



thermoscientific

Vanquish

Refractive Index Detector

VC-D60

Operating Manual

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ThermoFisher
SCIENTIFIC

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Original Operating Manual

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1 Using this Manual

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

1.1 About this Manual

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

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.

Note the following:

- Illustrations in this manual are provided for basic understanding. They can vary from the actual model of the device or component. However, this does not influence the descriptions.
- No claims can be derived from the illustrations in this manual.
- The detector is referred to as *device* or *detector* in this manual.

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

1.2 Conventions

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

1.2.1 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.

1.2.2 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 device or invalid test results.

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

1.2.3 Typographical Conventions

These typographical conventions apply to the descriptions in this manual:

Data Input and Output

The following appears in **bold** type:

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

For brevity, long expressions and paths appear in the condensed form, for example: Click **File > Save as**.

References and Messages

- References to additional documentation appear *italicized*.
- Messages that appear on the screen are identified by quotation marks.

Viewpoint

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

Particularly Important Words

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

Electronic Manual Version (PDF)

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

- Table of contents entries
- Index entries
- Cross-references (in blue text)

1.3 Reference Documentation

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

Hardware Documentation

Additional hardware documentation includes the following:

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

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

Go to the following web site: www.thermofisher.com/HPLCmanuals

Software Documentation

Additional software documentation includes the following:

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

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

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

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

Third-Party Documentation

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

2 Safety

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

2.1 Safety Symbols and Signal Words

2.1.1 Safety Symbols and Signal Words in this Manual

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

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



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



CAUTION

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



WARNING

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

2.1.2 Observing this Manual

Observe the following:

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



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

2.1.3 Safety Symbols on the Device

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

Symbol	Description
	Indicates a potential hazard. Refer to this manual to avoid the risk of personal injury and/or to prevent damage to the device.
	Power supply is on
○	Power supply is off
	Indicates alternating current.

2.1.4 Rating Plate

The rating plate is present on the device near the electrical connections. The rating plate indicates the serial number, part number, module name, revision number (if any), and the line and fuse rating.

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

2.2 Intended Use

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

The intended use of the Vanquish system is to analyze mixtures of compounds in sample solutions.

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

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

They are not intended for use in diagnostic procedures.

Laboratory Practice

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

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

2.3 Safety Precautions

2.3.1 General Safety Information

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



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

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

Safety Standard

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

2.3.2 Qualification of the Personnel

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



Installation

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

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



General Operation

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

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

2.3.3 Personal Protective Equipment

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



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

Protective Clothing

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

Protective Eyewear

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

Gloves

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

2.3.4 Electrical Safety Precautions



WARNING—Electric Shock or Damage to the Device

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

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

2.3.5 General Residual Hazards

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



WARNING—Hazardous Substances

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

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



WARNING—Biohazard

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

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

**WARNING—Hazardous Vapors**

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

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

**CAUTION—Sparking due to Electrostatic Discharge**

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

Prevent the generation of static electricity near the chromatography system.

2.3.6 In Case of Emergency

**WARNING—Safety Hazard**

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

2.4 Compliance Information

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

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

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

See also

 [Compliance Information](#) (▶ page 126)

2.5 Solvent and Additive Information

2.5.1 General Compatibility

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

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

TIP In a Vanquish Core system, normal-phase (NP) compatible solvents and additives may be used if the VC-pumps and the VC-autosamplers have been modified for NP applications. Dedicated conversion parts and kits are available for Vanquish Core systems. Contact Thermo Fisher Technical Support for assistance.

2.5.2 Allowed pH Ranges

Allowed pH ranges (standard system configuration):

System (Standard Configuration)	Allowed pH ranges	Remarks
Vanquish Core	1-13	<ul style="list-style-type: none"> • <i>pH value of 2 (Vanquish Horizon/Flex):</i> Short-term use only. The application time should be as short as possible. Flush the system thoroughly after these applications. • <i>pH value of 1-2 (Vanquish Core):</i> The application time should be as short as possible. Flush the system thoroughly after these applications. • <i>pH values higher than 9.5 with optical detectors:</i> Avoid using mobile phases with a pH value higher than 9.5 together with optical detectors. This can impair the functionality and optical performance of the detector flow cell. • <i>Mobile phases containing ammonium hydroxide:</i> In rare cases, a shortened lifetime of reversed-phase (UHMW-PE) piston seals has been observed with high pH, ammonium hydroxide containing mobile phases and prolonged exposure.
Vanquish Horizon	2-12	
Vanquish Flex		

2.5.3 Allowed Concentrations

Allowed concentrations (standard system configuration):

System (Standard Configuration)	Chloride	Buffer	Remarks
Vanquish Core	0.1 mol/L or less	1 mol/L or less	<ul style="list-style-type: none"> • <i>High chloride concentration:</i> The application time should be as short as possible. Flush the system thoroughly after these applications. • <i>Mobile phases containing ammonium hydroxide:</i> In rare cases, a shortened lifetime of reversed-phase (UHMW-PE) piston seals has been observed with high pH, ammonium hydroxide containing mobile phases and prolonged exposure.
Vanquish Horizon Vanquish Flex	1 mol/L or less	-	

2.5.4 Solvent Recommendations

Follow these recommendations on the solvents used with the detector:

- When an organic solvent that contains halogens, such as chloroform and methylene chloride, is used, flush out entire flow path with a solvent compatible with your chromatographic condition. (for example, hexane or another hydrocarbon).
- For isocratic work with a normal phase column, the alcohols methanol or isopropanol, a non-carcinogenic aromatic such as the xylenes, acetone, or an ether that is non-volatile and not a ready producer of peroxides can be used. Do not use ethyl ether.
- Fluorocarbon solvents will alter PTFE over long exposure. Flush with pentane or another light hydrocarbon.
- If a solvent listed below is in use, flush out all the flow path sufficiently with an inert solvent that is compatible with your chromatographic system. Buffers, acids, and other highly ionic aqueous solutions should be flushed out with large amounts of

water (5-10 times the volume of liquid from pump head to detector outlet. If you neglect this flushing, the pump, injector, and column may become corroded and badly damaged.

- ◆ Sulfuric acid, boric acid, citric acid, acetic acid, lactic acid
- ◆ Acetic anhydride, KOH, NaOH, hydrazine, sodium formate
- ◆ Ammonium salts: -formate, -perchlorate, -nitrate, -citrate, -oxalate, -sulfate, -H₂PO₄, ₂CO₃
- ◆ K, Na salts: -bicarbonate, -chlorate, -nitrite
- The following solvents should be avoided:
 - ◆ Hydrohalogenic, metal halides >2M
 - ◆ KCl
 - ◆ Ammonium halides
 - ◆ Ammonium formate
 - ◆ All hypochlorites
 - ◆ Tetrachloromethane
 - ◆ Acids: HCl, HF, etc.

2.5.5 Further Information

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

3 Device Overview

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

3.1 Detector Features

The detector comprises the following main features:

- The following features enable a wide range of applications:
 - ◆ High sensitivity and reproducibility
 - ◆ Refractive index of 1.00 - 1.75 RIU
 - ◆ Measuring range of $\pm 600 \mu\text{RIU}$
- Stable baselines with a maximum drift of $0.2 \mu\text{RIU/h}$ or less and with a maximum noise of 2.5 nRIU or less
- Flow cell temperature stabilization by active heating for improved baseline signal

3.2 Operating Principle

The detector is a deflection or Snell-type refractive index detector. It is designed for analyses requiring the continuous monitoring of the refractive index of a flowing liquid with respect to a reference.

Snell's Law states that a parallel light beam, when passing through a dielectric interface separating two media of different refractive index at an angle of incidence greater than zero, will be refracted at a function of the magnitude of difference of the refractive indices of the two media.

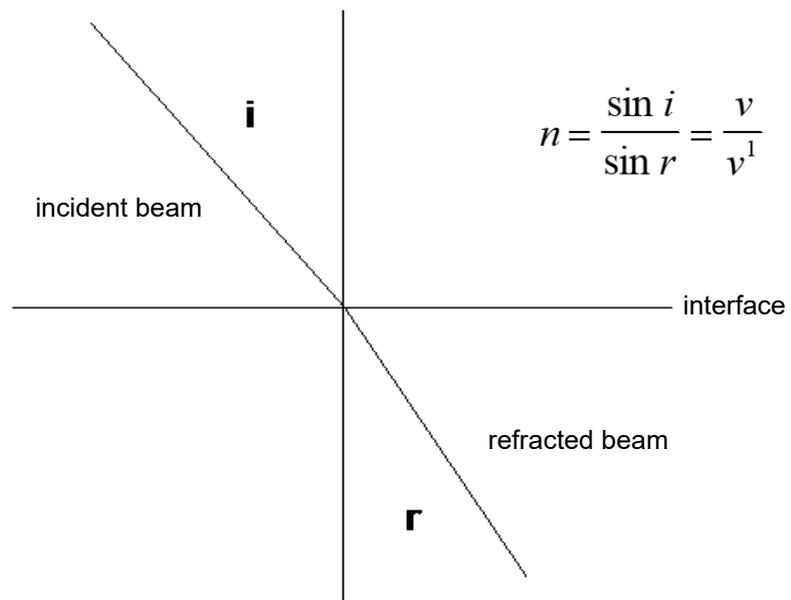


Figure 1: Snell's Law

Character	Description
n	index of refraction
i	angle of incidence
r	angle of refraction
v	velocity of light in first medium
v ¹	velocity of light in second medium

Optical system

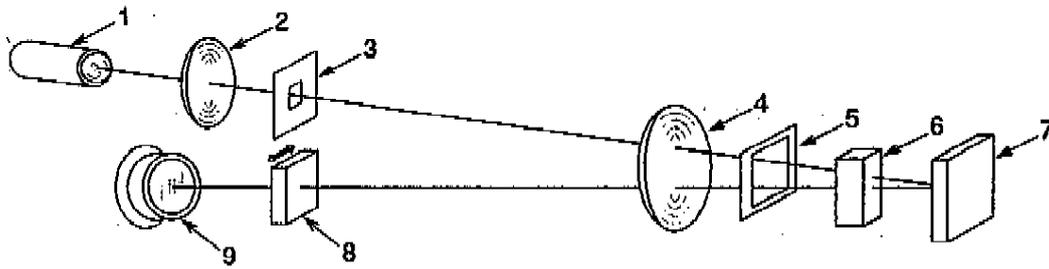


Figure 2: Optical system of the refractive index detector

No.	Description
1	Tungsten lamp
2	Condense lens
3	First slit
4	Collimator lens
5	Second slit
6	Flow cell
7	Mirror
8	Null glass
9	Photo sensor

Light from a low-power, long-lifetime tungsten lamp is collimated by a lens and slit and passed through reference and sample cells, reflected off a mirror, passed back through the optical cells, and focused by lenses onto a pair of photodiodes (photo sensor).

During operation, the detector's reference and sample cells are filled with mobile phase. The reference cell is then isolated from the flow path and mobile phase flows through the sample cell only. As long as no difference exists between the refractive indices of the media of the two cells, there is no refraction of the light passing through them.

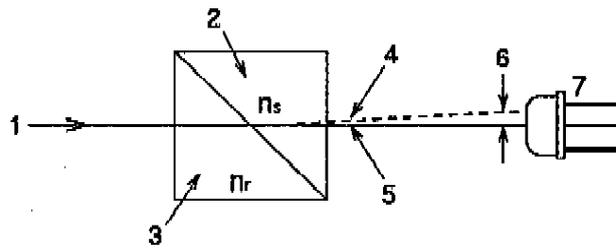
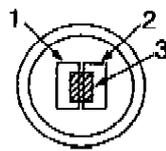


Figure 3: Optical path

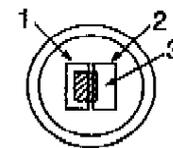
No.	Description
1	Light beam
2	Sample cell
3	Reference cell
4	Light axis ($N_s > N_r$)
5	Light axis ($N_s = N_r$)
6	Distance between [4]&[5] at the photo sensor
7	Photo sensor
n_s	Refractive index of mobile phase in sample cell
n_r	Refractive index of mobile phase in reference cell

Measurement

The light shines on a pair of photodiodes, each of which gives an electrical signal; these signals are amplified and the difference between the two signals is measured. Zero refraction should generate a zero-volt difference in these signals. During Autozero, an electrically controlled mechanical linkage allows the user to optimize the photodiodes' outputs for zero deflection via a refractive lens (null glass) in the optical path. Additional circuitry enables the user to easily correct the signal output to electronic zero.



$N_s = N_r$



$N_s > N_r$

Figure 4: Photo sensors

No.	Description
1	Photo sensor A
2	Photo sensor B
3	Light beam

When a change occurs in the refractive index of the mobile phase, the light passing through the interface between the sample and reference cells is refracted, causing the light intensity on one photodiode to increase and on the other to decrease. This difference gives a signal having both amplitude and polarity.

3.3 Interior Components

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

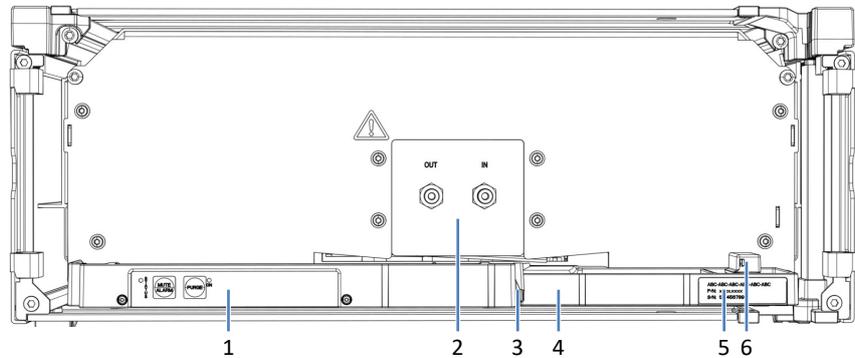


Figure 5: Interior view

No.	Description
1	Keypad with status indicators
2	Flow cell inlet and outlet
3	Capillary clip
4	Leak tray with leak sensor
5	Type label, indicating the module name, serial number, part number, and revision number (if any)
6	Leak sensor

3.4 Leak Detection

Leaks are a potential safety issue.

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

When the leak sensor detects leakage, the status indicators change to red and beeping starts to alert you. Follow the instructions in this manual to find and eliminate the source for the leakage.

3.5 Operation

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

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

Other data systems may support operation of this device. In this case, installation of additional software may be required. For details, contact the Thermo Fisher Scientific sales organization.

4 Unpacking

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

4.1 Unpacking

Damaged Packaging, Defective on Arrival

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

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

Unpacking the Device



CAUTION—Heavy Load, Bulky Device

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

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

Tools required

Screwdriver, Torx™ T20

Follow these steps

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

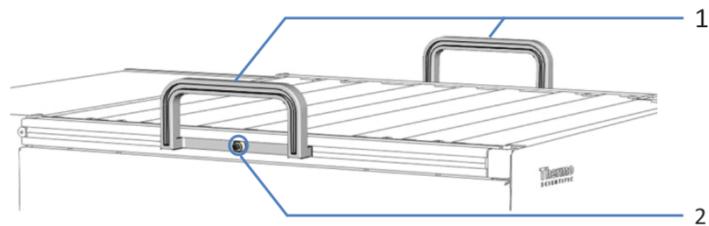


Figure 6: Carrying handles on the device

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

4. Place the device on a stable surface.
5. *If applicable:*
Remove any additional packing material. Leave any protective films attached to the surfaces of the device until it is properly positioned in the system stack.
6. On each carrying handle, loosen the attachment screw until the carrying handle is moveable in the rail. Do not remove the screws from the carrying handles completely.
7. Slide off the carrying handles from the rails towards the rear of the device.

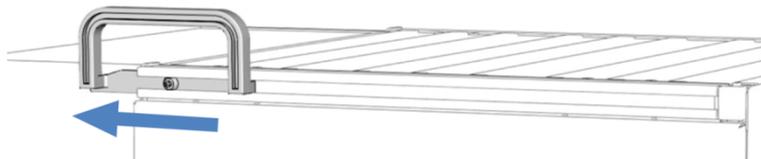


Figure 7: Sliding off the carrying handle from the left rail

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

8. 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.

4.2 Scope of Delivery

The following items are included in the delivery:

- Detector
- Ship Kit
- Operating manual (downloadable from customer manual web site)
- Power cord

For information on contents of the ship kit or reordering parts, see [Accessories, Consumables and Replacement Parts](#) (▶ page 119).

5 Installation

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

5.1 Installing the Detector (Overview)

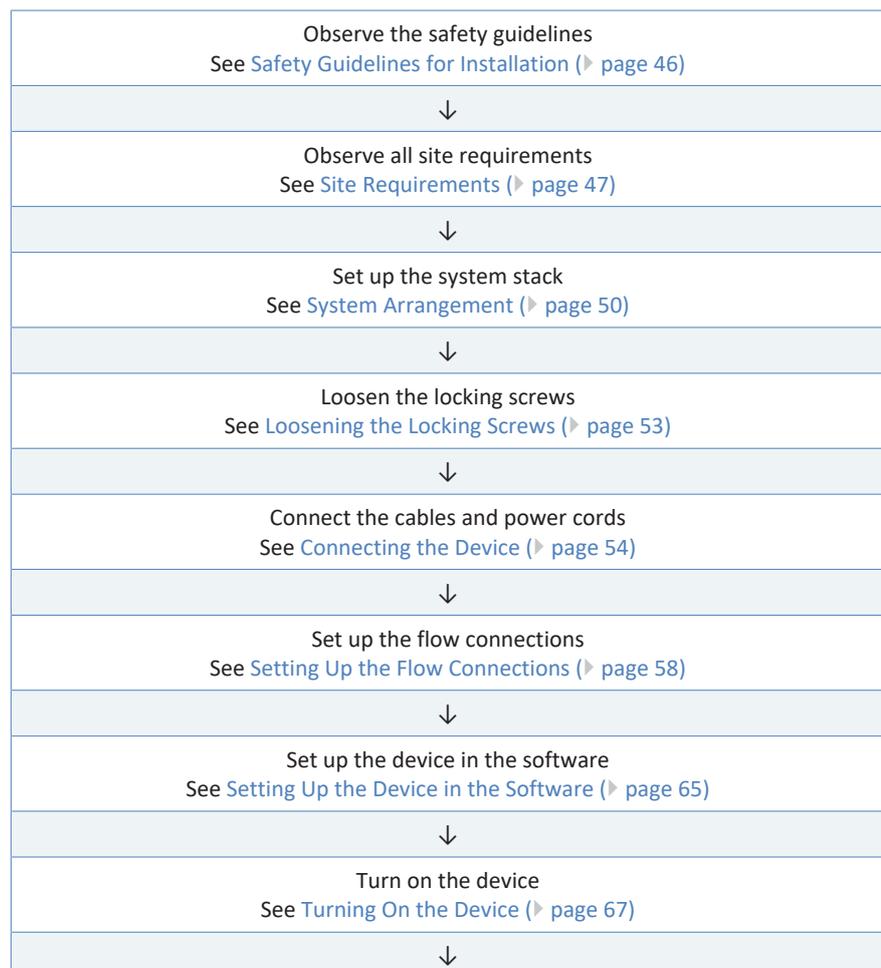
A Thermo Fisher Scientific service engineer installs and sets up the Vanquish system, including all modules and options or parts shipped with them. The service engineer checks that the installation is correct and that the Vanquish system and modules operate as specified. The engineer also demonstrates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

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

NOTICE

The device is part of the Vanquish system. Therefore, follow the order for installing the system modules as described in the *Vanquish System Operating Manual*.

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



<p><i>Recommended:</i> Perform Instrument Installation Qualification On the Chromeleon 7 Console, click Tools > Instrument Qualification > Installation Qualification.</p>
↓
<p><i>Recommended:</i> Perform Operational Qualification On the Chromeleon 7 Console, click Tools > Instrument Qualification > Operational Qualification.</p>

5.2 Safety Guidelines for Installation

Pay attention to the following safety guidelines:



Observe all warning messages and precautionary statements presented in [Safety Precautions](#) (▶ page 19).



CAUTION—Heavy Load, Bulky Device

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

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



CAUTION—Electric Shock or Damage to the Device

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

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

5.3 Site Requirements

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

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

- Operate the device only under appropriate laboratory conditions.
- The device is intended to be part of the Vanquish system. Observe the site requirements for the Vanquish system as stated in the *Vanquish System Operating Manual*.
- For specifications, see [Specifications](#) (▶ page 115) and the *Specifications* sections in the *Operating Manuals* for the other modules in the Vanquish system.
- For general residual hazards, see [General Residual Hazards](#) (▶ page 22).

5.3.1 Power Considerations

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



CAUTION—Electric Shock or Damage to the Device

Connecting the device to a line voltage higher or lower than specified could result in personal injury or damage to the device.

Connect the device to the specified line voltage only.

5.3.2 Power Cord

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

**WARNING—Electric Shock or Damage to the Device**

- Never use a power cord other than the power cords provided by Thermo Fisher Scientific for the device.
- Only use a power cord that is designed for the country in which you use the device.
- Do not use 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.

5.3.3 Condensation

NOTICE—Condensation in the device can damage the electronics and optics.

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

5.4 Accessing the Interior Components

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

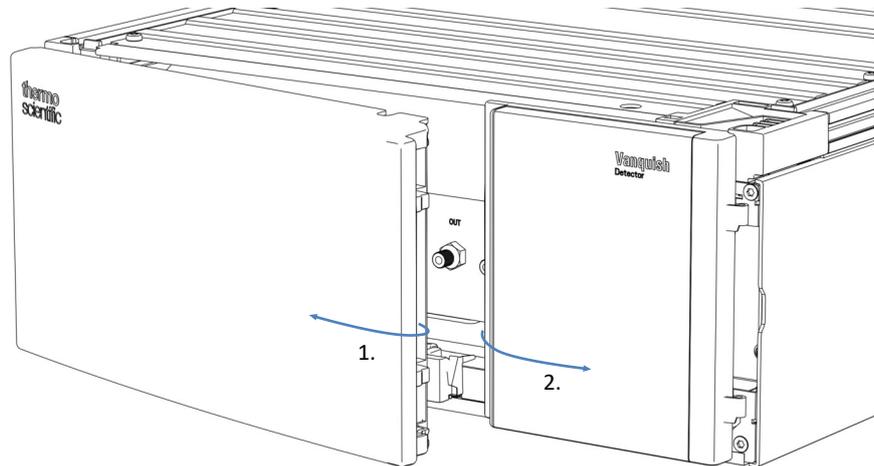


Figure 8: Opening the front doors

5.5 System Arrangement

The device is part of the Vanquish system. The system modules are typically arranged in a system stack, with the arrangement depending on the system configuration.

The following illustrations show configurations with a single refractive index detector, and with a refractive index detector as a second detector on top of a UV/VIS detector.

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

System with Single Detector

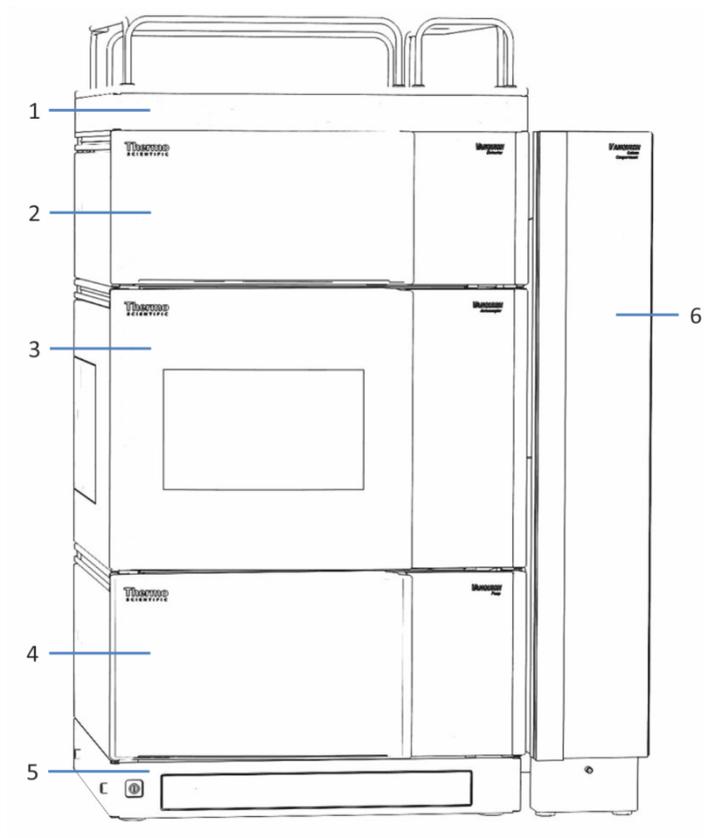


Figure 9: Vanquish system, standard configuration (example)

No.	Description
1	Solvent rack
2	Refractive index detector
3	Autosampler
4	Pump
5	System base
6	Column compartment

System with Refractive Index Detector as Second Detector

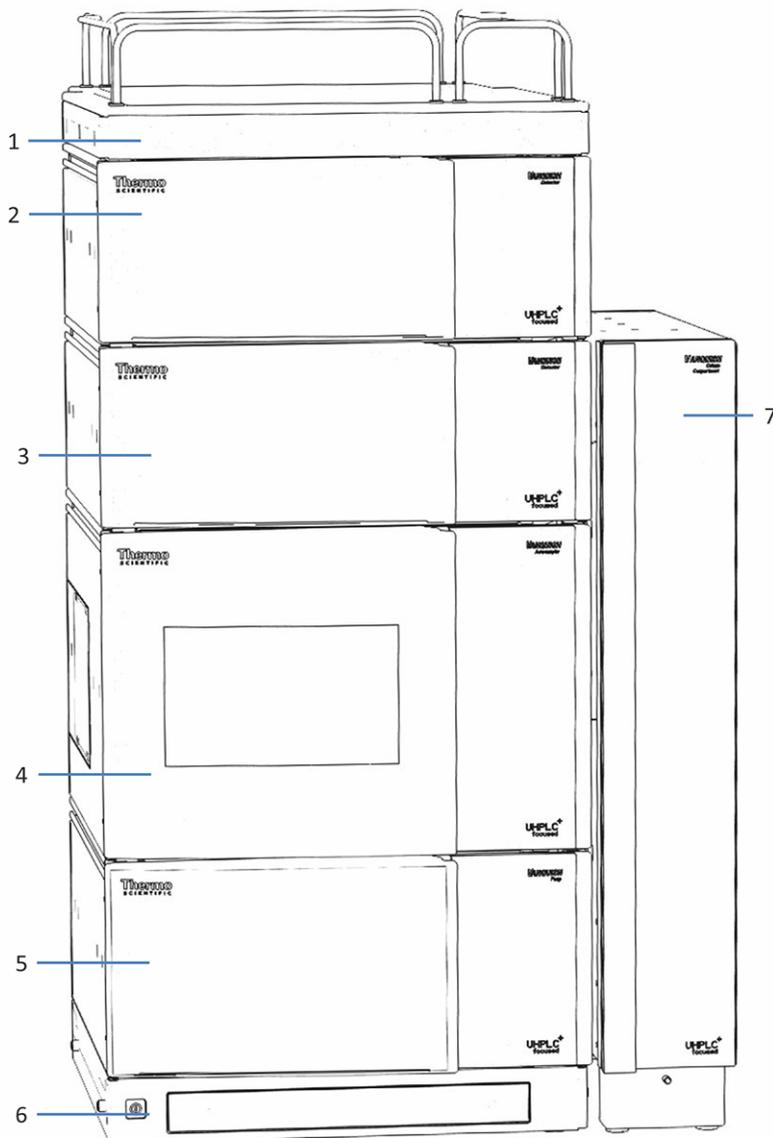


Figure 10: Vanquish system, configuration with two detectors (example)

No.	Description
1	Solvent rack
2	Refractive index detector
3	UV/VIS detector
4	Autosampler
5	Pump
6	System base
7	Column compartment

5.6 Loosening the Locking Screws

Before operating the detector, you need to loosen the locking screws on the bottom side of the slide-in module.

Tools required

Hexagon wrench, size 5 mm

Preparations

1. Remove the slide-in module (see [Removing the Slide-In Module](#) (▶ page 101)).

Follow these steps

1. Place the slide-in module on an even and clean surface with the bottom side facing up.
2. Loosen the 2 screws by 2 turns each. Do not fully remove them.

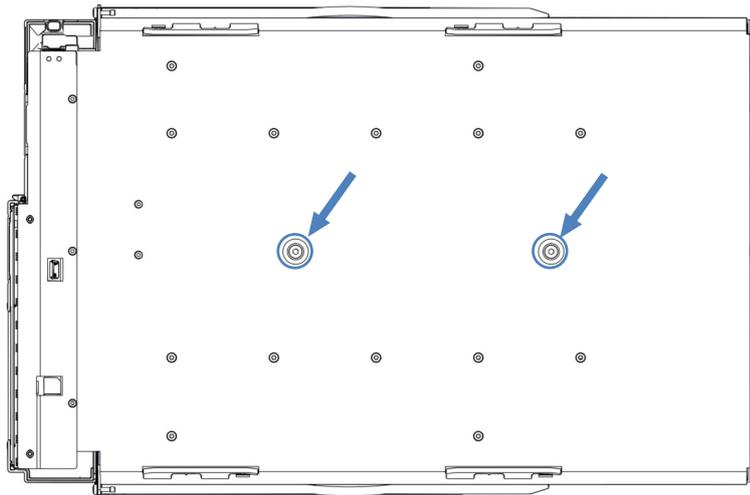


Figure 11: Loosening the locking screws

3. Install the slide-in module (see [Installing the Slide-In Module](#) (▶ page 103)).

5.7 Connecting the Device

Device Connectors

The following connectors are provided on the right side of the detector:

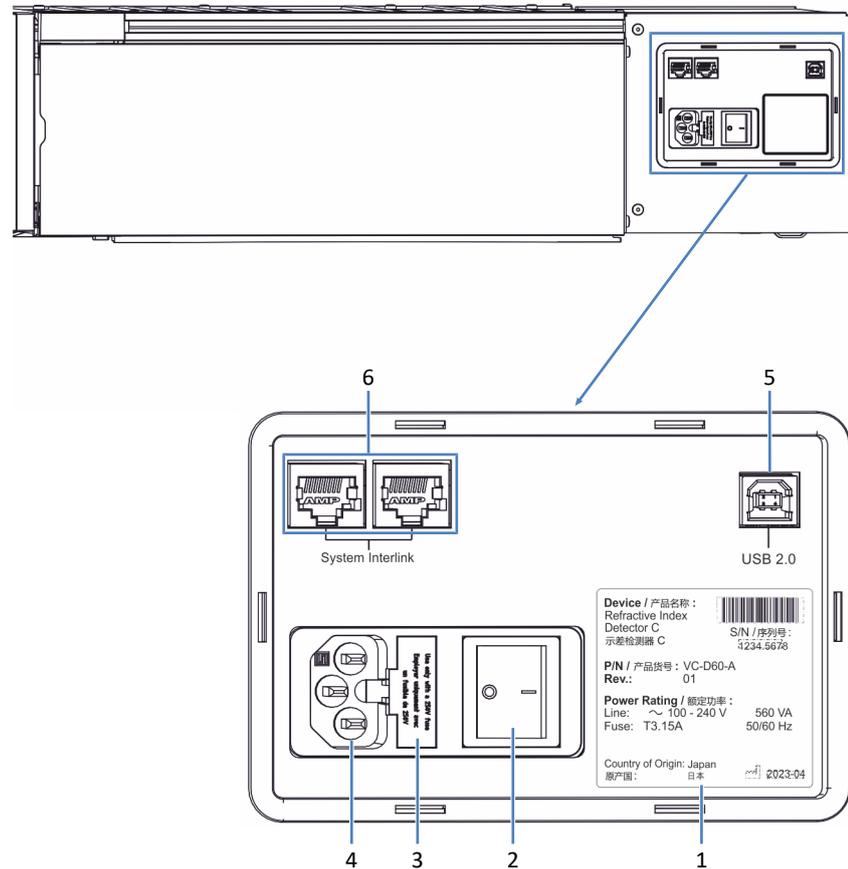


Figure 12: Electrical connectors on the right side of the detector

No.	Description
1	Rating plate, indicating the serial number, part number, module name, revision number (if any), and the line and fuse rating
2	Main power switch (on/off control)
3	Fuse holder
4	Power-inlet connector
5	USB (Universal Serial Bus) port ("B"-type connector): Allows connection to the computer on which the data management system is installed, such as the Chromeleon software.
6	System interlink port: Allows power on/off control for the detector from the system base.

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.

The following connector is provided on the rear side of the detector:

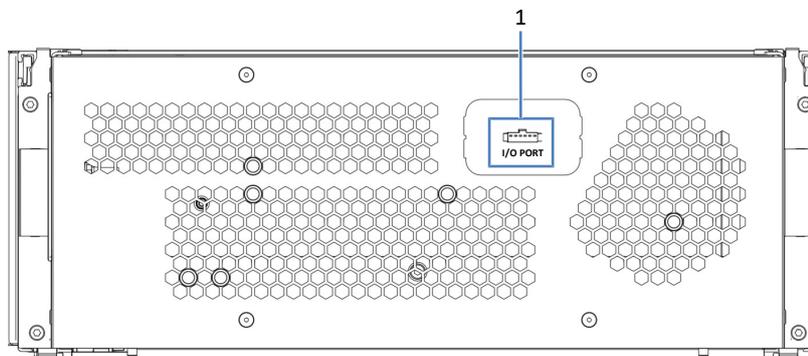


Figure 13: Electrical connector on the rear side of the detector

No.	Description
1	I/O PORT: Allows connection to an analog device: Use the analog I/O cable available from Thermo Fisher Scientific.

Note that the analog out settings such as the integrator range influence the analog signal. You can change these settings in Chromeleon. For pin assignments, see [Analog I/O Pin Assignment](#) (▶ page 129).

Follow these steps

NOTICE

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

1. Connect the required interface cables to the device.
The connection of the interface cables depends on whether the detector is used as the only detector or as a second detector in the Vanquish system. For instructions, see [Connecting Cables in a One-Detector-Configuration](#) (▶ page 56) or [Connecting Cables in a Two-Detector Configuration](#) (▶ page 56).
2. Connect the power cord (see [Connecting the Power Cord](#) (▶ page 57)).

5.7.1 Connecting Cables in a One-Detector-Configuration

USB

1. Connect a USB cable from a free **USB** port on the autosampler to a free **USB** port of the pump.
2. Connect a USB cable from a free **USB** port on the autosampler to a free **USB** port of the column compartment.
3. Connect a USB cable from the column compartment to a free USB port on the chromatography data system computer.
4. Connect a USB cable from the **USB** port on the refractive index detector to a free USB port on the chromatography data system computer.

System Interlink

For information about how to connect the system interlink cables in a standard Vanquish system, refer to the *Vanquish System Operating Manual*.

5.7.2 Connecting Cables in a Two-Detector Configuration

USB

If the refractive index detector is the second detector in the Vanquish system (for example, after the diode array detector), set up the USB connections as follows:

1. Follow the instructions in the *Vanquish System Operating Manual* to connect the other modules in the system.
2. Connect a USB cable from the free **USB** port on the refractive index detector to the chromatography data system computer.

System Interlink

If the refractive index detector is the second detector in the Vanquish system (for example, after the diode array detector), set up the system interlink connections as follows:

1. Follow the instructions in the *Vanquish System Operating Manual* to connect the other modules in the system up to the diode array detector.
2. Connect a system interlink cable from the free **System Interlink** port on the diode array detector to the refractive index detector.
3. Connect a system interlink cable from the free **System Interlink** port on the refractive index detector to the column compartment.

5.7.3 Connecting the Power Cord

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.

5.8 Setting Up the Flow Connections

5.8.1 General Information and Guidelines

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

NOTICE

Particulate matter from other system modules and components can deposit in the flow cell and clog it.

- Before you connect the flow cell to the flow path, make sure that you thoroughly flush the modules in the system flow path upstream of the device to waste.
- When you install devices or components to the system, always flush them to waste before connecting them in the system flow path. To flush the Vanquish modules, follow the instructions in the *Vanquish System Operating Manual*.

NOTICE

Flow cells and other fluidic components are highly sensitive to contamination, clogging and high backpressures. Even if the pressure exceeds the upper limit for a very short time only, this may lead to damage or sample loss. Observe the following notes when connecting the flow cell to the system flow path:

- Use only clean Viper capillaries which were provided for the flow cell and which have been properly protected by their cap before.
- Never expose the fluidic components of the detector to excessive backpressure. Observe the specified pressure rating for the detector (see [Performance Specifications](#) ▶ page 116).
- Use only the waste line which was provided for the flow cell.
- Connect the waste line to the flow cell only as described in the manual.
- Do not discharge waste from the flow cell through the open leakage drain system of the Vanquish system.

- 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.

5.8.2 Connecting Fittings, Capillaries, and Tubing

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

5.8.2.1 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.

5.8.2.2 Connecting Viper Capillaries

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

To connect Viper capillaries with knurls, follow these steps:

NOTICE

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

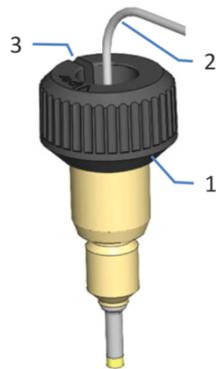


Figure 14: Viper fitting with knurl

No.	Description
1	Knurl
2	Capillary
3	Slot

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

TIP Note the slot in the knurl. You can easily remove the knurl from the capillaries through this slot if space is limited.

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

Resolving Leakage of Viper Fittings with Knurls

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

5.8.3 Connecting the Inlet Capillary

Depending on the modules in your Vanquish system, you can connect the inlet capillary directly from the column compartment or from a previous detector in the system flow path.

Observe the guidelines in [General Information and Guidelines](#) (▶ page 58).

Parts required

- Inlet capillary

Preparations

1. Flush the system modules and capillaries upstream of the detector to waste before you connect the detector to the system flow path. Refer to the *Vanquish System Operating Manual*.
2. Remove the plug from the flow cell inlet.

TIP Store the flow cell plugs, for example, in the drawer of the system base, to have them easily available when storing or shipping the detector.

Follow these steps

Connect the inlet capillary to the flow cell inlet as required by the system arrangement:

- From the column compartment (see below)

–or–

- From the outlet of the UV/VIS detector (see below)

Connecting the inlet capillary from the column compartment

1. Route the inlet capillary from the column compartment through the guide hole in the enclosure. Use the guide hole that is next to the column compartment.

TIP Always keep the capillary connection between the column compartment and the flow cell as short as possible to minimize peak dispersion (i.e. peak broadening effects due to extra dispersion volume).

2. Connect the capillary to the flow cell inlet (IN).

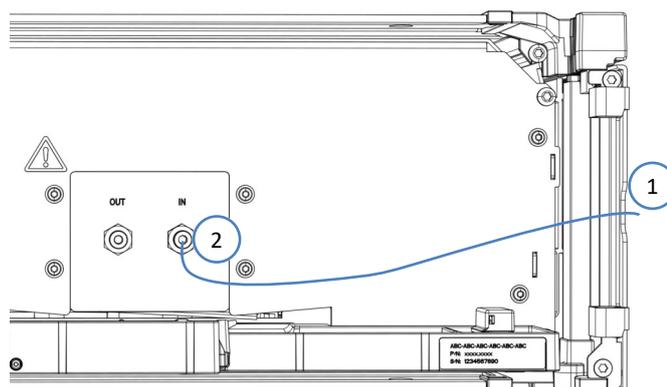


Figure 15: Connecting the inlet capillary

Connecting the inlet capillary from the UV/VIS detector

NOTICE

Be aware of the backpressure limit of the flow cell in the Vanquish UV/VIS detector (refer to the *Operating Manual for the UV/VIS detector*) in the flow path before the refractive index detector.

Avoid connecting any additional components in the flow path between the two detectors and connect the capillary from the UV/VIS detector directly to the refractive index detector flow cell inlet.

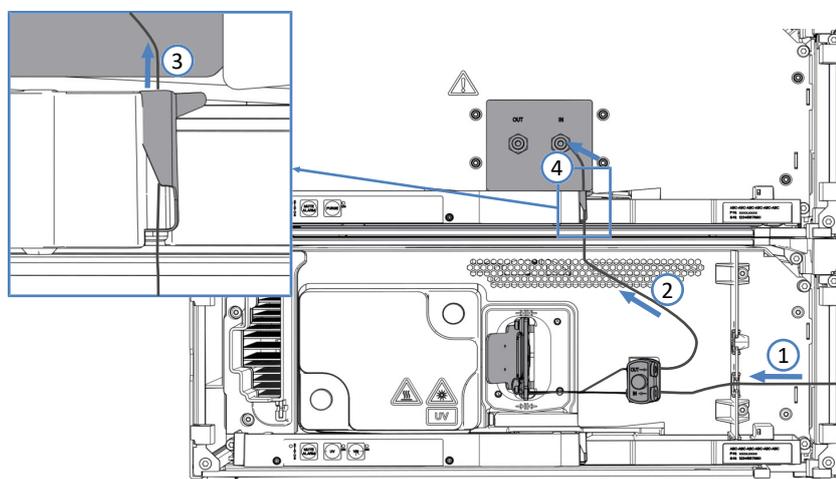


Figure 16: Connecting the inlet capillary from the UV/VIS detector (example)

1. Connect the inlet capillary from the column compartment to the flow cell inlet of the UV/VIS detector. Refer to the instructions in the *Operating Manual for the UV/VIS detector*.
2. Route the connecting capillary from the flow cell outlet of the UV/VIS detector upward to the refractive index detector.

3. On the leak tray of the refractive index detector, pull the capillary clip carefully to the right to open the clip.
 - a) Position the capillary behind the capillary clip.
 - b) Carefully release the clip and take care not to clamp the capillary. The capillary must be secured behind the clip.

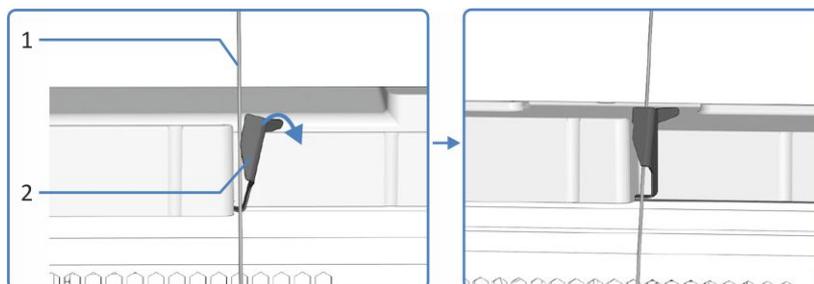


Figure 17: Securing the capillary behind the capillary clip on the leak tray

No.	Description
1	Capillary from the flow cell
2	Capillary clip

4. Connect the inlet capillary to the flow cell inlet of the refractive index detector.

5.8.4 Connecting the Waste Line

Parts required

Waste line

Observe the guidelines in [General Information and Guidelines](#) (▶ page 58).

Tools required

Tubing cutter (optional)

Preparations

1. If not already done, flush the system modules and capillaries upstream of the detector to waste before you connect the flow cell to the system flow path (refer to the *Vanquish System Operating Manual*).
2. Remove the plug from the flow cell outlet.

TIP Store the flow cell plugs, for example, in the drawer of the system base, to have them easily available when storing or shipping the detector.

Follow these steps

TIP Connect the refractive index detector as the last module in the flow path. This is due to the outlet pressure limit of the detector (0.05 mPa or less).

1. Connect the waste line to the flow cell outlet (OUT).

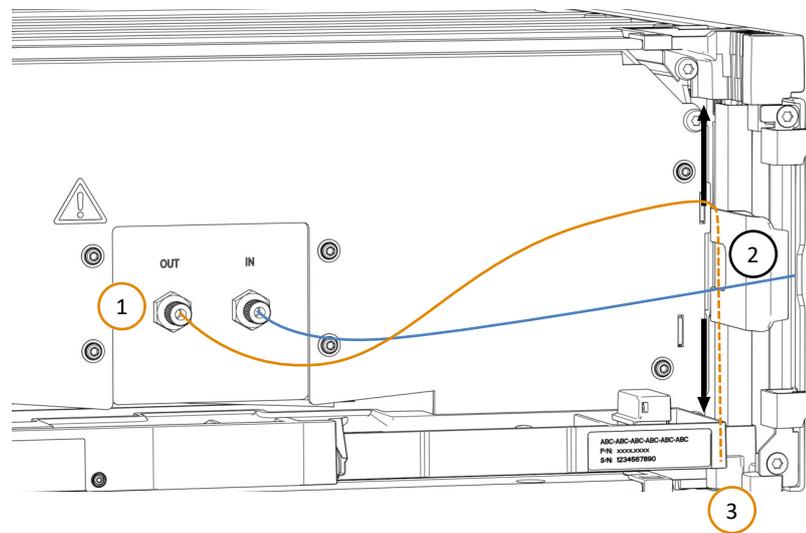


Figure 18: Connecting the detector waste line

2. Position the tubing bracket in the middle of the enclosure height to establish a slightly elevated routing of the waste line. Route the waste line behind the tubing bracket as shown in the figure.
3. Guide the waste line downward in the tubing guides of the system modules to the Vanquish system base.
4. On the system base, route the detector waste line through the dedicated detector waste outlet and connect the detector waste line to the waste container (refer to the *Vanquish System Operating Manual*).

TIP The waste line should go straight to the system base and to waste. Make sure that the line is positioned straight in the tubing guides.

5.9 Setting Up the Device in the Software

This section describes the steps for setting up the device in the Chromeleon 7 software.

The Vanquish RI Detector driver package is required to control the detector. For details on the supported Chromeleon versions, refer to the *Release Notes* for the driver package.

TIP Although the device is connected via USB, communication with the chromatography data system is realized through a virtual COM port. Do *not* turn on the detector before you have installed the virtual COM port driver.

Preparations

1. Verify that the chromatography software is installed on the data system computer.
2. Install the Vanquish RI Detector driver package. Refer to the *Release Notes*.

Installing the Virtual COM Port driver

1. Locate the **Drivers\USB Virtual COM Port** folder on the Chromeleon installation medium.
2. Check if the folder contains the **2.12.28** folder with further sub folders and PDF files. Locate the installation instructions for your operating system.
3. Install the drivers as described in the instructions for your operating system.
4. Turn on the detector (see [Turning On the Device](#) (► page 67)).
5. Windows installs the virtual COM port. When the message **Your device is ready to use** appears, open the message and note the number of the new virtual COM port (for example, COM3).

Configuring the Vanquish Refractive Index Detector driver

1. Start the Chromeleon 7 Instrument Configuration Manager.
2. Select the instrument and click **Add Module**.
3. On the **Manufacturers** list, select **Thermo Scientific HPLC: Vanquish**, and on the **Modules** list, select **Vanquish Refractive Index Detector**.
4. On the **General** page, in the **COM Port** box, select the new virtual COM port (usually the COM port with the highest number).

5. Click **Test Communication** to test the connection. This may take a few seconds.
 - ◆ If connection to the device was established, the Chromeleon software displays a box showing the model variant of the device.
 - ◆ If the Chromeleon software displays a message that the connection failed, or if a wrong serial number is displayed, you may have selected the wrong COM port. Try a different COM port and test the connection again.
6. Save the installation and close the Instrument Configuration Manager.

5.10 Turning On the Device

TIP Before turning on the power to the detector for the first time, verify that the chromatography software and virtual COM port driver are installed on the data system computer (see [Setting Up the Device in the Software](#) (▶ page 65)).

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

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

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

See also

 [Power On/Off Control](#) (▶ page 76)

6 Operation

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

6.1 Introduction to this Chapter

The information in this chapter assumes that the initial setup of the device has already been completed. If this is not the case, contact Thermo Fisher Scientific Technical Support for assistance.

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

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

6.2 Safety Guidelines for Operation

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



Observe all warning messages and precautionary statements presented in [Safety Precautions](#) (▶ page 19).

NOTICE

Flow cells and other fluidic components are highly sensitive to contamination, clogging and high backpressures. Even if the pressure exceeds the upper limit for a very short time only, this may lead to damage or sample loss. Observe the following notes:

- Never expose the fluidic components of the detector to excessive backpressure. Observe the specified pressure rating for the detector (see [Performance Specifications](#) (▶ page 116)).
- Avoid clogging of the flow cell or waste line.

6.3 General Guidelines for Operation

Consider the information and guidelines for operation to optimize detector performance.

- Keep the device doors closed during operation to avoid exposure of the module's front to mechanical shock or thermal changes.
- Ensure that the operating conditions are suitable. This includes:
 - ◆ Stable environmental conditions, such as a stable temperature
 - ◆ No air drafts
 - ◆ No vibrations or mechanical shocks caused by external sources
 - ◆ No EMC-related sources of strong interference other than, for example, certified laboratory equipment.
 - ◆ Stable backpressure and correct waste line setup

TIP During measurements, avoid touching the module's front (close the doors) or the electrical connectors as this may impair the measurement signal.

6.4 Control Elements

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

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

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

6.4.1 Keypad

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

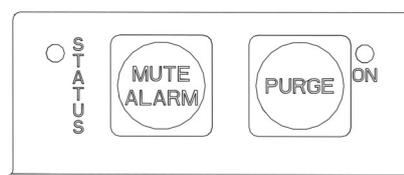


Figure 19: Keypad

STATUS

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

For status details, see [Status Indicators](#) (▶ page 74).

MUTE ALARM

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

PURGE

Pressing the button purges the reference part of the flow cell (see [Purging the Flow Cell](#) (▶ page 78)). To stop purging, press the button again. The LED next to the button indicates if the detector is purging (LED on) or not (LED off).

The button functionality is not available when the device is connected in the chromatography data system.

6.4.2 Status Indicators

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

LED Bar

The LED bar colors provide the following information:

LED Bar	Description
Off (dark)	The power to the device is turned off.
Dimmed	The doors of the device are open.
Yellow, flashing slowly	The power to the device is turned on, but the device is not connected in the chromatography data system.
Yellow	The device is connected in the chromatography data system, but PURGE is on, or light intensity is low (check Instrument Audit Trail for details).
Green, flashing	The device is equilibrating.
Green	The device is equilibrated, but no data acquisition is running.
Blue, running	A data acquisition is running.
Blue	An injection, sequence or validation procedure (such as span validation) is running.
Red	A problem or error has occurred. For the related message, check the Instrument Audit Trail. For remedial action, see Troubleshooting (▶ page 107).

STATUS LED

The **STATUS** LED on the keypad inside the device provides the following information:

STATUS LED	Description
Off (dark)	The power to the device is turned off.
Green	The device is functioning properly.
Red	A problem or error has occurred. For the related message, check the Instrument Audit Trail. For remedial action, see Troubleshooting (▶ page 107).

For information about the LED that is present next to the **PURGE** button on the keypad, see [Keypad](#) (▶ page 73).

6.5 Power On/Off Control

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

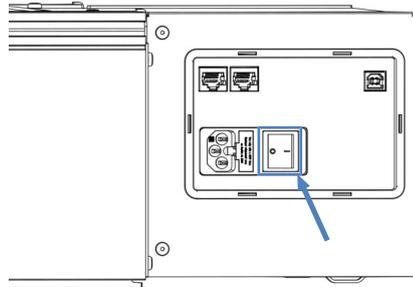


Figure 20: Main power switch

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

Observe the following:

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

6.6 Preparing the Detector for Operation

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

NOTICE—Damage to the Purge Valve Seals

Before activating the purge valve for the first time (LED Off), pump about 10 ml of liquid through the flow cell. This will flush out possible dust or particulate matter and reduce the possibility of damaging the valve seals.

1. Purge the flow cell (see [Purging the Flow Cell](#) (▶ page 78)).
2. Wait until the baseline is stabilized.
3. Perform an Autozero. This may take up to 40 seconds.

TIP The chromatography data system supports procedures for automatically starting a chromatography system, including stabilizing the noise and drift signal (Smart Startup). For details, refer to the *Chromeleon Help*.

6.7 Purging the Flow Cell

Purging the flow cell means that solvent flows through the reference part of the flow cell (PURGE = On). The purge function turns the purge valve on and off.

When

- The detector is operated for the first time, or after a long-term shutdown
- The eluent composition changes, for example, when changing to a different analytical method
- To remove air bubbles that may be trapped in either part of the flow cell
- Baseline drift or increased noise occurs
- At regular intervals as required

Follow these steps

TIP If your Chromeleon 7 version supports an Operational Qualification Noise and Drift test for the detector, you can run this test sequence to perform a purge cycle and stabilization phase. As an alternative, you can manually purge the flow cell as described below. Note that the keypad button functionality is not available when the device is connected in the chromatography data system.

1. Start pumping solvent at a flow rate of 1 mL/min. If you select a different flow rate, you may have to adapt the purge duration accordingly (longer purge cycles for lower flow rates).
2. To start purging, do one of the following:
 - ◆ Press the **PURGE** button on the keypad, or
 - ◆ Activate **Purge** on the ePanel in the chromatography data system.The LED next to the keypad button indicates that the detector is purging (LED on).
3. Press or activate/deactivate **PURGE** every 30 seconds to turn on/off the purge valve for a few minutes.
4. Keep pumping mobile phase solvent to the reference cell for about 20 minutes from the above step.
5. Press or deactivate **PURGE** again to turn off the valve. Mobile phase solvent flows to the sample cell.
6. Wait until the baseline is stabilized.

6.8 Flow Cell Temperature Setting

Refractive index detectors in general are very sensitive to changes in ambient temperature and airflow, which may result in baseline drift. Therefore, the Vanquish refractive index detector is equipped with active flow cell heating to minimize baseline drift, even if ambient temperatures change.

Temperature range

The flow cell temperature can be set between 30°C and 55°C, but the minimum temperature target value can only be approximately 10 K above the ambient temperature.

Example: The expected maximum temperature in the laboratory is 22°C. The minimum settable flow cell temperature is 32°C.

Stabilization times

The detector needs time to stabilize after the flow cell temperature setting was changed.

- The greater the difference between ambient temperature and flow cell temperature, the longer the detector will need to stabilize.
- If you select a lower temperature setting than was set before, the stabilization time will take longer compared to setting a higher temperature.

6.9 Shutdown

Flushing Out Corrosive Solvents

Some solvents may corrode the detector if they are left in the detector and should be thoroughly flushed from the entire system, including the reference and sample flow cell.

The quartz flow cell window in particular is easily etched by strong bases. Do not turn power to the detector off without rinsing these solvents from the detector.

Some solvents can be left in the cells at the end of an operation. For example, water, acetonitrile, isopropanol, the xylenes, and paraffinic hydrocarbons are quite innocuous. They may be left in the detector overnight or over a weekend.

No Flow Shutdown Versus Reduced Flow Shutdown

A continuous slow flow through the detector is the preferable shutdown procedure if the situation permits, especially if buffers, tetrahydrofuran and organohalocarbons are in use.

Reduced flow may be 50 $\mu\text{l}/\text{min}$. You may have to reduce the lower pressure limit for the pump.

Solvent or additive	Recommendation
Buffers	Even if the buffer is non-corrosive, it is better to keep the solvent flowing at a reduced rate to eliminate the possibility of salt precipitation in the flow cells and tubing.
Tetrahydrofuran (THF)	Because THF does oxidize, you may find that, if you keep solvent flowing at a reduced rate, the chromatographic system takes less time to re-stabilize upon start-up. Generally, a reduced-flow shutdown procedure will minimize re-stabilization time; the time saved is noticeable with THF as the solvent.
Organohalocarbons, such as methylene chloride and chloroform	Keep a small amount of flow to keep down the amount of corrosive chloride impurities in the cell.

Long-Term Storage

If the detector will not be used for a week or more, fill the sample and reference cells with isopropanol.

If the detector is to be exposed to sub-freezing temperatures, an antifreeze flush, such as methanol must be used. Ideally, you are suggested to expel residual solution out of the detector and to fill the sample and reference cells with isopropanol.

7 Maintenance and Service

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

7.1 Introduction to Maintenance and Service

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



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

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

The maintenance procedures do not require that you remove the doors. However, it is possible to remove a door if this should ever be required for a specific reason or procedure. If you need to remove a door, follow the related steps in [Replacing the Doors](#) (▶ page 93).

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 19).



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—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 device 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. Refer to the *Operating Manual* for the pump.
- Retighten the reservoir caps.



CAUTION—Electric Shock or Damage to the Device

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

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

7.3 Routine and Preventive Maintenance

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

7.3.1 Maintenance Plan

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

Frequency	What you should do...
Daily	<ul style="list-style-type: none"> Inspect the flow connections for signs of leakage or blockage. When you use buffers or salt solutions, flush the device thoroughly after use with an appropriate solvent that does not contain buffers or salts. Monitor the backpressure that the flow cell is exposed to.
Regularly	<ul style="list-style-type: none"> Inspect the flow connections for damage, such as cracks, nicks, cuts, or blockage. Check that all warning labels are still present on the device and clearly legible. If they are not, contact Thermo Fisher Scientific for replacement.
Annually	Have Thermo Fisher Scientific service personnel perform preventive maintenance once a year.

7.3.2 Cleaning or Decontaminating the Device

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

NOTICE

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

Decontamination

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

Parts required

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



CAUTION—Explosive Gas Mixtures from Alcoholic Cleaning Detergents

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

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

NOTICE

Observe the following:

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

Preparations

1. Turn off the power to the device and disconnect the power cord 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.

7.3.3 Performing Span Validation

You can perform a span validation to verify whether the refractive index of the detector is within the specified limits, that is, within 512 μ RIU \pm 5%. For this test, you must inject a special sucrose solution.

When

At regular intervals

Preparations

Prepare a fresh sucrose standard solution:

1. Weigh out 350 mg sucrose and transfer it quantitatively to a volumetric flask.
2. Dissolve in 100 mL de-ionized, filtered, degassed water and dilute to the flask's mark.

Follow these steps

1. Connect the detector in the chromatography data system.
2. On the ePanel for the refractive index detector, select **Service**.
3. On the **RI Detector – Service** ePanel, select **Start Span Validation**.
4. Follow the instructions on the ePanel. At one point, you will be asked to disconnect the pump and inject the sucrose solution. Fill the syringe with sucrose standard solution and gently inject the solution into the inlet port.

If span validation was successful, the validation date is updated.

If span validation fails, contact Thermo Fisher Scientific Technical Support for assistance.

7.4 Cleaning the Flow Cell

When

In many cases, performance degradation in sensitive instruments equipped with flow cells is caused by cell contamination. The use of filtered solvents will protect the flow cell from contamination and reduce the amount of cleaning required. However, contamination from trapped particulates or bubbles, from precipitates, or from thin films of residues can still occur.

Parts required

- Flushing and injection kit for flow cells (optional)
- De-ionized water
- Acetone
- 15% nitric acid solution



WARNING—Explosion Hazard

Do not allow nitric acid to contact methanol. An explosion could result. Completely rinse the flow cell with water following cleaning with nitric acid.

NOTICE—Fluidic components sensitive to high pressure

The fluidic components inside the detector can withstand only up to 0.05 mPa (7 psi). Higher pressures may lead to damage or sample loss.

- Gently flush flow cells under all conditions.
- If you encounter a high backpressure inside the detector, use extreme caution to proceed.

NOTICE—Hydrochloric acid corrodes flow cell

Hydrochloric acid in any concentration will corrode the flow cell.

- Never put hydrochloric acid in the flow cell. Use diluted (10-20%) or concentrated nitric acid as a cleaning solution instead.
- The sample and reference cells should be filled with water or air (blown dry) before proceeding.

Preparations

To introduce the cleaning solution into the detector, connect an inlet capillary directly from the pump to the flow cell inlet port, bypassing the column. For safety, make sure to connect a waste tubing to the outlet.

Some cleaning solutions, however, should be injected directly into the flow cell using a syringe due to their high corrosiveness or safety concerns. You can inject these solutions by using the optional flushing and injection kit.

TIP Clean all internal lines of the detector by injecting cleaning solution with PURGE Off, and inject cleaning solution again with PURGE On.

Cleaning procedure for organic solvent

1. Disconnect the inlet capillary and press **PURGE** to turn on the valve.
2. By syringe, inject 30 to 50 mL of solvents (in order of acetone, THF, chloroform, methanol and acetone).
3. Press **PURGE** every 10 seconds to on/off the purge valve while injecting those solvents.
4. As an alternative, fill the flow cell(s) with acetone and leave it overnight.

Repeat the procedure if the result is not satisfactory.

Binding of proteins, salts, or sugars

1. Connect detector with contamination free solvent delivery pump.
2. Press **PURGE** to turn on the valve.
3. Pump deionized water at 1mL/min flow rate and leave it overnight.
4. You may want to wash the flow path with 0.1M NaOH priority if you know there is a potential of proteins binding.

Repeat the procedure if the result is not satisfactory.

Heavy-duty cleaning

If the above whole procedure didn't work, you may apply 15% nitric acid solution. Make sure to flush the flow path with deionized water before and after.

Apply the nitric acid solution using a syringe and make sure the solution does not stay more than 5 minutes.

Typical cleaning procedure

Depending on the solvents used, the cleaning procedure can be varied. The below procedure is a typical cleaning procedure. Sometimes it helps to reverse flow and inject into the outlet port to remove particulate matter.

1. Fill the syringe with cleaning solution and connect it to the inlet port.
2. Carefully inject the cleaning solution.
 - ◆ Inject 10 mL cleaning solution (acetone) into the inlet port.
 - ◆ Inject 10 mL de-ionized water into the inlet port.
 - ◆ Inject 10 mL nitric acid solution (15%) into the inlet port.
3. Flush the flow cell with de-ionized water until the nitric acid solution is completely expelled. Flush for 15 to 30 minutes.
4. Exchange the de-ionized water with the mobile phase solvent.

Flushing out precipitated salt

If buffers or solutions of high salt content have been in use, the cells may be contaminated by precipitated salt. Pumping a large amount of distilled, de-ionized water, such as 1 mL/min, for up to several hours, is the simplest clean-up procedure.

An elevated cell temperature will speed dissolution. The water wash can be acidified if the precipitated salt is more soluble in acidic solutions. However, do not use strongly basic (pH 10 or higher) solutions, as these will etch the refractive index cells.

Non-aqueous solvent

If contamination is suspected when a non-aqueous solvent is in use, flush the cells with a solvent that is (1) miscible with your mobile phase, (2) a good solvent for the predicted contaminant, and (3) generally of greater polarity than your mobile phase.

7.5 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 steps in this section.

Parts required

Replacement door

Follow these steps

NOTICE

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

1. If the door is located directly 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.

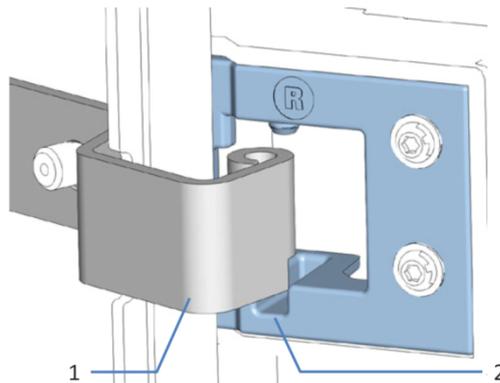


Figure 21: Unhinging a door

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. 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.

7.6 Replacing the Main Power Fuses

When

Blown fuses

Parts required

Fuses (2 fuses, T3.15A, 250 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.

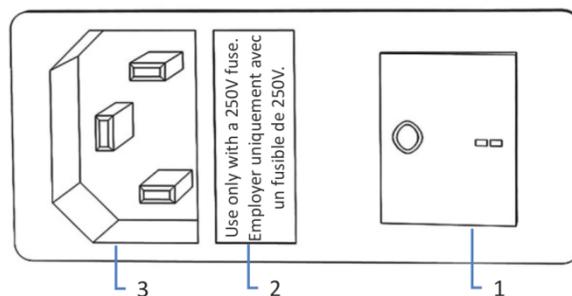


Figure 22: Fuse holder

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.

7.7 Transporting or Shipping the Detector

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

Observe the following safety guidelines:



CAUTION—Heavy Load, Bulky Device

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

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

Follow these steps

1. Prepare the device for transport. See [Preparing the Detector for Transport](#) (▶ page 97).
2. The step depends as follows:
 - ◆ To transport the device to a new location, follow the instructions in [Transporting the Detector to a New Location](#) (▶ page 99).
 - ◆ To ship the device, follow the instructions in [Shipping the Detector](#) (▶ page 99).

7.7.1 Preparing the Detector for Transport

To prepare the detector for transport, follow these steps:

1. Flush out solvents and prepare the detector for long-term storage (see [Shutdown](#) (▶ page 80)).
2. Turn off the device with its main power switch and disconnect the power cord.
3. Remove all cables and flow connections to other devices.
4. Tighten the locking screws (see [Tightening the Locking Screws](#) (▶ page 98)).

5. Proceed depending on the situation:

Situation	Steps
If you want to remove the detector from the system stack	Follow the instructions on dismantling the system stack in the <i>Transporting or Shipping the System</i> section of the <i>Vanquish System Operating Manual</i> .
If you want to remove the slide-in module	The slide-in module is already removed after tightening the locking screws.

See also

 [Removing the Slide-In Module \(▶ page 101\)](#)

7.7.2 Tightening the Locking Screws

Before shipping or transporting the detector, you need to tighten the locking screws on the bottom side of the slide-in module.

Tools required

Hexagon wrench, size 5 mm

Preparations

1. Remove the slide-in module (see [Removing the Slide-In Module \(▶ page 101\)](#)).

Follow these steps

1. Place the slide-in module on an even and clean surface with the bottom side facing up.
2. Gently tighten the 2 screws.

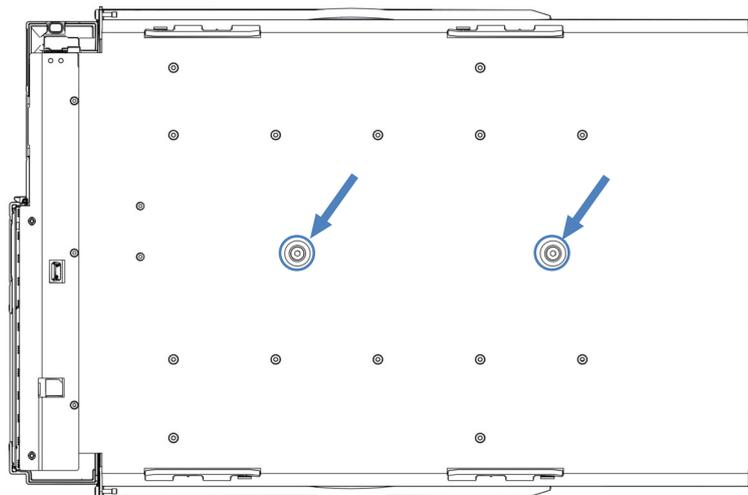


Figure 23: Tightening the locking screws

3. Install the slide-in module (see [Installing the Slide-In Module](#) (▶ page 103)).

7.7.3 Transporting the Detector to a New Location

Preparations

Prepare the detector for transport. See [Preparing the Detector for Transport](#) (▶ page 97).

Follow these steps

1. Transport the detector to the new location.
2. Install the detector in the system stack. Follow the instructions on mounting the system stack in the *Vanquish System Operating Manual*.
3. Loosen the locking screws (see [Loosening the Locking Screws](#) (▶ page 53)).
4. Set up the detector:
 - a) Connect the detector (see [Connecting the Device](#) (▶ page 54)).
 - b) Set up flow connections (see [Setting Up the Flow Connections](#) (▶ page 58)).
 - c) Prepare the detector for operation (see [Preparing the Detector for Operation](#) (▶ page 77)).

7.7.4 Shipping the Detector

Preparations

Prepare the detector for transport. See [Preparing the Detector for Transport](#) (▶ page 97).



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.

Follow these steps

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

Restarting the Device after Shipping

To install the device after shipping, follow the instructions on mounting the system stack in the *Vanquish System Operating Manual*.

7.8 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.

7.8.1 Removing the Slide-In Module



CAUTION—Heavy Load, Bulky Device

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

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

Tools required

Screwdriver, Torx T20

Preparations

1. Prepare the device for transport. See [Transporting or Shipping the Detector](#) (▶ page 97).

Follow these steps

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

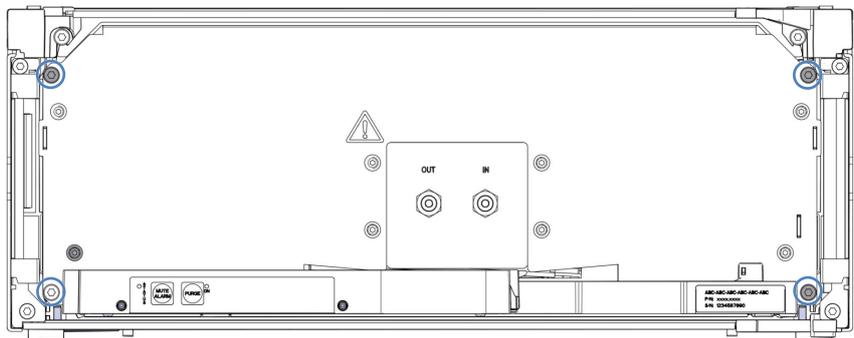


Figure 24: Captive screws on the slide-in module

2. Push all tubing and capillaries, which are present in the tubing chase of the Vanquish system modules, into the tubing chase. Otherwise, you will not be able to remove the slide-in module properly from the enclosure in the next step.
3. Grasp the slide-in module by the leak tray and pull the module out of the enclosure by approximately 10 cm.

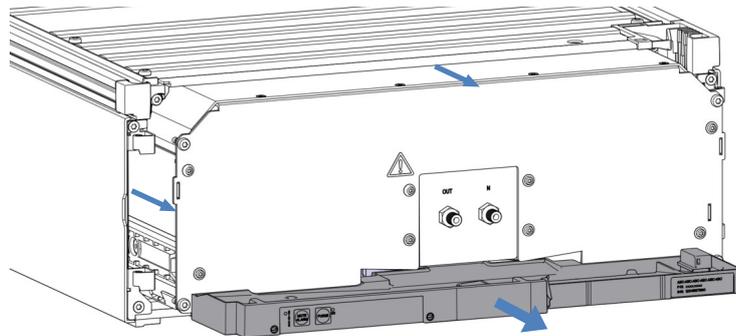


Figure 25: Pulling out the slide-in module

NOTICE

The slide-in module can fall down when pulling it out of the enclosure too far.

Pull out the slide-in module just far enough so that you can grasp it on both sides from below.

4. Remove the slide-in module from the enclosure. The following steps require a team effort:
 - a) Take the slide-in module on both sides from below.
 - b) Pull the slide-in module from the rails towards the front.
 - c) Place the slide-in module on a clean and stable surface.
5. *If the module is transported over a longer distance or if it is shipped:* Fasten the locking screws (see [Tightening the Locking Screws](#) (► page 98)).

7.8.2 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 from the enclosure. See [Removing the Slide-In Module](#) (▶ page 101).

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 103).

7.8.3 Installing the Slide-In Module



CAUTION—Heavy Load, Bulky Device

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

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

Tools required

Screwdriver, Torx T20

Preparations

1. *If the detector was transported over a longer distance or shipped:* Loosen the locking screws. See [Loosening the Locking Screws](#) (► page 53).
2. When installing the slide-in module to an enclosure in the system stack, check that the enclosure is placed correctly in the stack.

Follow these steps

1. 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.

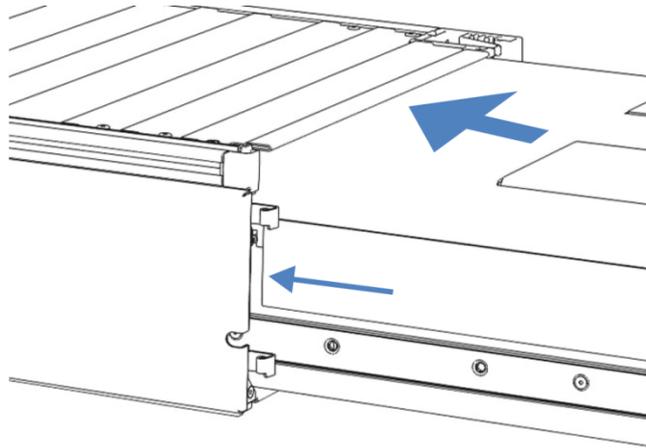


Figure 26: Inserting the slide-in module

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.

7.8.4 Setting Up the Slide-In Module

After you have reinstalled the slide-in module in the enclosure, set up and restart the device.

Follow these steps

1. Set up the slide-in module:
 - a) Connect the slide-in module and set up flow connections (see [Installation](#) (► page 43)).
 - b) Prepare the slide-in module for first-time operation (see [Preparing the Detector for Operation](#) (► page 77)).
2. Prepare *all other* modules of the Vanquish system for operation and restart them. Refer to the *Operating Manuals* for the modules.
3. Before starting an analysis, let the chromatography system equilibrate and be sure that it is ready for operation.
4. In the Chromeleon software, run the device-specific **Performance Qualification** (PQ) tests.

8 Troubleshooting

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

8.1 General Information about Troubleshooting

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

Status Indicators

The status indicator LED bar on the front side of the device and the **STATUS** LED on the keypad inside provide quick visual feedback on the operational status of the device. If the device firmware detects a problem, the status indicators are red.

Alarms

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

Instrument Audit Trail Messages

If the device firmware detects a problem, the problem is reported to the chromatography data system.

The data system logs information about all events related to instrument operation for the current day in an Instrument Audit Trail. The Instrument Audit Trail is named with the current date, using the format `yyyymmdd`. For example, the Instrument Audit Trail for May 15, 2019, is named `20190515`.

The Instrument Audit Trails can be found on the ePanel Set (Audit ePanel). In addition, Audit Trails for each instrument are available in the Chromeleon 7 Console Data view, in the folder of the Instrument.

8.2 Messages

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

Message	Description and Remedial Action
Leak detected	<p>There is a solvent leak. The heater for the flow cell temperature is immediately turned off.</p> <p>Find and eliminate the source for the leakage (see Resolving Liquid Leaks (▶ page 111)).</p> <p>By default, the current sequence is aborted when a solvent leak error occurs. You can set the LeakAbort property to Off to prevent this, for example, if you are not using the flow cell temperature setting.</p>
Low Light Intensity	<p>This indicates inadequate light intensity. There are several possible causes for this message.</p> <ul style="list-style-type: none"> • Different state of solvents between sample side and reference side of flow cell. Purge the reference side of the flow path with fresh solvent (see Purging the Flow Cell (▶ page 78)). • Air bubbles in flow cells. Repeatedly turn PURGE on and off with flow to remove the air bubble. • Optical axis is off from the center. Execute Autozero. • The flow cell is empty. Fill the flow cell with eluent.
Null Glass Home Position Error	<p>The null glass does not come back to its home position. If this message appears when you execute Autozero, see “Optical Balance Error”.</p> <p>If this message appears when you turn on the detector, contact Thermo Fisher Scientific Technical Support.</p>
Optical Balance Error	<p>Autozero was not successful. Insufficient solvent exchange of reference flow path might cause this. Try purging the flow cell to fill the reference flow path with fresh solvent at once (see Purging the Flow Cell (▶ page 78)).</p>
Overheating Error	<p>This indicates an overheating of the optical block. Contact Thermo Fisher Scientific Technical Support.</p>
Parameter Error	<p>The units failed to store data. Contact Thermo Fisher Scientific Technical Support.</p>
Temperature control has been deactivated.	<p>There is a solvent leak. The heater for the flow cell temperature has been turned off.</p> <p>Find and eliminate the source for the leakage (see Resolving Liquid Leaks (▶ page 111)).</p>
The span validation procedure failed. A span value could not be confirmed. Please check the used sucrose solution and try again.	<p>An error occurred during span validation. Verify that the sucrose solution was prepared as described in Performing Span Validation (▶ page 89).</p>

Message	Description and Remedial Action
The span validation procedure failed. The last successful validation date was xx with span yy μ RIU and lamp voltage zz V. Please ensure a stable environment and try again.	An error occurred during span validation. This may be due to unstable environmental conditions. Stabilize conditions if possible and repeat span validation.
Unstable Temperature	The flow cell temperature has not met the preset temperature. For hints regarding temperature setting, see Flow Cell Temperature Setting (▶ page 79).

8.3 Operating Issues

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

8.3.1 Resolving Liquid Leaks

When

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

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 83).

Follow these steps

1. Check the connections at the inlet and outlet ports for leaks.
2. Tighten or replace the connection as required.
3. With a cloth or tissue, thoroughly absorb all liquid that has collected in the leak tray and under the leak sensor. Be careful not to bend the sensor.
4. Allow the sensor to adjust to the ambient temperature for a few minutes.
5. If leakage is no longer reported, you can resume operation.

If you suspect that the leakage has occurred inside the detector, for example, inside the flow cell, contact Thermo Fisher Scientific Technical Support for assistance.

8.3.2 Additional Device Operating Issues

This section provides additional issues that may arise during operation of the device. 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.

Also check the Instrument Audit Trail for a related message if an operating problem occurs. The message may provide additional information.

Note that this section provides information on symptoms and causes directly related to the device. For information about troubleshooting for the Vanquish system, refer to the *Vanquish System Operating Manual*.

TIP 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.

Symptom	Possible Cause	Remedial Action
Noise	Air bubbles in the pump	See section <i>System Troubleshooting</i> in the <i>Vanquish System Operating Manual</i> .
	Air bubbles in the detector	<ul style="list-style-type: none"> • Verify that the waste line is guided with an elevation as shown in Connecting the Waste Line (▶ page 63) to create a minimum backpressure. • Premix and degas mobile phase well.
	Flow cell dirty	Clean the reference and sample cells. See Cleaning the Flow Cell (▶ page 90).
	Weak lamp	Check the value for the ValidationLampVoltage . If it exceeds 4.5 V, contact Technical Support.
	Ambient temperature fluctuations	Place the detector in a more stable environment.
	Mechanical shock	Avoid touching the module's front (close the doors) or the electrical connectors during measurement.
	Vapor pressure of the mobile phase is too high for the detector	<ul style="list-style-type: none"> • Turn temperature control off, or reduce the nominal temperature. • Modify your method to exclude or decrease the concentration of troublesome solvent.
	Electrical transients from power line or radio frequency source	Isolate the detector power source from other heavy equipment, such as motors.
Cyclic noise	Ambient temperature fluctuations	Place the detector in a more stable environment.
	Air bubbles in reference cell	Flush the detector with PURGE on/off (see Purging the Flow Cell (▶ page 78)).
Cyclic noise matching the pump stroke frequency	Waste line is too narrow	<ul style="list-style-type: none"> • Verify that you have installed the correct waste line at the outlet port. • Check the waste line for crimps.

Symptom	Possible Cause	Remedial Action
Drift	Flow cell dirty	Clean the reference and sample cells. See Cleaning the Flow Cell (▶ page 90).
	Flow cell damaged	Check for liquid in drain tubing indicating a broken flow cell. Contact Technical Support.
	Contamination from HPLC System	Flush the HPLC system with a solvent stronger than the mobile phase (less polar for reversed phase) until the contaminant disappears.
	Contaminated or non-HPLC-grade solvents	Prepare fresh mobile phase (premixed, degassed).
	Vapor pressure of mobile phase is too high for operating temperature, causing air bubble formation in the reference cell	<ul style="list-style-type: none"> • Turn temperature control off, or reduce the nominal temperature. • Modify your method to exclude or decrease the concentration of troublesome solvent.
	Tetrahydrofuran (THF) in the mobile phase oxidizes in reference cell	<ul style="list-style-type: none"> • Add an antioxidant to stabilize the THF, if compatible with other chromatographic requirements. • Allow >2 hours stabilization time for oxidation in reference cell to reach a steady state condition.
Baseline drift occurs in few hours of start	Reference cell solvent has aged and deteriorated	Flush reference cell with mobile phase (see Purging the Flow Cell (▶ page 78)).
Baseline will not zero	Sample and reference cells do not contain identical solutions	Flush sample and reference cells with mobile phase (see Purging the Flow Cell (▶ page 78)).
	Reference cell contains air bubbles	Flush sample and reference cells with mobile phase (see Purging the Flow Cell (▶ page 78)).
	Flow cell dirty	Clean the reference and sample cells. See Cleaning the Flow Cell (▶ page 90).
	Flow cell damaged	Check for liquid in drain tubing indicating a broken flow cell. Contact Technical Support.
	Lamp deteriorated or out of adjustment	Check the value for the ValidationLampVoltage . If it exceeds 4.5 V, contact Technical Support.
Intensity alarm	Flow cell dirty	Clean the reference and sample cells. See Cleaning the Flow Cell (▶ page 90).
	Lamp burned out	Contact Technical Support.
	Flow cell empty	Fill the flow cell with eluent.

9 Specifications

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

9.1 Performance Specifications

The device performance is specified as follows:

Type	Specification
Refractive index range	1.00 to 1.75 RIU
Response time (RT)	0.05 s, 0.1 s, 0.25 s, 0.5 s, 1 s, 1.5 s, 2 s, 3 s, 6 s
Data collection rate (DCR)	0.5 Hz, 0.67 Hz, 0.83 Hz, 1 Hz, 1.25 Hz, 2 Hz, 2.5 Hz, 3.33 Hz, 5 Hz, 10 Hz, 20 Hz, 25 Hz, 50 Hz
Polarity	Positive and negative
Temperature control	30 to 55°C Flow cell temperature stabilization by active heating only
Flow cell	2 chambers 8 µL flow cell volume
Measuring method	Deflection type
Measuring range	± 600 µRIU
AutoZero	Optical and electrical
AutoZero resolution	≤ 1 nRIU at 8 mV/µRIU, 4 nRIU at 2 mV/µRIU
Offset range	0 to 500mV
Integrator output (sensitivity)	0 to 1 V DC (2 mV/µRIU, 8 mV/µRIU)
Maximum flow rate	10 mL/min (with water)
Pressure rating	0.05 MPa (this is the output pressure)
Internal volume	Inlet port/flow cell: approx. 50 µL Flow cell/outlet port: approx. 480 µL Total: 530 µL
PC connection	USB 2.0
I/O interface	Analog I/O
System Interlink	2 System Interlink ports (RJ45-8 connectors)
Safety features	Leak detection and safe leak handling
Control	Chromeleon 7 Keypad with 2 buttons for performing certain functions directly from the device
Good Laboratory Practice (GLP) features	All system parameters are logged in the Chromeleon Audit Trail.
Biocompatible	No
pH	1-13 For details, refer to Allowed pH Ranges (▶ page 25).
Buffer concentration	≤ 1mol/L
Chloride concentration	≤ 0.1 mol/L
NP compatibility	Yes

Type	Specification
Materials in the flow path	Stainless steel, SiO ₂ , Al ₂ O ₃ , FFKM, FEP, ETFE, PTFE
Linearity	< 5.0% RSD
Noise	+/- 1.25 nRIU, response time 3 s, data collection rate 50 Hz
Drift	≤ 200 nRIU/hour, response time 3 s, data collection rate 50 Hz

9.2 Physical Specifications

The physical conditions of the device 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
Power requirements	100 – 240 V AC, ± 10 %; 50/60 Hz; max. 250 W / 560 VA
Overvoltage category	II
Emission sound pressure level	None
Dimensions (height x width x depth)	16 x 42 x 62 cm
Weight	16.5 kg

10 Accessories, Consumables and Replacement Parts

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

10.1 General Information

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

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

10.2 Ship Kit

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

Item	Quantity in shipment
System interlink cable	1
Tubing bracket	1
USB cable, USB 2.0, high-speed, type A to B, 1m	1
Viper capillary, 350 mm length, stainless steel, I.D. 0.18 mm	1
Waste line	1

For reordering information, see [Consumables and Replacement Parts](#) (▶ [page 123](#)).

10.3 Optional Accessories

Item	Part No.
Flushing and injection kit for flow cells, including syringe	6078.4200
Post-column cooler, 1 μ L, 0.1 x 590 mm for configurations with VH-C10 column compartment and the Vanquish Refractive Index Detector	6732.0520
Analog I/O cable, 6 pin, for Vanquish Refractive Index Detectors	6060.0006

10.4 Consumables and Replacement Parts

Capillaries and tubing

Description	Part No.
Viper capillary, 0.18 mm I.D., 350 mm length, stainless steel, for connection from the column	6040.2375
Waste line	6036.2425
Flow cell plugs for inlet and outlet	6261.1300
For system capillaries, refer to the <i>Vanquish System Operating Manual</i> .	

Miscellaneous

Description	Part No.
Front door kit, including right door and left door	6083.3018
Fuses kit, Vanquish system The kit includes the appropriate fuses for the Vanquish system modules. For the detector, use only T3.15A, 250 V AC, slowblow fuses.	6036.0002
Packing material for detector with enclosure	6083.0090

Interface cables

Description	Part No.
System interlink cable	6036.0004
USB cable, type A to type B, high-speed, USB 2.0 Cable length: 1 m	6035.9035A

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 I/O pin assignment.

11.1 Compliance Information

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.

EAC Declaration of Conformity

The device has satisfied the requirements for the EAC mark and is compliant with the applicable requirements.

RoHS Compliance

This product complies with the RoHS (Restrictions of Hazardous Substances) directives:

- *European RoHS Directive*
Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment

The CE mark on the device indicates that the product is compliant with the directive.
- *China RoHS regulations*
Measures for Administration of the Pollution Control of Electronic Information Products

One of the following logos may be present on the device if applicable:

Logo	Description
	The green logo marks items that do not contain the hazardous substances identified by the regulations.
	The orange logo including a one-digit or two-digit number marks items that contain hazardous substances identified by the regulations. The number indicates the environment-friendly use period (EFUP) of the item. During this period, the item (when used as intended) will not cause serious damage to human health or environment. For more information, go to http://www.thermofisher.com/us/en/home/technical-resources/rohs-certificates.html

UKCA Declaration of Conformity

The device has satisfied the requirements for the UKCA mark and is compliant with the applicable requirements.

UL/CSA 61010-1 Compliance

The label of the NRTL Lab on the device (for example, cTUVus or CSA mark) indicates that the device has satisfied the requirements of the applicable standards.

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 27: 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	VC-D60-A-01
1.1	VC-D60-A-01

The instructions were prepared in English (original instructions). Other language versions are translations based on the English original instructions.

11.2 Analog I/O Pin Assignment

The analog I/O port can be used to connect an analog external device. The table below lists the functions assigned to the connector pins.

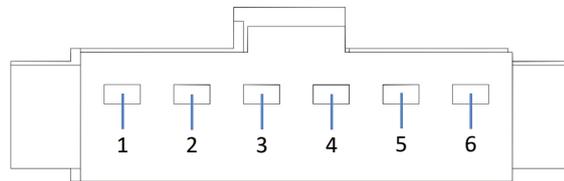


Figure 28: I/O port pin assignment

Pin	Signal Name	Wire color	Content
1	Integrator Sig(+)	white	Analog output: Range 500 μ RIU: 500 μ RIU/V Range 125 μ RIU: 125 μ RIU/V
2	Integrator Sig(-)	black	
3	Frame ground (FG)	clear	
4	A_Zero	-	Not used
5	Purge	-	Not used
6	COM	-	Not used

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