible, 10 µm (pack of 10)	6268.0117

*Tubing and parts for wash systems*

Description	Part No.
Peristaltic and wash tubing kit The kit includes peristaltic tubing (PharMed), silicone tubing, and tubing connectors for use in <ul style="list-style-type: none"> <li>• Seal wash system in the pump and in the autosampler</li> <li>• Drain pump in the autosampler</li> </ul> <b>NOTICE:</b> Use the thick silicone tubing (and related tubing connectors) in the autosampler. Use the thin silicone tubing (and related tubing connectors) in the pump. Use the screwable connectors for the pump head.	6044.1150
Seal wash detector (drop detector) with funnel	6044.1898
VN rear sealing and screws kit (VN pump), seal wash plate/pump head, including: <ul style="list-style-type: none"> <li>• Pump head seal, for seal wash plate (O-ring seal, 11x1.5) (2 seals)</li> <li>• Pump head seal, for seal wash plate screw (O-ring seal, 6.5x1) (8 seals)</li> <li>• Screw, seal wash plate (8 screws)</li> </ul>	6251.2234
Piston seal (RP) and seal wash seal, pump head (pack of 2 each)	6251.1143
Needle wash PEEK kit, including <ul style="list-style-type: none"> <li>• Wash port waste PEEK capillary (2 pieces)</li> <li>• Connection from wash pump outlet to wash port</li> </ul>	6252.1930

## 10.4.4 Pump Replacement Parts

### *Pump head and components*

Description	Part No.
Pump head (complete assembly)	6251.1102
Piston	6251.1155
Seal-handling tool	6251.5122
Piston seal (RP) and seal wash seal, pump head (pack of 2 each)	6251.1143
Support ring (pack of 2)	6040.0012
Check valve, inlet check valve	6251.1153
Check valve, outlet check valve	6044.2310
Capillary kit, pump head, including: <ul style="list-style-type: none"> <li>• U-tube</li> <li>• Capillary from pump head to flowmeter</li> </ul>	6251.0086
VN rear sealing and screws kit (VN pump), seal wash plate/pump head, including: <ul style="list-style-type: none"> <li>• Pump head seal, for seal wash plate (O-ring seal, 11x1.5) (2 seals)</li> <li>• Pump head seal, for seal wash plate screw (O-ring seal, 6.5x1) (8 seals)</li> <li>• Screw, seal wash plate (8 screws)</li> </ul>	6251.2234

### *Flowmeter*

Description	Part No.
Filter kit, flowmeter, including filter screw, screw seal, and filter frit (2 µm) To replace the filter or filter frit on both flowmeter inlets, two kits are needed.	6251.0111
Flowmeter waste line, see <i>Low-Pressure Tubing Kit</i>	

### *Low-pressure tubing kit*

Description	Part No.
Low-pressure tubing kit, pump, including: <ul style="list-style-type: none"> <li>• Flowmeter waste line from flowmeter to waste outlet port</li> <li>• Solvent lines (A, B) from shut-off valves to pump heads</li> <li>• Solvent lines from degasser to shut-off valve</li> </ul>	6251.0150
Also see <a href="#">Solvents and Wash Systems</a> (▶ page 375) and <a href="#">System Capillaries and Drainage</a> (▶ page 373).	

*Maintenance kit*

Description	Part No.
Pump maintenance kit, including: <ul style="list-style-type: none"> <li>• Screws, seal wash plate (8 screws)</li> <li>• Silicone tubing (clear tubing)</li> <li>• Peristaltic tubing (PharMed, white tubing)</li> <li>• Tubing connector (straight)</li> <li>• Tubing connector (90°-angled)</li> <li>• Tubing connector (I.D. 1/16") (pack of 4)</li> <li>• Piston seal (pack of 2)</li> <li>• Pump head seal, for seal wash plate (O-ring seal, 11x1.5) (pack of 2)</li> <li>• Pump head seal, for seal wash plate screws (O-ring seal, 6.5x1) (pack of 8)</li> <li>• Cleaning swabs (pack of 25)</li> <li>• Seal wash seal (pack of 2)</li> <li>• Solvent line filter holder (pack of 6)</li> <li>• Solvent line filter frit (biocompatible, 10 µm) (pack of 10)</li> <li>• Solvent line adapter (1/8-1/16) (pack of 6)</li> </ul>	6251.0130

*Miscellaneous*

Description	Part No.
NanoViper capillary, fused silica, I.D. x length 20 µm x 350 mm, for use as backpressure capillary during pump maintenance	6250.5240
Fitting plug, Viper, biocompatible	6040.2303
Front door kit, including right door and left door	6044.1920
Syringe and tubing kit, including <ul style="list-style-type: none"> <li>• 12 mL plastic syringe (pack of 5)</li> <li>• Silicone tubing (O.D. x I.D. 2.8 x 1.3), 3 m</li> </ul>	6000.0010
Rinsing tubing, silicone (O.D. x I.D. 2.8 x 1.3), 3 m	6007.9100
Cleaning swabs (pack of 25)	6040.0007
Fuses kit, Vanquish system For the pump, autosampler, and column compartment, use the 5 AT, 230 V AC, slow-blow fuses.	6036.0002

## 10.4.5 Autosampler Replacement Parts

### Capillaries

Description	Part No.
Fitting plug, Viper, biocompatible	6040.2303
NanoViper Capillary, I.D.x L 50 µm x 120 mm	6252.5124
Waste capillaries with T-piece	6252.1930
For further capillaries, see <a href="#">System Capillaries and Drainage</a> (▶ page 373).	

### Flow components

Description	Part No.
Capillary kit for internal autosampler flow components, including <ul style="list-style-type: none"> <li>• Viper capillary, pressure sensor inlet</li> <li>• Viper capillary, pressure sensor outlet</li> <li>• Viper capillary, metering device</li> <li>• Viper capillary, check valve</li> <li>• Wash port waste PEEK capillary (2 pieces)</li> <li>• nanoViper capillary, FS/PEEK sheathed, 1/32"</li> </ul>	6252.1920
Metering device head, volume 100 µL	6850.1743
Needle seat	6252.2470
Needle unit	6252.1130
Check valve, including capillary	6252.2310
For tubing of wash systems, see <a href="#">Solvents and Wash Systems</a> (▶ page 375).	

### Miscellaneous

Description	Part No.
Front door kit, including right door and left door	6850.0100
Insulation cover	6252.1647
Shipping lock for carousel	6850.5849
Torque screwdriver for tightening nanoViper connections and the needle seat	6250.2110
Rinsing tubing, silicone (O.D. x I.D. 2.8 x 1.3), 3 m	6007.9100
Fuses kit, Vanquish system For the pump, autosampler, and column compartment, use the 5 AT, 230 V AC, slow-blow fuses.	6036.0002

### 10.4.6 Column Compartment Replacement Parts

Description	Part No.
Column clips (pack of 6)	6722.0290
Cover plates (pack of 2)	6253.1647
Front door kit, including right door and left door	6250.1620
Rotor seal, 2p-6p, C72/C82, E5 valve, 1/16", 0.15 mm	6041.0008B
Rotor seal, 2p-6p, C2/C3 valve, 1/16", 0.25 mm	6820.0035
Stator, 2p-6p, C72/C82 valve, 1/16", 0.15 mm, N60C	6041.0007
Stator, 2p-6p, C1/C2 valve, 1/16", 0.25 mm	6820.0034
Fuses kit, Vanquish system For the pump, autosampler, and column compartment, use the 5 AT, 230 V AC, slow-blow fuses.	6036.0002



## 10.4.7 Interface Cables and Power Cords

### Interface cables

Description	Part No.
System interlink cable, length: 0.5 m To connect the pump to the autosampler.	6310.2012
System interlink cable, length: 0.25 m To connect the following: <ul style="list-style-type: none"> <li>• System base to the system controller</li> <li>• System controller to the pump</li> </ul>	6310.2013
USB cable, type A to type B, high-speed, USB 2.0, length: 0.5 m To connect the pump to the autosampler.	6720.8910A
USB cable, type A to type B, high-speed, USB 2.0, length: 1 m To connect the pump to the column compartment	6035.9035A
USB cable, type A to type B, high-speed, USB 2.0, length: 5 m To connect the pump to the computer.	6911.0002A
Digital I/O signaling cable, 6-pin, cable length: 5 m	6036.0006

### 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



# 11 Appendix

This chapter provides additional information about compliance and the use of the digital I/O ports.

## 11.1 Compliance Information

Thermo Fisher Scientific performs complete testing and evaluation of its products to ensure full compliance with applicable domestic and international regulations.

### 11.1.1 Declarations of Conformity

#### *CE Declaration of Conformity*

The device has satisfied the requirements for the CE mark and is compliant with the applicable requirements.

#### *UKCA Declaration of Conformity*

The device has satisfied the requirements for the UKCA mark and is compliant with the applicable requirements.



#### *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 of North America Inc.

#### *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 <a href="http://www.thermofisher.com/us/en/home/technical-resources/rohs-certificates.html">http://www.thermofisher.com/us/en/home/technical-resources/rohs-certificates.html</a>

### 11.1.2 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 228: 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.

### 11.1.3 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.

### 11.1.4 Manual Release History

Revision	Covering
1.0	VN-A10-A-02, VN-C10-A-01, VN-P10-A-01, VN-S10-A-01

The instructions were prepared in English (original instructions). Other language versions are translations based on the English original instructions.

## 11.2 Digital I/O (Pin Assignment)

The digital I/O ports (Dig I/O) can be used to exchange digital signals with external instruments, for example, a mass spectrometer. Each port provides:

- one digital input
- one relay output

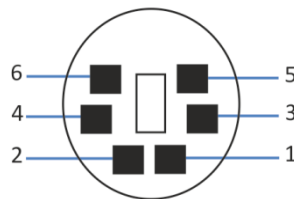


Figure 229: Digital I/O port

Pin	Description — Signal Name
1	Not used
2	Relay output — Relay_NC (Normally Closed contact)
3	Ground — GND
4	Digital input — Input
5	Relay output — Relay_COM COM is the common contact for NO and NC. If the relay is not activated or if the device is turned off, the connection is between COM and NC. If the relay is activated, the connection is between COM and NO.
6	Relay output — Relay_NO (Normally Open contact)

The next table lists the functions assigned to the connector pins and the color of the cable wire connected to each pin.

Pin	Wire Color	Signal Name	Signal Level	Remarks
1	Pink			Not used
2	Gray	Relay output — Relay_NC	Potential free 0-24 V, 0-100 mA	Opening contact
3	Green	Ground — GND	Ground	Reference potential
4	Yellow	Digital input — Input	Input (low active): On: 0-0.4 V Off: 2.2-5 V Pull-up resistor: 47 kΩ to 5 V	Digital input; reference potential is ground. Note the following: <ul style="list-style-type: none"> <li>• The maximum input voltage at the input must not exceed +5 V with reference to ground.</li> <li>• The minimum input voltage must not be lower than the ground potential.</li> </ul>
5	White	Relay output — Relay_COM	Potential free	Common contact for NO and NC
6	Brown	Relay output — Relay_NO	Potential free 0-24 V, 0-100 mA	Closing contact

#### See also

 [Connecting a Mass Spectrometer \(▶ page 115\)](#)





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