

thermoscientific

Vanquish

Solvent Monitor

Installation Guide

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SCIENTIFIC

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1 About this Manual

This manual provides instructions for installation, set up, maintenance and troubleshooting.

This manual is intended as a supplementary document to the *Operating Manual* for your pump. Refer to the *Operating Manual* for general safety information and the typographic conventions used throughout this manual.

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.

2 Overview

The Vanquish Solvent Monitor (VSM) tracks the volume in solvent reservoirs and waste containers based on physical measurements. It enables routine customers to run their HPLC systems safely and with minimum downtime.

The solvent monitor can be controlled and the volumes can be visualized via the:

- ePanel in the Chromeleon™ software
- Chromeleon parameters

If a Vanquish System Controller is also installed, the measured volumes can also be monitored via the Vanquish Display or an internet web browser.

3 Installation

3.1 Scope of Delivery

The following items are included in the delivery:

- Solvent monitor
- Ship Kit
- Installation Guide

For information on contents of the ship kit or reordering parts, see [Ship Kit](#) (► page 44) and [Consumables and Replacement Parts](#) (► page 46).

3.2 Rating Plate

The rating plate is located on the rear side of the solvent monitor. The rating plate indicates the serial number, part number, module name, revision number (if any), line rating, and the manufacturer's address.

3.3 Allowed Concentrations

The allowed salt concentration for the solvent monitor is 1 mol/L or less.

NOTICE

If the solvent monitor is used in a Vanquish Core system, observe the lower chloride concentration allowed for this system (refer to the *Vanquish System Operating Manual*).

3.4 Installing the Solvent Monitor

TIP If the system stack has not already been set up, install the solvent monitor before the column compartment because the cables need to be guided between the system stack and the column compartment.

The recommended position of the solvent monitor is the right side of the front railing.

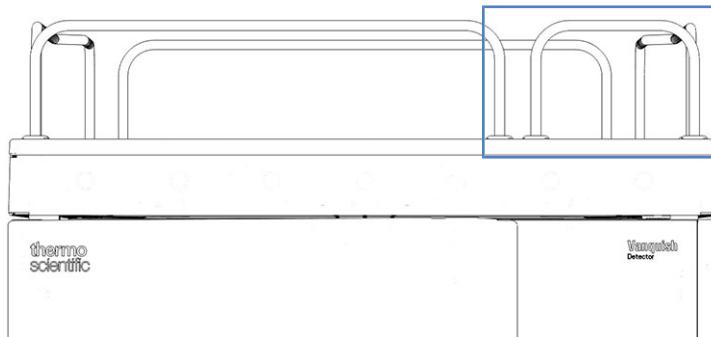


Figure 1: Recommended position of the solvent monitor

If a Vanquish Display is also to be installed, refer to the *Vanquish User Interface Installation Guide* for information where to mount the Vanquish Display. The instructions below describe how to mount the solvent monitor at the right side of the front railing.

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

1. Loosen the screw of the mounting bracket on the rear side of the solvent monitor.
2. Hook the mounting bracket of the solvent monitor onto the right side of solvent rack railing.

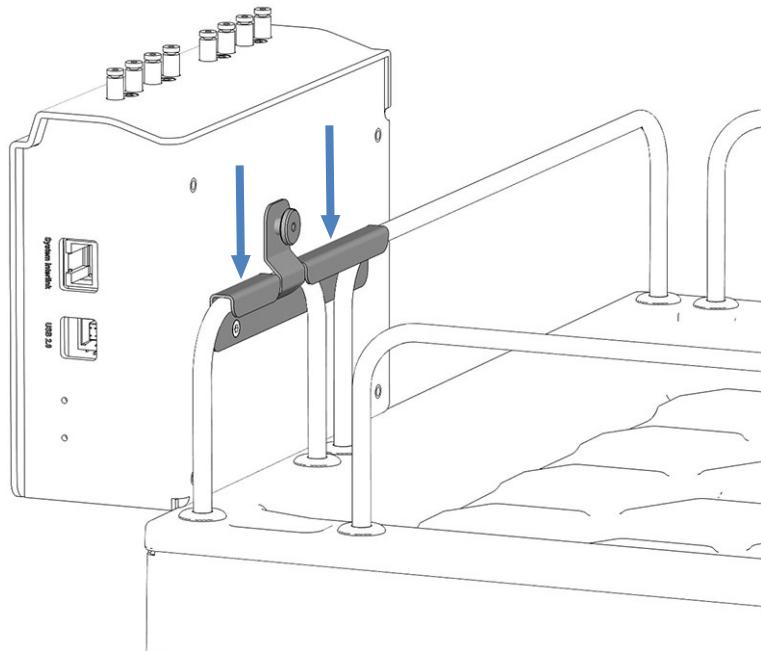


Figure 2: Hooking the solvent monitor onto the right side of the solvent rack railing (view from the right side)

3. Fix the mounting bracket to the railing by fastening the screw.

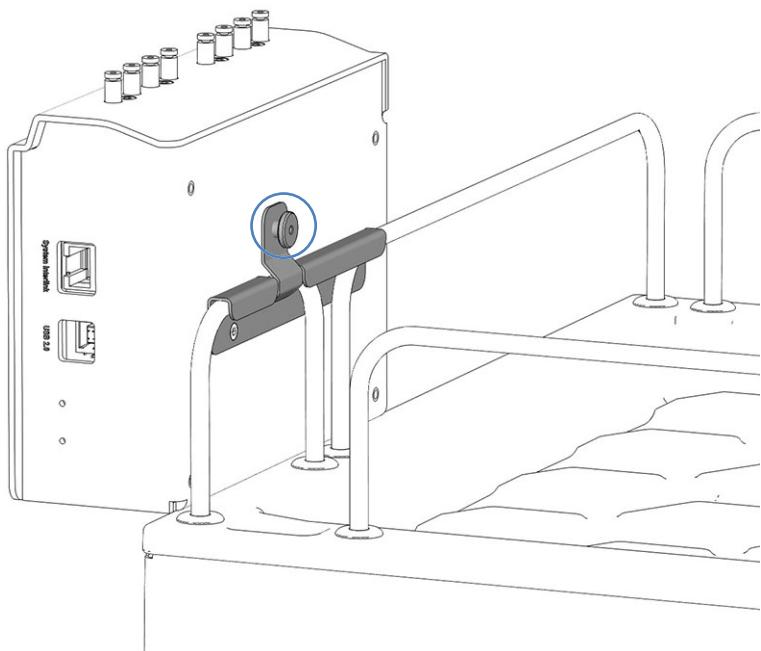


Figure 3: Fastening the screw

3.5 Connecting Signal Cables to the Solvent Monitor

Device Connectors

The following connectors are provided on the device:

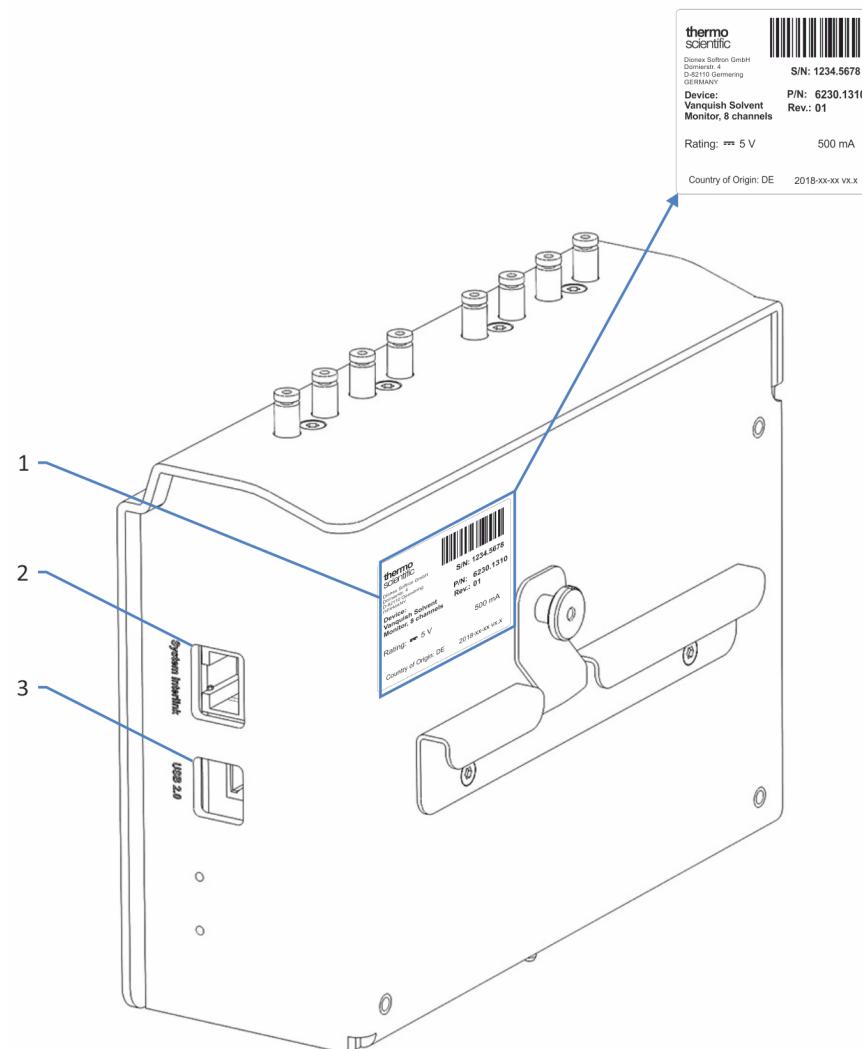


Figure 4: Connectors on the rear side of the solvent monitor

No.	Description
1	Rating plate, indicating the serial number, part number, module name, revision number (if any), and the manufacturer's address
2	System Interlink port Allows device communication and synchronization between the device and other modules in the Vanquish system.
3	USB (Universal Serial Bus) port ("B" type connector) Allows: <ul style="list-style-type: none">• Connection to the computer on which the data management system is installed• Power on/off control for the solvent monitor

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.

Parts required

The following parts are needed:

- From the ship kit:
 - ◆ Cable cover
 - ◆ System interlink cable
 - ◆ USB cable
- Pair of scissors for cutting the cable cover
- System interlink cables

Follow these steps

1. Connect the "B" connector of the USB cable to the port labeled USB 2.0 of the solvent monitor.
2. Connect the "A" connector of the USB cable directly to a USB port of the data system computer.
If the system is powered, the solvent monitor now powers up. On the right side of the solvent monitor, an LED shows the status of the solvent monitor.

NOTICE—Communication problems

Connecting the USB port of the solvent monitor to a USB port of a module in the system stack may cause communication problems.

Connect the USB port of the solvent monitor directly to the data system computer.

3. Connect one end of the system interlink cable to the port labeled System Interlink on the solvent monitor.
4. Connect the free end of the system interlink cable to a free system interlink port of one of the devices in the system, preferably that of the detector or the autosampler.

5. Connect the other system modules using system interlink cables (see images below).

The images below show the two possible system interlink connection configurations. In the left image, the solvent monitor is connected to the autosampler. In the right image, the solvent monitor is connected to the detector.

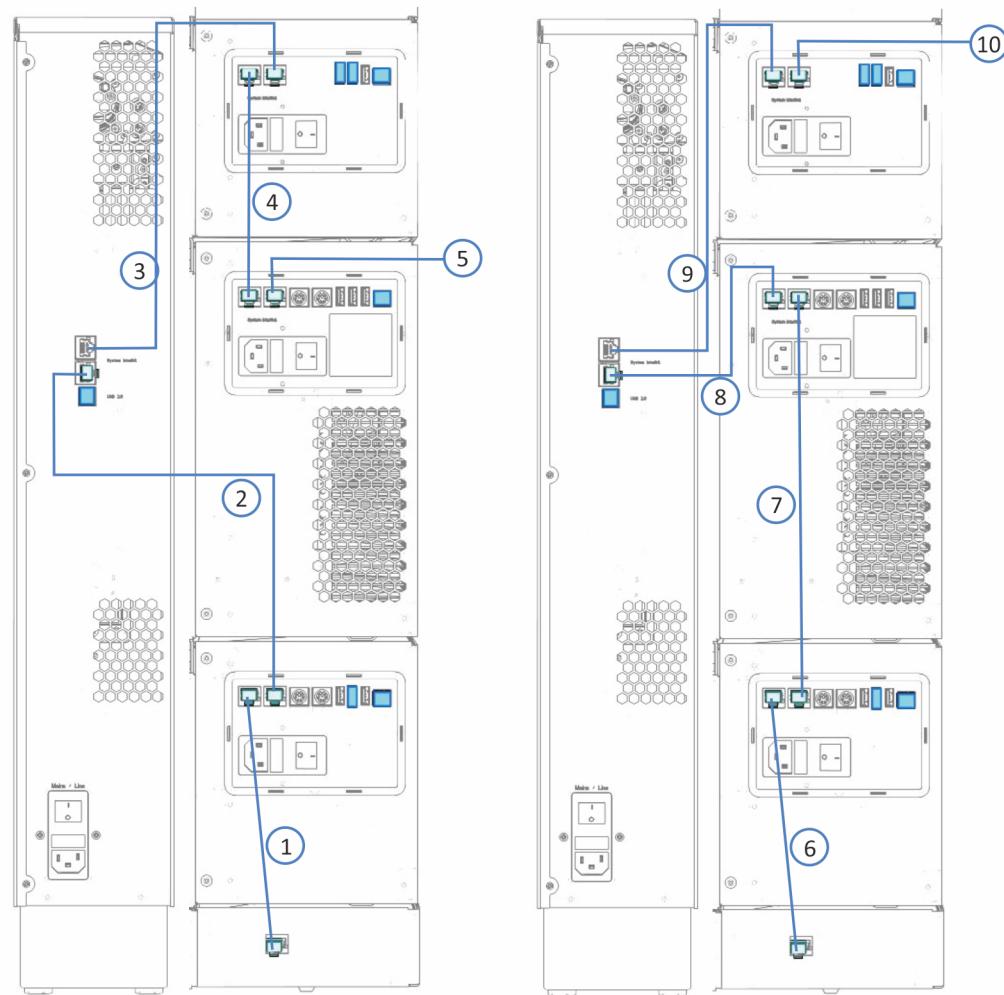


Figure 5: System interlink connections (system shown from the right side and column compartment shown from the rear)

No.	System interlink connection between
1	System base to pump
2	Pump to column compartment
3	Column compartment to detector
4	Detector to autosampler
5	Autosampler to solvent monitor
6	System base to pump

No.	System interlink connection between
7	Pump to autosampler
8	Autosampler to column compartment
9	Column compartment to detector
10	Detector to solvent monitor

6. *If the column compartment is attached to the right side of the Vanquish system stack and if the system stack includes a detector:* Detach the column compartment from the system stack (refer to the *Operating Manual* of the column compartment).
7. *If the system stack includes a detector:*
 - a) Cut the cable cover to a length of 33 cm with a pair of scissors.
 - b) Insert the USB cable into the cable groove of the module nearest to the cable.
 - c) Insert the system interlink cable into the same cable groove.

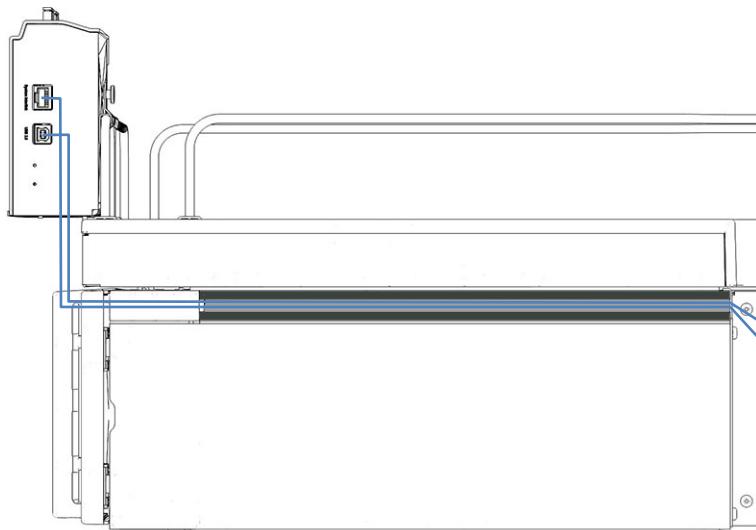


Figure 6: Cables in cable groove (system seen from the right side)

- d) Fix the cable cover to the cable groove.
8. *If the column compartment was attached to the right side of the Vanquish system stack:* Attach the column compartment to the system stack (refer to the *Operating Manual* of the column compartment).
9. *If the system stack does not include a detector:* Put the cables in the gap between the column compartment and the autosampler.

3.6 Connecting the Solvent Monitor Lines

This section describes how to connect the solvent monitor lines to the solvent monitor.

3.6.1 Short Solvent Monitor Lines

From each monitored solvent reservoir, draw only:

- Solvent for modules of one Vanquish system containing one pump (one dual pump included) and one autosampler and that are attached to the solvent monitor
- Small amounts of autosampler needle wash liquid

Parts required

- The following parts from the ship kit:

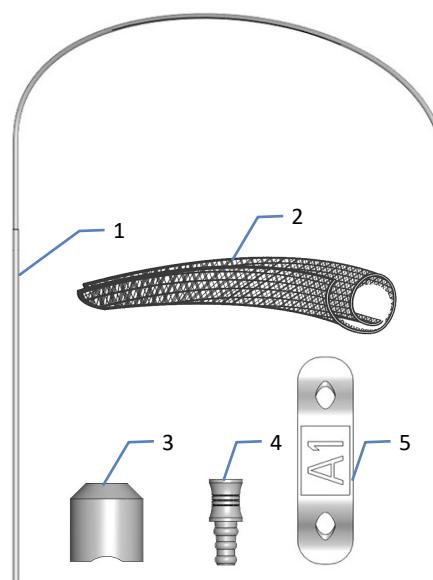


Figure 7: Required ship kit parts

No.	Description
1	Short solvent monitor line with dipstick
2	Line sleeve
3	End cap
4	Retaining guide
5	Line label

- Parts not included in the ship kit:
The table shows the necessary parts and the requirements.

Needed part	Capacities	Maximum height	Remarks
Solvent reservoirs	<ul style="list-style-type: none"> • 0.25 L • 0.5 L • 1 L • 2 L • 2.5 L • 5 L 	34 cm	<p>Do not use air-tight caps, for example, caps with air valves.</p> <p>Recommended: Fisherbrand™ solvent reservoirs (for ordering information, contact your local Thermo Fisher Scientific sales organization)</p>

Tool required

Capillary cutter delivered with the solvent monitor

Follow these steps

1. Connect the solvent lines to the pump (refer to the *Operating Manual* of the pump).
2. Take a solvent monitor line.

3. Optional: Cut the dipstick of the solvent monitor line to length with the capillary cutter, so that the dipstick stands out of the solvent reservoir by only a few centimeters, with the dipstick being straight in the solvent reservoir. Although this step is optional, keep in mind that a small solvent reservoir may tilt with a low solvent level and a long dipstick.

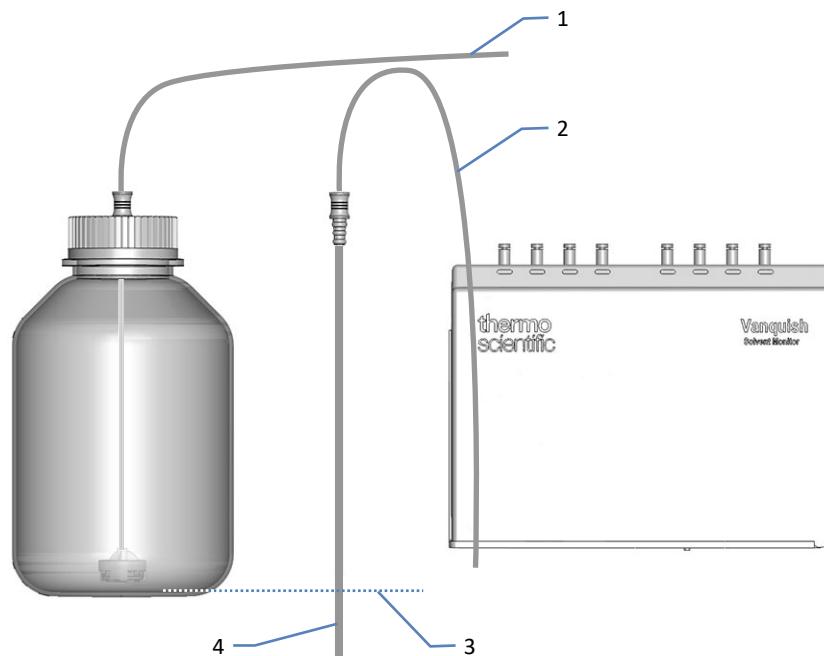


Figure 8: Cutting the dipstick to length

No.	Description
1	Solvent line
2	Solvent monitoring line
3	Location to cut the dipstick to length with the capillary cutter
4	Dipstick

4. Slip a line label over the solvent monitor line.
5. Slip a retaining guide over the dipstick.
6. Feed the dipstick of the solvent monitor line through an open hole in a cap.
7. Attach an end cap to the dipstick of the solvent monitor line.
8. Insert the dipstick into the solvent reservoir until the end cap is slightly above the solvent reservoir bottom and tighten the cap onto the solvent reservoir.
9. Press the retaining guide into the cap.

10. Adjust the dipstick so that the end cap rests on the bottom of the solvent reservoir and the dipstick is straight. Doing so ensures high measurement accuracy.

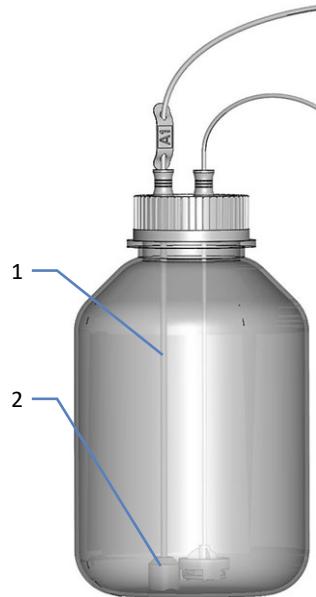


Figure 9: Correctly placed dipstick in a solvent reservoir

No.	Description
1	Dipstick
2	End cap

11. Thread the solvent monitor line and the solvent line of a solvent reservoir into a line sleeve.

12. Cut the solvent monitor line to length with the capillary cutter.

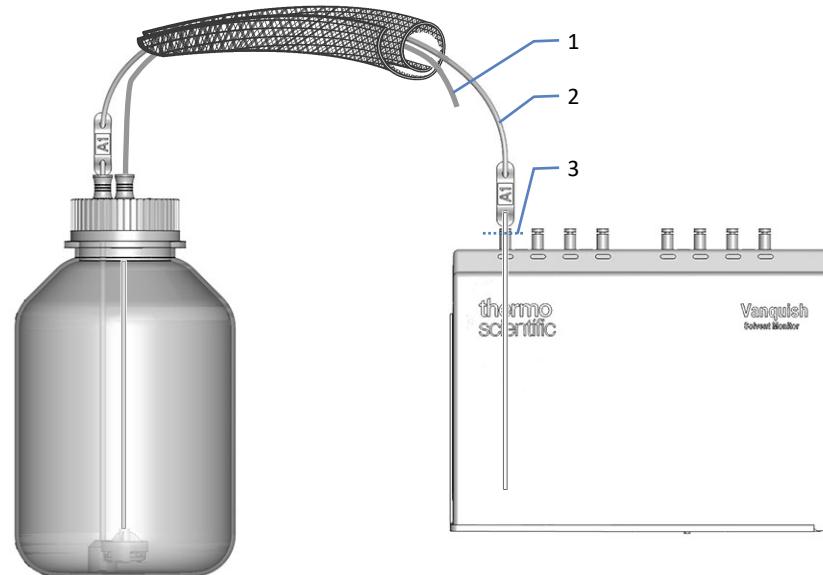


Figure 10: Cutting the solvent monitor line to length

No.	Description
1	Solvent line to the pump
2	Solvent monitor line
3	Location to cut the solvent monitor line to length with the capillary cutter

13. Slip an appropriate second line label over the other end of the solvent monitor line to identify the solvent monitor line at the solvent monitor.

14. Insert the solvent monitor lines into the solvent monitor:

15. Push the solvent monitor line straight into one of the ports of the solvent monitor until you perceive a resistance and then, push it down about 5 mm further. The ports to use depend on the solvent monitor type and the pump type.

The first table shows the assignment for the 4-channel version and the second table shows the assignment for the 8-channel version.

Pump type	Port 1	Port 2	Port 3	Port 4
Quaternary	A	B	C	Waste
Binary	A1	A2	B1	B2
Dual	A _L	B _L	A _R	B _R
Isocratic	A	-	-	Waste

Pump type	Port 1	Port 2	Port 3	Port 4	Port 5	Port 6	Port 7	Port 8
Quaternary	A	B	C	D	-	-	-	Waste
Binary	A1	A2	A3	-	B1	B2	B3	Waste
Dual	A _L	B _L	C _L	-	A _R	B _R	C _R	Waste
Iso-cratic	A	-	-	-	-	-	-	Waste

16. To check proper connection, pull slightly on the line. If the line does not slip out of the fitting, it is fixed correctly.
17. To remove any air bubbles from the solvent lines, purge the pump. The image shows one set of correctly fixed solvent line, solvent monitoring line, line label, and line sleeve.

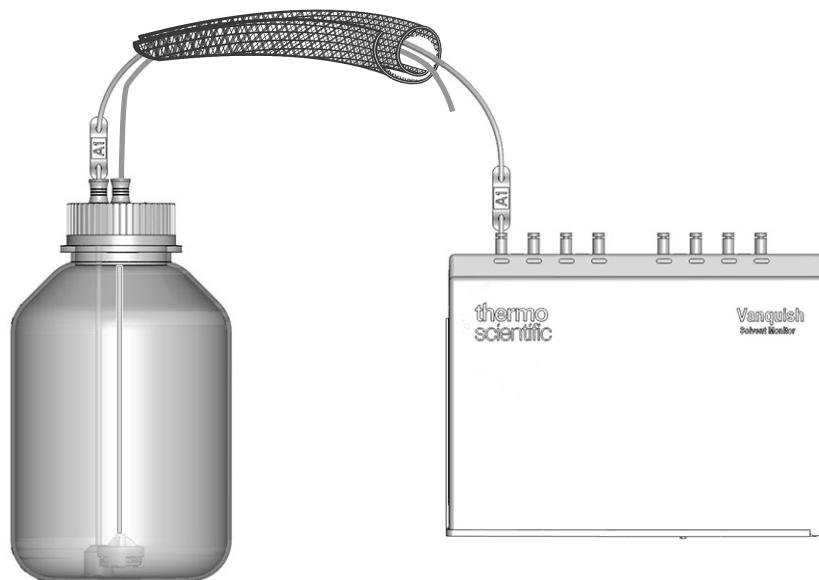


Figure 11: Connected solvent monitor line and solvent line fixed with a line sleeve

3.6.2 Long Solvent Monitor Line

Into each monitored waste container, lead only:

- The waste of modules of one Vanquish system containing one pump (one dual pump is supported) and one autosampler and that are attached to the solvent monitor
- Small amounts of autosampler needle wash waste liquids

Parts required

- The following parts from the ship kit:

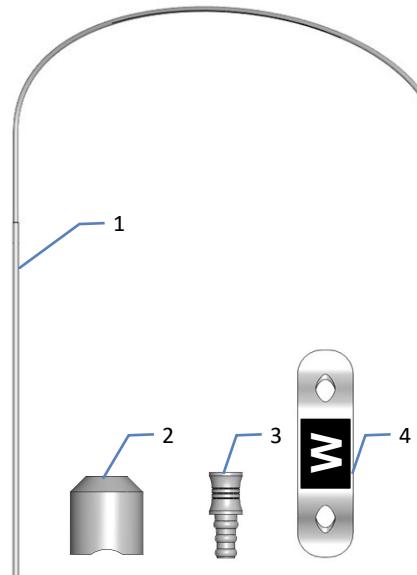


Figure 12: Ship kit parts

No.	Description
1	Long solvent monitor line with dipstick
2	End cap
3	Retaining guide
4	Line labels

- Parts not included in the ship kit:
The table shows the necessary parts and the requirements.

Needed part	Maximum capacity	Maximum height	Remarks
Waste container	10 L	34 cm	<p>Further requirements:</p> <ul style="list-style-type: none"> Do not use air-tight caps, for example, caps with air valves. Cap with a 5.6-mm hole for fixing the dipstick (recommended: caps from S.C.A.T. Europe GmbH) Fisherbrand™ waste containers (for ordering information, contact your local Thermo Fisher Scientific sales organization) Constant cross-section for most of the waste container height <p>Recommendations:</p> <ul style="list-style-type: none"> Maximum distance between waste container and solvent monitor: 3 m. For the first operation, use an empty waste container.

Tool required

Capillary cutter delivered with the solvent monitor

Follow these steps

TIP For a fast calibration, use an empty waste container.

- Take a long solvent monitor line.
- Optional: Cut the dipstick of the solvent monitor line with the capillary cutter to length, so that the dipstick stands out of the waste container by only a few centimeters, with the dipstick being straight in the waste container.
Although this step is optional, keep in mind that a small waste container may not be stable enough with a low waste level and a long dipstick.
- Slip a line label over the solvent monitor line.
- If needed for fixation, slip a retaining guide over the dipstick.
- Feed the dipstick of the solvent monitor line through an open hole in a waste container cap.
- Attach an end cap to the dipstick of the solvent monitor line.

7. Insert the dipstick into the waste container until the end cap is slightly above the waste container bottom and tighten the cap onto the waste container.
8. Press the retaining guide into the cap.
9. Adjust the dipstick so that the end cap rests on the bottom of the waste container and that the dipstick is straight. Doing so ensures high measurement accuracy.
10. Guide the other end of the solvent monitor line through the detector waste outlet in the system base.

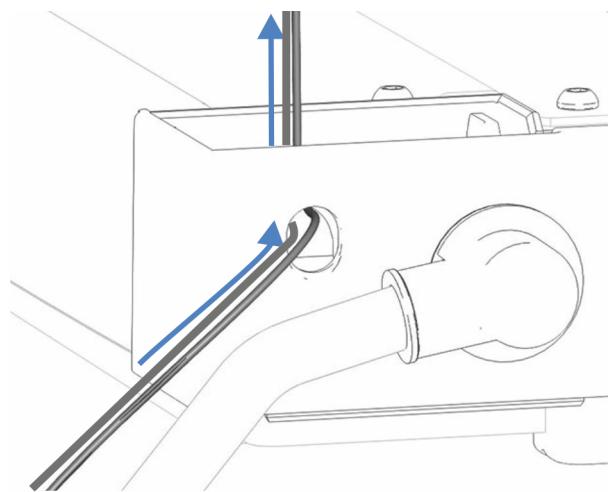


Figure 13: Guide the solvent monitor line through the detector waste outlet in the system base (system base shown from the right side)

11. Guide the solvent monitor line from the detector waste outlet in the system base through the tubing guides of all modules in the system stack.
12. Guide the solvent monitor line through the guide hole in the solvent rack.
13. Slip a line marker over the solvent monitor line to identify the solvent monitor line at the solvent monitor.
14. If necessary, cut the solvent monitor line to length with the capillary cutter.
15. Push the solvent monitor line straight into port 4 of the 4-channel solvent monitor or port 8 of the 8-channel solvent monitor until you perceive a resistance and then, push it down about 5 mm further.
16. To check proper connection, pull slightly on the line. If the line does not slip out of the fitting, it is fixed correctly.

After you have turned on the system (refer to the *Vanquish System Operating Manual*), the solvent monitor is ready to operate. For general information on calibration and operation, see [Notes on the Solvent Monitor Operation \(▶ page 26\)](#). For information on solvent monitor operation parameters in the Chromleon software, refer to the *Chromleon Help*.

4 Operation

This chapter describes the status indicators and provides general information about the operation.

For operating the solvent monitor, pump firmware revision 2.00 or later is needed.

4.1 Status Indicators

The solvent monitor has status indicators for each channel and for the solvent monitor.

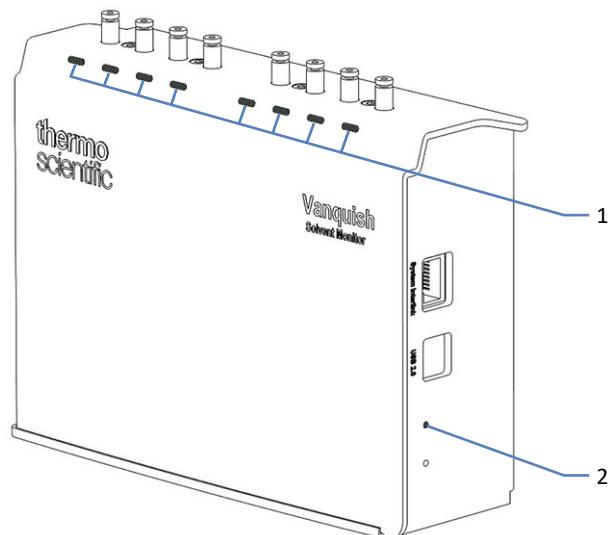


Figure 14: Status indicators (here: on the 8-channel solvent monitor)

No.	Description
1	Channel status indicator
2	Solvent monitor status indicator

Channel Status Indicators

The table describes the various statuses a channel status indicator can assume.

Color	Description
Off	Channel deactivated
Green (flashing)	Channel is activated and the solvent monitor waits until an initial measurement is performed (takes about 30-60 seconds per channel).
Green	Channel is activated and there is sufficient solvent/waste capacity
Yellow	Warning level reached Solvent reservoirs: The level in the solvent reservoir has fallen below the warning level Waste containers: The level in the waste container has risen above the warning level For information on the possible causes and remedial actions, see Operating Issues (▶ page 35) .
Red	Error level reached Solvent reservoirs: The level in the solvent reservoir has fallen below the error level Waste containers: The level in the waste container has risen above the error level For information on the possible causes and remedial actions, see Operating Issues (▶ page 35) .

The status of the solvent reservoirs and waste containers is also indicated on the ePanel and on the Vanquish Display. Messages in the Audit Trail give more background information on the status.

Solvent Monitor Status Indicator

The table describes the various statuses the solvent monitor status indicator can assume.

Color	Description
Off	Solvent monitor is turned off.
Green	Solvent monitor is turned on and is functional.
Red	Solvent monitor is turned on, but the firmware is not running.

Messages in the Audit Trail give more background information on the status.

4.2 Operating Principle

The solvent monitor accurately measures the real-time consumption of each solvent and accumulation of HPLC waste using hydrostatic pressure.

Initially, the solvent monitor measures the ambient pressure and then forces a small volume of air out of each activated channel port to determine the hydrostatic pressure at the bottom of the solvent reservoir/waste container. These measurements are performed throughout solvent consumption improving the volume estimation accuracy. The solvent monitor continuously self-calibrates with respect to the used solvent and solvent reservoir/waste container size.

4.3 Notes on the Solvent Monitor Operation

TIP Although this section states solvent reservoirs, it also applies to waste containers, if not stated otherwise.

System safety

If the error limit is reached, Chromeleon will perform the following:

- Complete the current injection
- Abort the queue
- Perform an emergency program (if defined)

However, the solvent monitor will not prevent the system from running dry. Therefore, you need to define an emergency method in the Chromeleon software to stop the pump flow and/or additional emergency steps.

Calibration and accuracy

Very first power up After the solvent monitor has powered up, the channel status indicator flashes green while the solvent monitor performs the first pressure measurement. Upon this measurement, a first volume estimation based on the entered solvent reservoir size is shown. This first estimation is inaccurate, typically $\pm 15\%$.

The solvent monitor continues to acquire calibration data. After the system has consumed 5% of the solvent reservoir volume, an accuracy of about 10% is obtained and improved further during the process.

Solvent reservoir change or subsequent power up The calibration data acquired for the previous solvent reservoir will also be used for the following solvent reservoir. Depending on the next solvent and solvent reservoir size, the accuracy will be as follows:

Situation	Accuracy	Remarks
Solvent reservoir size and solvent are the same	The results are accurate from the beginning.	During Ready Check, Chromleon issues the following warning: "It is unknown whether the solvent error limit for channel x ... has been reached." That means that the volume estimations may be inaccurate even if the next solvent reservoir is identical to the previous one.
Solvent reservoir size or solvent are different	The results are inaccurate until the solvent monitor has completed another calibration cycle.	

Applicable to both cases The following information applies to the very first power up, to a solvent reservoir change, and subsequent power up.

If you fill the solvent reservoir up to the bottleneck (conical and narrow part of a solvent reservoir), accurate volume estimation will take longer because the solvent monitor needs at least some measurements with the solvent level below the bottleneck.

Waste containers only: Depending on the flow rate, calibrating the waste channel takes typically 5 hours and the waste container volume is only shown after the calibration has finished.

During the first measurement after the first power up or solvent reservoir change, a few air bubbles emerge from the end cap. During normal operation, the following behavior can be observed:

- The solvent monitor lines are filled with air.
- No air bubbles will emerge.
- No solvent will enter the solvent monitor lines.

Recommendations for Operation

Observe the following recommendations:

- Before operation:
 - ◆ Do not use air-tight caps (e.g. caps with air valves) as this will perturb the pressure measurement.
 - ◆ Except for system configurations using dual pumps, solvent reservoir/waste container sharing is not supported. Do not lead additional liquid in the waste container or draw additional solvent from a solvent reservoir as this will disturb the calibration.
 - ◆ If the dipstick is not placed on the container bottom, the solvent monitor will ignore the volume below the end cap.
 - ◆ Do not fill the solvent reservoir up to the bottleneck.
 - ◆ Waste containers only: To obtain accurate waste volume estimations from the beginning, start with an empty waste container.
- For operation: Set the correct nominal solvent reservoir/waste container value in Chromeleon. If you change the solvent reservoir/waste container size, do not forget to set a new nominal size.
- During operation: During Ready Check for the queue, Chromeleon checks whether there is enough solvent for the queue. If you add injections to the queue without repeating the Ready Check and if there is not enough solvent, Chromeleon will abort the queue. Do not add injections to the queue or perform a Ready Check, after you have started a queue.

5 Maintenance and Service

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

5.1 General Rules for Maintenance and Service

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

- Before starting maintenance or service procedures, turn off the power supply by unplugging the USB cable.
- Use only the replacement parts specifically authorized and qualified for the device by Thermo Fisher Scientific.
- Follow all instructions step by step and use the tools recommended for the procedure.
- 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.

See also

 [Consumables and Replacement Parts \(▶ page 46\)](#)

5.2 Routine and Preventive Maintenance

5.2.1 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 or buffer solutions used with the device.

Frequency	What you should do...
Regularly	<ul style="list-style-type: none"> • If using solvents containing salt, check the dipsticks for salt precipitations. • Inspect the solvent monitor lines for damage, such as cracks, nicks, cuts, or blockage. • Check whether the dipstick and the end cap are discolored and whether microbial growth is present by swirling the liquid in the solvent reservoir. If you discover discoloration or microbial growth, replace the endcap, dipstick, and solvent reservoir.
Semiannually	<ul style="list-style-type: none"> • Replace the solvent monitor lines. • Replace the end caps.

5.3 Replacing the Solvent Monitor Lines

When

- Solvent monitor line is:
 - ◆ Leaking
 - ◆ Clogged
 - ◆ Contaminated
 - ◆ Discolored, kinked or otherwise damaged
- Semiannually

Parts required

As applicable:

- Short solvent monitor line
- Long waste monitor line

Tools required

Capillary cutter

Preparations

1. Turn off the pump flow and wait until the system pressure is down to zero.

Follow these steps

1. Unscrew the cap of the solvent reservoir/waste container and remove the solvent monitor line together with the cap from the solvent reservoir/waste container.
2. Remove the end cap from the dipstick.
3. Pull the solvent monitor line out of the solvent reservoir cap/waste container cap.
4. Remove the retaining guide.
5. Remove the line label.
6. Pull the line(s) out of the line sleeve.
7. Push the thrust ring on the solvent monitor port down firmly and evenly and pull out the solvent monitor line. Do not pull the solvent monitor line without having pushed down the thrust ring.
8. Remove the line label.
9. *Long waste monitor lines:* Remove the solvent monitor line from the tubing guide of all modules above the system base in the system stack. When removing the solvent monitor line from the tubing guides, be careful not to pull on other lines in the tubing guides.
10. Unpack the replacement solvent monitor line.
11. To connect a new solvent monitor line, follow the steps in [Connecting the Solvent Monitor Lines \(▶ page 14\)](#).
12. To remove any air bubbles from the solvent lines, purge the pump.

5.4 Replacing the End Caps

When

- End cap is:
 - ◆ Contaminated
 - ◆ Discolored or otherwise damaged
- Semiannually

Parts required

Replacement end cap

Preparations

1. Turn off the pump flow and wait until the system pressure is down to zero.

Follow these steps

1. Unscrew the cap of the solvent reservoir/waste container and remove the cap and the solvent monitor line from the solvent reservoir/waste container.
2. Remove the end cap from the solvent monitor line.
3. Attach a new end cap to the solvent monitor line.
4. Insert the solvent monitor line with the end cap into the solvent reservoir/waste container ensuring that the end cap rests on the bottom of the solvent reservoir/waste container and that the dipstick is straight.
5. To remove any air bubbles from the solvent lines, purge the pump.

5.5 Replacing the Retaining Guides

When

Retaining guide is damaged.

Parts required

Replacement retaining guides

Preparations

1. Turn off the pump flow and wait until the system pressure is down to zero.

Follow these steps

1. Unscrew the cap of the solvent reservoir/waste container and remove the solvent monitor line together with the cap from the solvent reservoir/waste container.
2. Remove the end cap from the solvent monitor line.
3. Pull the solvent monitor line out of the solvent reservoir/waste container cap.
4. Remove the retaining guide.
5. Slip a new retaining guide onto the solvent monitor line.
6. Feed the dipstick of solvent monitor line through an open hole in a solvent reservoir/waste container cap.
7. Attach an end cap to the dipstick of the solvent monitor line.
8. Insert the dipstick of the solvent monitor line with the end cap into the solvent reservoir/waste container and tighten the cap onto the solvent reservoir/waste container.
9. Adjust the solvent monitor line so that the end cap rests on the bottom of the solvent reservoir/waste container and that the dipstick is straight.
10. Press the retaining guide into the cap.
11. To remove any air bubbles from the solvent lines, purge the pump.

5.6 Updating the Device Firmware

When

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

Items required

Firmware version/Chromeleon version as appropriate

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

Preparations

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

Follow these steps

1. Start the Instrument Configuration Manager program.
2. Perform a firmware update from the **General** tab page in the configuration dialog box for the device. For details, refer to the *Chromeleon Help*.
The firmware update may take several minutes.

NOTICE

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

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

3. Monitor the Audit Trail of the Instrument Configuration Manager program to see whether the firmware update was successful or failed.

6 Troubleshooting

6.1 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.

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

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

6.2 Operating Issues

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

Issues shown via status indicators

Symptom	Possible cause	Remedial actions
Channel status indicator yellow	Solvent reservoir lower limit/waste container warning limit reached	Refill solvent reservoir/empty waste container or change the warning limit setting.
Channel status indicator red	Solvent reservoir lower limit/waste container upper limit reached	Refill solvent reservoir/empty waste reservoir or change the error limit setting.
Solvent monitor status indicator stays red	Firmware update has failed	Retry the firmware update (see Updating the Device Firmware (▶ page 34)).

Volume estimation

Symptom	Possible cause	Remedial actions
Jump in the volume estimation	Initial volume estimation switched to the calibrated, actual solvent reservoir/waste container volume	No remedial actions necessary Background information: After you start using the solvent monitor or after having entered a new nominal volume, the solvent monitor calculates the volume based on various assumptions. After sufficient throughput, the solvent monitor switches to show the calibrated, actual volume. The volume may differ by ±15%.
	The solvent monitor was already calibrated when the dipstick was moved in the solvent reservoir/waste container.	1. Make sure that the dipstick stands straight in the solvent reservoir/waste container and that the end cap is placed on the bottom of the solvent reservoir/waste container. 2. Start the pump flow and wait until the self-calibration has finished.
No volume estimation	The hydrostatic pressure has not yet been measured.	After you start using the solvent monitor or after having changed a solvent reservoir/waste container, the solvent monitor needs about 20-60 seconds per channel for an initial hydrostatic pressure measurement. 1. Wait a few minutes for a volume estimation to appear. 2. If it does not appear, check the Audit Trail.
	Self-calibration of the waste channel is not yet finished.	Self-calibration of a partially filled waste container is time consuming (approximately 5 hours) and could have been interrupted by a movement of the waste container or of the dipstick. Empty the waste container. A volume close to 0 mL should be shown within the next minutes which will increase during pump flow. The solvent monitor will self-calibrate during operation. Or: 1. Check whether the dipstick is firmly attached with the retaining guide and is straight, whether the end cap is placed on the waste container bottom, and whether the waste container stands on a stable surface. 2. Check the waste level manually and start a measurement. After 25% of the waste container volume throughput, the actual volume should be shown. 3. During calibration and operation, do not move the dipstick or the waste container.

Volume accuracy

Symptom	Possible cause	Remedial actions
Volume inaccuracy is above $\pm 15\%$ of the nominal bottle volume	Wrong connection of solvent monitor line	Connect the solvent monitor line to the correct solvent reservoir/waste container (see solvent monitoring channel assignment table in Short Solvent Monitor Lines (▶ page 14)).
	Mismatch between actual solvent reservoir/waste container size and entered nominal volume	Enter the correct nominal value for the used solvent reservoir/waste container. The previous calibration data will be erased, and an initial volume estimation will be given.
	The solvent was changed to a solvent with a significantly different density while the solvent reservoir size remained the same.	<p>The calibration data from the previous solvent does not match the actual solvent.</p> <p>Wait until the solvent monitor has finished recalibration which typically takes a solvent consumption of:</p> <ul style="list-style-type: none"> • 5% of the nominal solvent reservoir volume withdrawal if the fill level is significantly below the bottle neck. • 25% of the nominal solvent reservoir volume withdrawal if the fill level is within bottle neck.
	Self-calibration erroneous because the dipstick was moved during the calibration phase	Make sure that the dipstick stands straight in the solvent reservoir/waste container and that the end cap is placed on the bottom of the solvent reservoir/waste container. The solvent monitor will then finish the calibration successfully.
	Solvent reservoir does not comply with the requirements/recommendation (see Short Solvent Monitor Lines (▶ page 14)).	Start the pump flow and wait until the self-calibration has finished.
	Solvent monitor line is damaged.	<ol style="list-style-type: none"> 1. Check whether the solvent monitor line is bent or otherwise damaged. 2. Cut 1 cm from the solvent monitor port end with the capillary cutter. 3. Check whether there is liquid in the solvent monitor line. If yes, replace it.

Miscellaneous

Symptom	Possible cause	Remedial actions
Channel cannot be activated	Refer to the error messages in the Chromleon Audit Trail.	Refer to the remedies of the error messages in the Chromleon Audit Trail.
Solvent drops in a solvent monitor line	Leaking solvent monitor line	<ol style="list-style-type: none"> 1. Inspect the solvent monitor line for cracks or cuts. 2. Check whether the solvent monitor line is inserted correctly into the solvent monitor fitting: Pull it slightly. If it does not slip out of the fitting, it is fixed correctly. 3. Check the cut of the solvent monitor line. If it is damaged, cut 1 cm from the solvent monitor port end with the capillary cutter. 4. Replace the solvent monitor line.
Solvent monitor detected a change of a solvent reservoir/waste container erroneously	The dipstick was moved.	<ol style="list-style-type: none"> 1. Check whether the dipstick is firmly attached with the retaining guide and stands straight. 2. Check whether the end cap is placed on the waste container bottom. 3. Check whether the waste container stands on a stable surface.
	Solvent monitor line is leaking.	<ol style="list-style-type: none"> 1. Check the solvent monitor line for cracks or cuts. 2. Check whether the solvent monitor line is inserted correctly into the solvent monitor fitting by pulling it slightly. If it does not slip out of the fitting, it is fixed correctly. If it slips out of the fitting, re-insert it (see Connecting the Solvent Monitor Lines (▶ page 14)). 3. Check the cut of the solvent monitor line. If it is damaged, cut 1 cm from the solvent monitor port end with the capillary cutter. 4. Replace the solvent monitor line.

6.3 Messages

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

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

- To facilitate finding a message, the table lists the messages sorted by code.
- If you cannot find the code you are looking for, check the message text. The two messages "Unexpected module behavior" and "Module malfunction detected" can be assigned to different codes. See the beginning of the table for more information.

TIP If you are unable to resolve the problem following the instructions in this manual, or if you encounter a message not listed in the table, write down the code and wording of the message and contact us. For details, refer to the *Contacting Us* section at the beginning of the *Vanquish System Operating Manual*.

Message and Code	Description and Remedial Action
Unexpected module behavior. Code xx	<p>xx = Two-digit to four-digit code number.</p> <p>When the message appears, write down the message code and turn off the module. Wait for 5 seconds and turn on the module again. If the message appears again, contact Technical Support.</p>
Code 36 Download failed.	<p>The firmware download has not been successful. Repeat the download.</p>
Code 37 Download firmware mismatch.	<p>The firmware download has not been successful. The firmware is not suitable for the solvent monitor.</p> <p>Verify that the correct firmware file was selected. Repeat the download.</p>
Code 93 Unexpected module behavior.	<p>Update the firmware. If this message appears again, contact Technical Support.</p>
Code 113 Module malfunction detected	<p>The firmware may be defective. Update the firmware (see Updating the Device Firmware (▶ page 34))</p>
Code 1000 Measurement error. Check tubing connection.	<p>Solvent monitor line disconnected, solvent reservoir is empty/waste container is full</p> <ul style="list-style-type: none"> • Make sure the solvent monitor line is properly attached to the solvent monitor fitting. • Refill the solvent reservoir. • Make sure the end cap of a solvent monitor line in the solvent reservoir is submerged.
Code 1001 Measurement error. Timeout.	<p>Timeout occurred while the solvent monitor attempted to measure the volume.</p> <p>Make sure that the dipstick and the end cap are inserted correctly (see Connecting the Solvent Monitor Lines (▶ page 14)).</p>
Code 1005 Larger than normal measurement deviations.	<ul style="list-style-type: none"> • Make sure that the solvent reservoir/waste container stands on a stable and even surface. • Make sure that the dipstick and the end cap are inserted correctly (see Connecting the Solvent Monitor Lines (▶ page 14)).
Code 1011 Liquid detected in the tubing.	<p>This error will clear after a while. If this error only occurs rarely, ignore it. If it persists:</p> <ul style="list-style-type: none"> • Ensure that the solvent monitor line is free of liquid. • Check whether the solvent monitor line is discolored, kinked or otherwise damaged. Replace the solvent monitor line, if needed.
Code 1012 Liquid detected in the tubing.	<ul style="list-style-type: none"> • Check the solvent monitor line for correct installation, kinks and crimps. • Replace the solvent monitor line.
Code 1013 Missing endcap detected	<p>If this error appears several times, make sure that the end cap is installed correctly (see Connecting the Solvent Monitor Lines (▶ page 14)).</p>

Message and Code	Description and Remedial Action
Code 1017 System Interlink connection timeout.	<p>The connection to a module via the system interlink has timed out.</p> <ul style="list-style-type: none"> • Make sure the system interlink cable is attached to the solvent monitor and the autosampler/detector and that the system interlink cable is not damaged. • Check whether the modules show the following statuses on their respective ePanels: <ul style="list-style-type: none"> ◆ Pump: ready ◆ Solvent monitor: operable
Code 1024 Warning limit reached.	<ol style="list-style-type: none"> 1. Make sure that there is enough solvent in the solvent reservoir/ enough capacity in the waste container. 2. If necessary, check the warning limit parameter and adapt it.
Code 1025 Error limit reached.	<ol style="list-style-type: none"> 1. Make sure that there is enough solvent in the solvent reservoir/ enough capacity in the waste container. 2. Check the error limit parameter and adjust it, if necessary.
Code 1026 System Interlink connection lost.	<ul style="list-style-type: none"> • Make sure the system interlink cable is attached to the solvent monitor and the autosampler/detector and that the system interlink cable is not damaged. • Check whether the modules show the following statuses on their respective ePanels: <ul style="list-style-type: none"> ◆ Pump: ready ◆ Solvent monitor: operable
Code 1029 Leak detected in the VSM tubing or connection.	<p>The pressure dropped during a measurement indicating a leak.</p> <ul style="list-style-type: none"> • Make sure the solvent monitor line is correctly inserted into the solvent monitor fitting (see Connecting the Solvent Monitor Lines (▶ page 14)). • Push the thrust ring on the solvent monitor port down firmly and evenly and pull out the solvent monitor line out of the solvent monitor fitting and cut the first 10 mm with the capillary cutter. • Check the solvent monitor line and the dipstick for damage. If necessary, replace the solvent monitor line. • Check whether the solvent monitor line is discolored, kinked or otherwise damaged. If necessary, replace the solvent monitor line.
Code 1031 Recoverable channel error. Please re-enable the channel.	<p>An error has occurred prior to this message so that the channel cannot deliver results.</p> <ul style="list-style-type: none"> • Check the previous errors in the Chromeleon Audit Trail and perform the remedial actions. • Disable and enable the channel to trigger new measurements.
Code 1032 Non-recoverable channel error.	<p>An error has occurred prior to this message so that the channel cannot deliver results.</p> <p>Check previous errors in the Chromeleon Audit Trail and perform the remedial actions listed in the error messages.</p> <p>If the error persists, disable the channel and use a different one for your measurement. If all channels are used, replace the solvent monitor.</p>

Message and Code	Description and Remedial Action
Code 1033 Repeating measurement to ensure accuracy.	<p>The solvent monitor repeats a measurement when there was an error during the previous measurement. A measurement will be repeated up to three times.</p> <p>If this error persists, refer to the remedies of the preceding error messages.</p>
Code 1037 Not ready.	<ul style="list-style-type: none">• Wait for initial measurements to complete.• Check the previous errors in the Chromleon Audit Trail and perform the remedial actions listed in the error messages.

7 Specifications

7.1 Performance Specifications

The solvent monitor performance is specified as follows:

Type	Specification
Operating principle	Hydrostatic pressure measurement with intelligent automatic calibration for solvent density and bottle dimensions
Volume assessment	Fully automated, independent of solvent type or composition
Hydrostatic pressure sampling	Repeatability of pressure sampling of 1%
Pressure range	Up to 350 mm water liquid level, solvent reservoir/waste container at atmospheric pressure
Number of solvent lines	4 or 8
Solvent and additives information	Common HPLC-grade solvents The allowed salt concentration for the solvent monitor is 1 mol/L or less. For further information, refer to the <i>Operating Manual</i> for your Vanquish pump.
Solvent reservoir/waste container sizes	All solvent reservoirs/waste containers from 0.25 L to 5 L (and additionally 10 L for waste containers) with a maximum height of less than 350 mm are supported with any solvent.
Solvent reservoir/waste container types	Solvent reservoir/waste containers of any suitable material with a uniform cross section along the entire height are supported. Solvent reservoirs of any suitable material with a uniform cross section along the entire height are supported with reduced accuracy. If the liquid level is within the bottleneck, the accuracy may be reduced. Solvent reservoirs/waste containers must not be sealed tight and air valves or other one-way valves must not be used. Filtering caps are acceptable. Fisherbrand solvent reservoirs/waste containers are recommended.
Biocompatible	Yes
Metal free	Yes
Communication	1 USB port (USB 2.0, "B" type connector) 1 system interlink port (RJ45-8 connector)
Control and user interface	Chromleon 7 (and Vanquish User Interface) and status indicators on the solvent monitor
Wetted materials	PEEK For information about the chemical resistance of materials, refer to the technical literature.
Good Laboratory Practice (GLP) features	All system parameters are logged in the Chromleon Audit Trail.

7.2 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	Via USB connection (max. 500 mA)
Oversupply voltage category	II
Emission sound pressure level	< 40 dB(A)
Dimensions (height x width x depth)	13 x 17 x 6 cm
Weight	800 g

8 Ship Kit

Ship kit

4-Channel Version

Item	Quantity in shipment
Cable cover	1
Cables, system interlink	1
Cables, USB	1
Capillary cutter	1
End cap	6
Line label	1 pack
Line sleeve, with small diameter	4
Line sleeve, with big diameter	1
Retaining guide	4
Solvent monitor lines, short (for solvent reservoirs)	3
Solvent monitor lines, long (for waste containers)	1

For reordering information, see [Consumables and Replacement Parts](#) ([► page 46](#)).

8-Channel Version

Item	Quantity in shipment
Cable cover	1
Cables, system interlink	1
Cables, USB	1
Capillary cutter	1
End cap	12
Line label	1 pack
Line sleeve, with small diameter	8
Line sleeve, with big diameter	1
Retaining guide	8
Solvent monitor lines, short (for solvent reservoirs)	6
Solvent monitor lines, long (for waste containers)	2

For reordering information, see [Consumables and Replacement Parts](#) ([► page 46](#)).

9 Consumables and Replacement Parts

The device must be operated only with the replacement parts specifically authorized and qualified by Thermo Fisher Scientific.

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.

Description	Part No.
End caps, set of 6	6230.1302
Retaining guide, set of 5	6000.0042
Solvent monitor line kit containing: • 3 short solvent monitor lines • 1 long solvent monitor line	6230.1314
Solvent monitor line labels	6230.1335
Solvent reservoirs/waste containers, 0.25 L ¹	2270.0026
Solvent reservoirs/waste containers, 1 L ¹	2270.0012
Solvent reservoirs/waste containers, 2 L ¹	2270.0021
Tubing cutter	6300.0401

¹For ordering information for all other solvent reservoir/waste container sizes, contact your local Thermo Fisher Scientific sales organization.

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